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Traditional water management in Southern Italy

A case-study from Pantelleria

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Author's declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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ABSTRACT OF THESIS submitted by:

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Understanding the logic behind natural resource management techniques and practices, including how they have been implemented over long periods of time, is essential not only for maintaining cultural heritage but also for developing a new paradigm that will allow traditional techniques to address contemporary problems. As a result of managing ecosystems holistically and responsibly, archaic societies have often produced outstanding technical, artistic, and architectural works that are universally admired for their ability and have often been able to learn, adapt, and renew themselves in response to changing conditions. The development, maintenance and use of traditional knowledge is increasingly recognized as science. It is a science that advocates an innovative and participatory process that engages all stakeholders and considers not only productive functions but also environmental, cultural, and social factors. By analyzing the case study of Pantelleria, an island with a living heritage of landscape and water management in the Sicilian Channel, and utilizing the Appreciative Inquiry methodology, which is a tool that encourages conversations challenging the status quo, we can gain insights into innovative strategies for adapting to climate change. This research aims to surface the logic behind traditional knowledge and its successful implementation over a long period of time. This approach is vital for safeguarding cultural heritage and establishing a new paradigm for reappropriating traditional techniques in the modern era, in light of contemporary challenges, including but not limited to climate change. As a result of 79 interviews conducted on the island, exchanges, questions, comparisons, and discussions with experts and various stakeholders and bearers of this knowledge, it has become apparent that traditional knowledge provides not only innovative solutions to current challenges but also an excellent strategy for preserving and managing the land and water of Pantelleria under the conditions of climate change. According to this study, water management should be viewed the same way as in Pantelleria, utilizing the same attitude of traditional knowledge, understanding and developing strategies in balance with the environment. The ability of this community over millennia to manage and not exploit ecosystem functions has been stratified in landscape, knowledge and practices, Pantelleria serves as a model to demonstrate how similar regions experiencing water-related issues may benefit from its solutions.

Keywords: traditional water management, traditional knowledge, climate change adaptation, Pantelleria**,** Appreciative Inquiry

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List of Abbreviations

AI	Appreciative Inquiry
CEST	European Charter for Sustainable Tourism
EBA	Ecosystem-Based Adaptation
EEA	European Environment Agency
ELC	European Landscape Convention
EU	European Union
IK	Indigenous knowledge
Int.	Interviewed
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
JRC	Joint Research Center
MAB	Man and the Biosphere Programme
NRW	Non-Rainfall Water
PES	Payments for ecosystem services
PRG	General Regulatory Plan
SES	Socio-ecological system
TEK	Traditional Ecological Knowledge
TK	Traditional Knowledge
UNCCD	United Nations Convention to Combat Desertification
UNEP	United Nations Environmental Program
UNESCO	United Nations Educational, Scientific and Cultural Organization

1. Introduction

To adapt to climate change, communities must develop effective water management and governance strategies. An important object of this study is examining the role of traditional water management systems in supporting landscape-level adaptation to harsh climate conditions on Pantelleria, a volcanic island located in the Sicilian Channel in Italy. The traditional water management in this thesis recognizes the organic landscape of Pantelleria resulting from a capacity for ecological conservation and management with a long-term community-building capacity, social value and environmental effectiveness.

The Intergovernmental Panel on Climate Change (IPCC) defines climate adaptation in human systems as "the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities" (IPCC 2018a, 542). IPCC refers to traditional knowledge as the understandings, skills, and philosophies developed by societies with a long history of interaction with their natural surroundings, as well as local knowledge as the skills and understandings developed by individuals and populations in the context of their local environment (IPCC 2018b).

Applying narrative inquiry to a case study in this thesis responds to the notion that "we are drowning in information but starved for knowledge" by Nasbitt (1982, 17). Utilizing the appreciative inquiry method (AI) is aimed at clarifying how modern society treats, maintains and uses such knowledge and the necessity to rediscover and give room to traditional knowledge that is part of the layered history and interventions which have been identified as socio-ecological in the nature of the landscape. According to the EU Adaptation Strategy (2021), addressing the uncertainty related to adaptation strategies and their impacts is one of the most significant challenges in responding effectively to climate change (see also Brugnach and Van de Hoeck 2023). Using Pantelleria as a case study, I query how adaptation to climate change could be accompanied by preserving ecosystem functionality and using land management capacity that already exists in the territories. Traditional knowledge embodies the knowledge necessary to achieve more effective land management, even in region where such practices are more difficult to find. The important lesson in this regard lies in the crucial importance of balancing land and water use with the environmental context, which requires collaboration among stakeholders and especially giving a voice to people who carry this knowledge. The adaptation measures implemented through traditional ecosystem management approaches in my case study confirm that ecosystem functions and services relevant to communities can be

selected and actively maintained over extended periods of time. As a result, traditional knowledge and practices may not only offer innovative and time-proven solutions to current environmental challenges, but also to potential future challenges, including, but not limited to, climate change.

1.1 Problem statement

It has been well established in the field of environmental science and policy that climate change impacts, such as droughts, floods, and desertification, have increased the threat to water quality and availability (IPCC 2022a; UNCCD 2022; Corona et al. 2006; Millennium Ecosystem Assessment 2005a). Water is an essential resource for human well-being and healthy ecosystem function (Millennium Ecosystem Assessment 2005b). According to the European Commission's Joint Research Centre (JRC 2024a and 2024b), since January 2024, the Mediterranean region has experienced critical drought conditions, mainly affecting Southern Italy, Southern Spain and Malta, as a result of a persistent lack of precipitation and positive temperature anomalies (Toreti et al. 2024; Tabari and Willems 2023; see also European Drought Observatory Map online). The extent of the water shortage in the region is revealed by various sources (see e.g., JRC 2024b; Essa et al. 2024; European Commission 2007), reducing soil moisture and river flows and stunting crops and plants during their critical growing season (Zellou et al. 2023; European Commission 2007). As the situation in Catalonia, Spain, shows, the choice of adaptation tools matters, and if the ones chosen are not suitable or adequate, more radical measures may be needed (Lissner et al. 2024).

According to the European Drought Risk Atlas (2023), European droughts will become increasingly frequent and last for years rather than months (Fig. 1). It will not be sufficient to rely on buffers or emergency measures. In the European Drought Risk Atlas (2023), the approach is fundamental: it no longer refers to water scarcity as a matter of disasters; instead, it explicitly states that we need to move from the concept of water emergency to that of water proactive and preventive development, which entails the planning of new water-related policies across various sectors. Even though my thesis is focused on adaptation, these interventions should be conducted alongside mitigation policies, as the more temperatures rise, the smaller our margin for successful adaptation becomes. In fact, according to Lissner et al. (2024), with actual technologies and development, water adaptation is effective at 90 per cent in a 1.5°C warmer world but degrades to 69 per cent in a +2°C warmer world, 62 per cent in a +3°C scenario, and 46 per cent in a +4°C world.

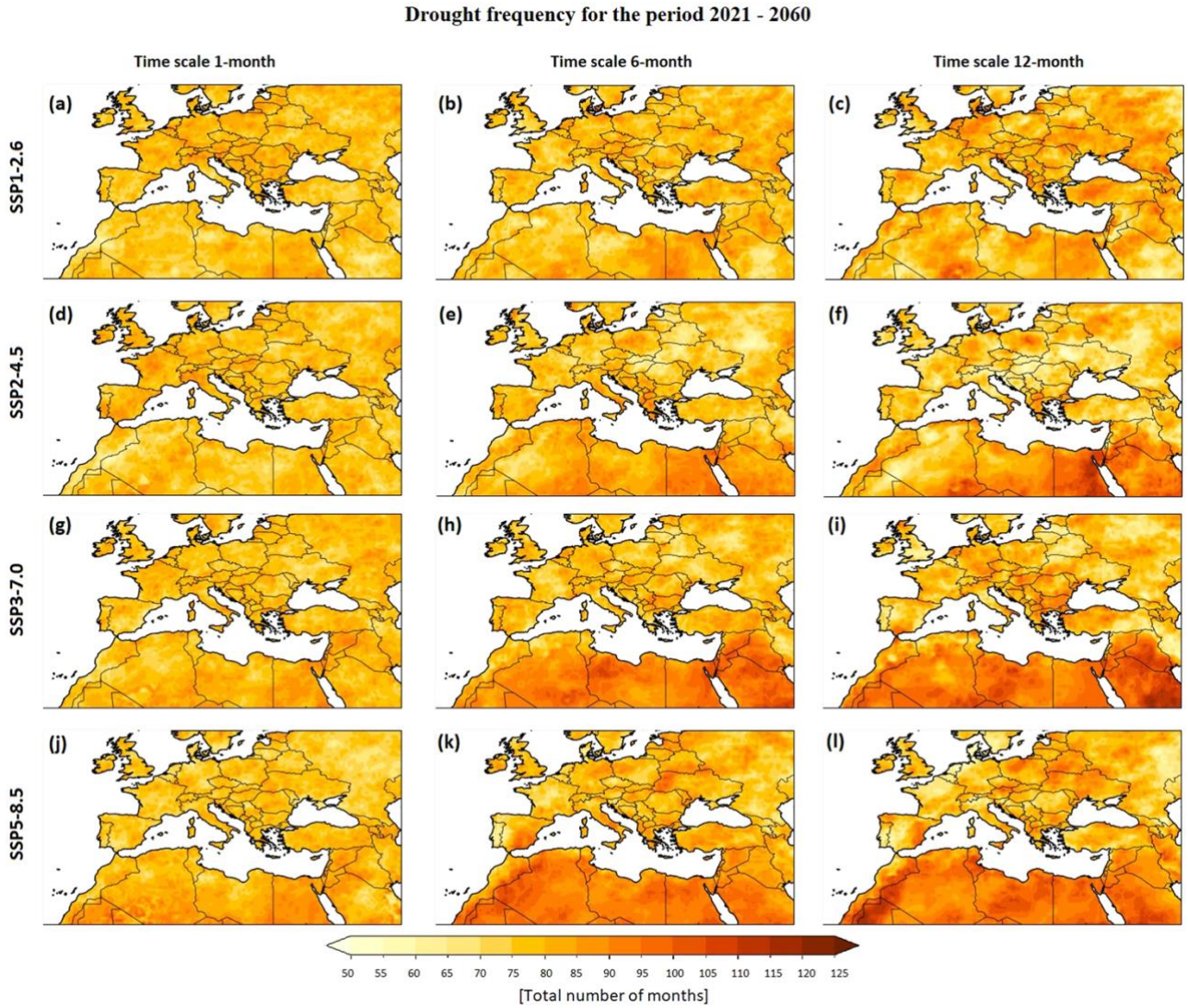

Figure 1: Drought frequency projection for the Mediterranean region. *Drought frequency based on the SPEI at time scales of 1, 6, and 12 months, spanning the projection period 2021–2060 from the CMIP6 MMM under the climate change scenarios SSP1–2.6 (a–c), SSP2–4.5 (d–f), SSP3–7.0 (g–i), and SSP5–8.5 (j–l) (From Essa et al. 2023, used under Creative Commons Attribution 4.0 International License)*

Due to these factors, effective water management and governance are essential for ensuring the resilience and adaptation of communities and territories to changing environmental conditions. Based on the premise that water shortages, degradation, and desertification will likely occur in the Mediterranean region, this work focuses on the South of Italy, where traditional water management practices have a significant potential for adaptation. The thesis examines current practices, their relevance, and how the ongoing practices can contribute to land adaptation to climate change from a socio-ecological perspective by exploring how they interact with water governance systems (see e.g., Durán-Díaz 2023; Bourne et al. 2016). The island of Pantelleria, a volcanic island in the Sicilian Channel, is used as a case study to explore traditional water management practices due to its unique characteristics of aridity, lack of fresh water, considerable wind, and a variable climate plus a documented history of traditional water and land use practices. A commitment to preserving the value

of cultural diversity is embodied in the recovery of traditional knowledge. Climate change and adaptation, and, as the case may be, maladaptation policies (IPCC 2022a and 2022c), play a critical role, as desertification occurs from a physical and a cultural attitude (Weichselgartne 2015; Laureano 2001).

1.2 Water and traditional knowledge

Water is one of the most important concepts in traditional knowledge: when Alexander the Great, who, after conquering Egypt, decided to visit the tomb of Hermes Trismegistus, the mythical founder of ancient science, that was carved out in the basement of the pyramid at Giza, he discovered an emerald tablet inscribed with the "most important secret of the universe" (Principe 2013, 53). In this enigmatic writing, Alexander began to read the famous declaration about "what is above corresponds to what is below", a bit like Bateson's "the larger whole is primarily beautiful" in *Mind and Nature* (1979, 33). Upon further examination, the essence at the origin of all things described in these mysterious words was revealed: *Its father is the Sun, its mother the Moon, the Wind carries it in its womb, the Earth is its nurturer. It generates the world's wonders. The power of this thing is perfect. It gently separates the earth from the fire, the subtle from the dense. It slowly ascends from the earth to the heavens and descends back to the earth, gathering in itself the power of higher and lower things* (in Principe 2013, 55 and Laureano 2001, 13, translated by the author).

Beyond the poetry and beauty of the fragment, and despite the uncertain meaning of the text and the ongoing debate (Principe 2013; Hamvas n.d.) about its interpretation, what if we take it literally? We can read in it, putting aside its esoteric meaning, the characteristics of water: water is raised by the heat of the sun, condensed by the cold light of the moon, transported by the wind, and then precipitates into the earth. Along the way it nourishes all beings and enables them to generate: it activates the seed and transforms dirt into plant energy, making plants capable of blossoming in the sun. It is a conception that includes the inert and the organic, energy and life within a continuous process of transformation, where earth and sky, microcosm and macrocosm, individual and universe are not separated (Magnaghi 2020; Berkes 2008; Laureano 2001; Odum 1997; Bateson 1976 and 1984). Most traditional technical solutions are based on the belief that humanity, nature, and the world at large are interdependent (see e.g., Perry and Gordon 2021; Wolfe 2017)

Given its synthetic, integrated perspective, I have selected a socio-ecological approach to this topic, which recognizes that social and ecological systems are interdependent and mutually influence each other (Herrero-Jáuregui 2018). It emphasizes the importance of understanding the complex relationships and interactions between humans and the environment and the need for

interdisciplinary collaboration to address environmental issues (Petrosillo et al. 2015). This perspective has been supported by international works published by the United Nations Convention to Combat Desertification (UNCCD) in 1998 and 1999, demonstrating that traditional knowledge encompasses both normative and practical aspects, intricately linked to ecological, socioeconomic, and cultural factors. Traditional knowledge is generated by and transmitted to populations by recognized and competent actors; it is systemic (intersectoral and holistic), experimental (empirical and practical), passed from generation to generation, and culturally significant. The dissemination of this type of knowledge promotes diversity as well as enhances and reproduces local resources (Ray 2023; Laureano, 2001; Folke 2004; UNCDD 1988 and 1999). Over time, this definition has been carried on, for example, by IPBES (2013 and 2023) with terms such as Local and Indigenous Knowledge or Weaving Knowledge (Pintér 2023; Tengö et al. 2017), which demonstrates how local and indigenous knowledge simultaneously integrates multiple factors (including social and cultural factors) into their understanding, in contrast to scientific knowledge of an analytical nature that attempts to dissociate factors in order to emphasize cause-and-effect relationships (McElwee et al. 2020). Since these holistic knowledges fall into very different epistemological domains, they are generally poorly understood by scientists, who find it difficult to prove their validity (Tengo et al. 2017, Diaz et al. 2018). According to different studies (see e.g., Deguillame 2022; D'Ascanio et al. 2021; De Pasquale 2020), the Pantelleria farmers have a lifestyle of reciprocal exchange, in which they provide the plants with what they require at specific times in order to ensure their well-being, as well as to meet the needs of humans. Using the relational perspective of reciprocity and not exploitation, farmers are aware that each element of the environment plays a significant role in the shared cycle of life that binds them together with the environment.

Above all, the literature emphasizes the importance of developing an awareness of the fact that traditional and local knowledge are always part of a complex system, and they cannot be reduced to a set of technical solutions confined to a set of distinct applications that are determined by the desired outcome (Reyes-García 2023; Folke 2004). Multiple factors influence their effectiveness. A traditional practice does not serve as a gimmick, but rather is an elaborate, often multifunctional method that is part of a comprehensive approach (society, culture, economy) that is closely related to a worldview based upon the careful management of local resources (Folke 2004; Laureano, 1995 and 2001) as part of an integrated approach. For example, terracing protects slopes, rebuilds soils, and collects water simultaneously (see e.g., Jia et al. 2022; Sakellariou et al. 2021; UNCCD 1988 and 1989). Berkes (2008) also teaches us that traditional knowledge, that he identifies as ecological (TEK), has not only aesthetic values but also functions within social organizations and has a shared

value system that sustains and relies upon it. Terracing is one example of this kind of knowledge. Occasionally, the procedures and achievements are infused with deeper symbolic meaning, more or less consciously depending on the context, with a continuous interplay of references and analogies between techniques, art and nature. Agricultural fields in the desert are known as gardens, just as in Southern Italy and Pantelleria with Pantelleria gardens, thus eliminating the distinction between a productive garden and a pleasure garden (La Mantia 2023; Laureano 2001).

In modern technology, immediate effectiveness is achieved using specialized knowledge managed by dominant structures capable of mobilizing external resources (Hordern 2021; Mancuso 2019). Traditional knowledge measures its functionality over a long and very long period by serving shared knowledge created by generations and passed on through them, utilizing renewable internal resources, which are natural and cultural assets that can be replenished within a community or ecosystem without depleting them. Examples include biological resources, which are used for food, medicine, and other purposes and managed in a manner that allows them to regenerate (Withanage and Gunathilaka 2022). It also includes the knowledge and wisdom passed down through generations, including knowledge and understanding of local ecosystems, species behavior, and climate patterns necessary for a sustainable lifestyle (UNESCO 2021). As a result of multifunctional techniques– methods that serve multiple purposes and benefit the community and the environment as a whole – success has been achieved across various fronts. These techniques, such as soil fertility management, organic matter management, crop rotation, and water governance, have enabled communities to thrive despite adversity (Santoro 2023; Laureano 1995). For instance, constructing terraces and rainwater harvesting structures are practical examples of these techniques, preventing erosion and enhancing water availability (Santoro 2023; Laureano 1995). Collaboration and symbiosis have enabled self-propelled development, independent of exogenous or occasional factors, by reusing all produced within the system (Capra and Luisi 2014; Berkes 2008; Laureano 1995).

To summarize, the traditional technique is part of a highly integrated network of nexuses and relationships governed by social constructions of signs and meanings. It functions according to a socially shared cultural structure: the historical system of science and local knowledge (Berkes 2008; Laureano 2001). Consequently, it is incorrect to isolate individual technologies, which are always contextualized, not only with respect to an environmental situation but also with respect to a specific historical moment and a complex social construction. The consideration of these factors is essential to the fusion, reproducibility, or re-proposition of traditional practices in contemporary forms. As a matter of fact, it cannot always be assumed that a traditional technique will yield favorable results in different situations and at different times. Rather than viewing traditional knowledge as a set of ideas

to replace the mainstream body of knowledge, it should be considered as the development of a new paradigm that can complement the existing body of knowledge (Pintér 2023; La Mantia 2023; Wall Kimmerer 2002; Laureano 1995 and 2001). From local traditional knowledge, one learns not a set of miracle solutions, but the method on which they are based, which may be repurposed through modern technology. Considering the literature (see e.g., La Mantia 2023; UNESCO 2021; Folke 2004; Laureano 1995 and 2001), I support this possibility of integration, but each individual can form their conclusions. Indeed, one could argue that traditional knowledge's prominent feature is that it develops slowly, involving piecemeal evolution, trial and error, and the low possibility of making a critical error. Regarding long-term and indirect effects, modern technology is often associated with high speed and limited learning opportunities.

Nevertheless, an explanation of what is meant can be found in the following table from Laureano work (2001):

Table 1: Traditional and modern knowledge. *A comparison of the characteristics of traditional and modern knowledge according to Laureano 2001, 27.*

Modern Knowledge	Traditional Knowledge
Specific solution	Multifunctionality
Immediate effectiveness	Long-term functionality
Specialization	Holism
Dominant powers	Autonomy
Separation	Integration
External Resources	Internal Inputs
Competition and conflict	Symbiosis
Monoculture	Relations and complexity
Uniformity	Diversity
Rigidity	Flexibility
Costly maintenance	Self-regulation and labor intensity
Standardization	Contextualization
Spendthrift	Savings
Technicality and Rationalism	Symbolism and Meaning
Dependence	Autopoiesis

1.3 Cultural heritage and traditional knowledge approach

This thesis emphasizes that cultural heritage and traditional knowledge are interrelated, which, in my opinion, is beautifully illustrated by Jorge Luis Borges' description of the *Babel library* (1941) as an infinite architecture that contains texts derived from combining the characters of every existing language and all unimaginable languages: a collection of all books that could ever exist. As a result of the immense volume of books contained in the library, its own librarians are unable to use the library because they lack the reading reference key. This view is well suited to the current situation in which we find ourselves as a society with an unlimited heritage of knowledge preserved in the natural environment, human organizations, and landscapes, whose characteristics may seem meaningless without the reading reference key. We live in a cultural landscape, resulting from a historical process of spatial modification (UNESCO 1992, in Pressouyre 1996), which is both tangible and intangible in nature. This landscape reflects the projects of societies whose material and intangible needs are subject to change as time passes (O'Donnell 2023). By virtue of its inherent dynamism, the landscape is capable of adapting to the future, to its inevitable unpredictable nature, to the questions that will arise, to the needs that will emerge based on the past and current histories of the community, through participation, sharing, and melting of diverse knowledge (O'Donnell 2023; De Pasquale 2020).

The landscape is an expression of the interaction between nature and man (UNESCO 1992, in Pressouyre 1996); it is a combination of land use, agricultural and productive transformations, the introduction and spread of plant species, water management, and the social customs of those who inhabit or traverse it, in addition to their legal systems (Laureano 1995). It may include land that has been left "to be" with no apparent utilitarian human value or a purpose beyond that of human purpose (personal comment Pintér 2024). As a result, all of this produces a historical library of culture handed down through the ages and generations, a legacy of experience and knowledge that has been verified over millennia, as well as a treasure chest of knowledge and skills. In the modern world, ancient territorial wisdom has been undervalued and, in fact, extinct as a result of the enormous capacity of technology to make changes, in some cases capable of erasing the past and denying the identity of people.

Is not our situation similar to that of the librarians of Babel? Traditional knowledge can be found within Babel itself, but it cannot be read by technologies that do not recognize its principles or

alphabet. A new approach must be taken in order to make the library a repository of historical knowledge from which to draw constructively and consciously.

This thesis, albeit in a small way, aims to provide us with the opportunity to browse through some texts that reflect this collective heritage, tangible and intangible, that surrounds us, to allow us to re-discover what has been and to develop and inspire capacities for action for the future that is based on co-evolution and co-existence with nature. In other words, it is a kind of self-maintenance which can preserve what is useful in every transformation. Continually recovering, through association and symbiosis, the vast amount of knowledge and experience that nature possesses.

1.4 Why Pantelleria?

In the Sicilian Channel between Sicily and Tunisia (Fig. 2), Pantelleria is a volcanic island without permanent surface water sources. Over the centuries, Pantelleria's inhabitants have developed an elaborate and ingenious system for collecting, storing, and distributing rainwater for domestic, agricultural, and environmental purposes (D'Ascanio 2021; Mantellini 2015; Barbera et al. 2012; Barbera and La Mantia 1998). To understand Pantelleria and its importance in the Mediterranean context, one must examine the uniqueness of its landscape: the density of the dry-stone walls, the unique feature of the "gardens", the "stone towers," as they have been known, that protect a single citrus plant from the strong winds that characterize the island (Sottile et al. 2013; Legambiente 2021). There has never been a moment of true emptiness in the history of Pantelleria's ancient colonization; in fact, Pantelleria's water system has a long and complex history, dating back to prehistoric times, and has been influenced by a variety of civilizations and cultures that have inhabited or visited the island, including the Phoenicians, Romans, Arabs, Normans, Spanish, and Italians (Gentilcore 2021; De Pasquale 2020; Mantellini 2015; Agnoletti 2012). Various elements have been incorporated into the landscape, such as cisterns, terraces, dry walls, gardens, and buildings (*dammuso*) (Laureano 2001 and 2008; Mantellini 2015; De Pasquale 2020). UNESCO has recognized Pantelleria as a biosphere reserve and a world heritage site (National Park of Pantelleria 2014 and 2018; D'Ascanio et al. 2021), providing an example of local traditional knowledge that has evolved over time as a result of harsh and variable climatic conditions in the Mediterranean region, providing lessons for many other water-scarce regions around the world (Hein et al. 2020).

Figure 2: Island of Pantelleria *(Map courtesy of Wikipedia)*

One of the fascinating aspects that led me to choose this island is its living heritage (see e.g., Miura 2005; UNESCO n.d.). Here, as in all places where traditional knowledge is still alive, the essence of this knowledge lies not in the individual techniques, but rather in the system within which they are rooted. An approach to knowledge that draws upon, although partly unconsciously, the fundamental assumptions of agroecology, a science developed in the 1980s to apply ecological concepts to agriculture. Integrated ecology that draws upon economics, sociology, and economics in order to study not only productive functions, but also those of the environment, culture, and society (De Pasquale and Barbera 2020).

In choosing Pantelleria as a case study, I was guided by the fact that, with the exception of the local scholars, Pantelleria is largely neglected in scientific literature, reflecting the North-South tensions of the world (see e.g., Sabzalieva 2020; Hudson 2016). And, more importantly, due to its isolation, represents a real reservoir of biodiversity (Sottile et al. 2013). Additionally, Pantelleria has a unique landscape characterized by fertile soils due to its volcanic nature, but also by steep slopes, lava flows, and rock fields, making land management and practices difficult. All agronomic and construction decisions are designed to conserve water and adapt to the whims of climate (Pasta and La Mantia 2003; Barbera et al. 1997; Gianguzzi 1999). Additionally, I speak the local language,

which enables me to gain a deeper understanding of cultural nuances and gestures. I was interested in exploring the interaction between these practices and formal and informal institutions and actors involved in water governance, and their potential for influencing and inspiring water management and governance in other contexts. In the course of my studies, I have gained a great deal of knowledge regarding these issues, which require a comprehensive approach that incorporates both infrastructure and ecological adaptations. It is essential for political actors to transcend political science to learn from the territories, to avoid limited purpose assuming laws or rules that are not locally shared, and to avoid maladaptation policies (IPCC 2022a). With this thesis, I deepen this approach in a manner that is not only theoretical and personal but also practical and effective. A critical finding of this study is that in order to develop political strategies, someone needs to be on the ground; you cannot drop specific solutions from above (Reyes-García 2023; Salvador and Sancho 2021; Magnaghi 2020). A clear demonstration of this can be found in the tensions reported in the sections of the interview (see *Results* and *Discussion*) on the National Park in Pantelleria. Lastly, I chose Pantelleria as a case study, not only because it is a "dark gem" (Olivetti 2019, 283) but also because it is a living heritage that can provide general insights applicable to the global context.

1.5 Research design

The thesis consists of an analysis of the literature review complemented by an explanation of the context of the case study, accompanied by a description of the data collection and methodology employed during the study. Data was collected through semi-structured interviews utilizing appreciative inquiry methods (Elliott 1999). Appreciative inquiry (AI) is a strengths-based method that focuses and enhances the positive core of a human system (Elliott 1999; Bushe 2007) by identifying strengths, possibilities, and positive aspects related to my research topic. According to Mohr and Watkins' "Roadmap for Creating Positive Futures" (2002), the proper questions from this approach, known as 5-D questions (Fig. 3), serve as a guide to develop not only the interview questions, but also the research questions for understanding *how traditional water management systems can contribute from a socio-ecological perspective adapting to climate change.*

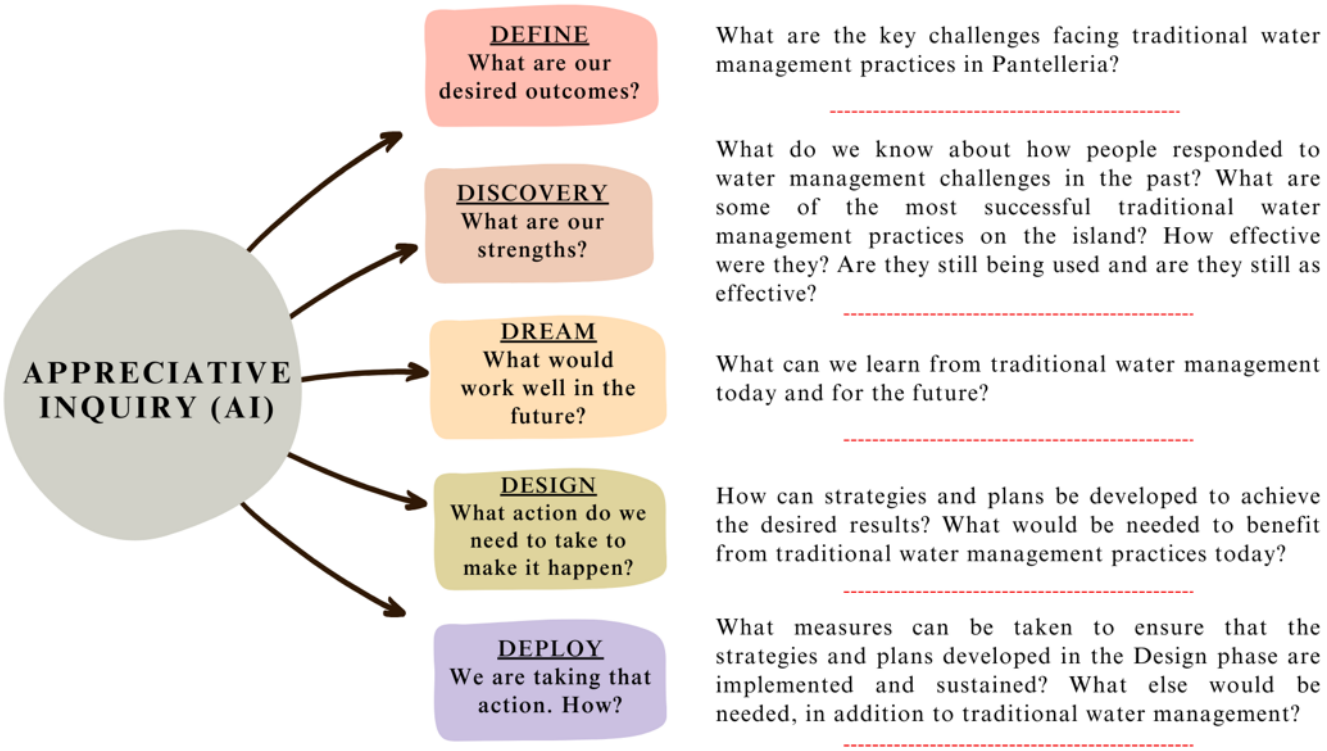

Figure 3: Conceptual model of 5-D approach and research questions. *The left section illustrates the 5-D approach, while the right section depicts the research questions and interviews pertinent to the study (Graph by the author)*

AI questions are open-ended; they seek to identify what works well and what can be improved in order to gain a better understanding of the perspectives of experts and relevant stakeholders, including those who manage land to prevent overexploitation of water, not necessarily those with the capital to invest (Bushe 2007; Elliott 1999). It is also important to note that AI is a good fit for this thesis since it allows a comprehensive and positive exploration of complex, multifaceted issues. The generative interactions emphasized by AI align with the social construction of reality, where knowledge and understanding are co-created through dialogue and shared experiences (Bushe 2007). The interconnections can take place between communities living in a territory and the territory itself, as well as its biotic and physical interactions (Odum 1997).

During February and March 2024, 79 people were interviewed (see the *Appendix*), primarily in Pantelleria but also in Palermo, representing a diverse community of experts, the island community, to which I decided to add the community of Pantelleria people in Aprilia, near Rome. Some of the experts interviewed from Palermo University examined the island from an architectural perspective, from a geological perspective, from a biological perspective, and others from a historical, rural, and historical landscape perspective. Additionally, this variety characterizes the islanders interviewed, who work in sectors that are more or less explicitly linked to water management, particularly farmers who maintain these traditional knowledge systems. There are varying ages to determine if there is an active generational knowledge transmission; all live in Pantelleria or frequent it; however, a few are

occasional visitors. I conducted 4 interviews in April 2024 with members of the 1970s migrant community from Pantelleria in the Lazio region. Though they are a limited sample, I found that the views of community members who moved away added a lot to the research in terms of further inquiry, as well as providing an opportunity to compare the experiences on the island with those who are also from there but in a different agricultural context.

1.6 Research aim

This research examines how humans have used the water cycle over time in a way that respects rather than overexploiting water resources (Kravčík et al. 2007; Laureano 1999) and demonstrates the importance of traditional practices, as well as their successful implementation over long periods. This is not only for the preservation of cultural heritage, but also for a new paradigm that builds on and integrates traditional techniques into modern societies. In the course of my stay at Pantelleria between February and March 2024, I gained a deeper understanding of water governance and management from a traditional perspective within a Mediterranean context. Here, I will not be focusing on demonstrating a new or innovative practice, but rather on assessing the extent to which traditional practices are still being practiced and whether they can act as adaptation opportunities in light of the emerging conditions of climate change and the governance approaches to coping with climate change. Understanding the logic of traditional techniques and their successful implementation over a long period of time is essential not only to safeguard a vast cultural heritage but also to establish a new paradigm for reappropriating traditional techniques in modern times.

I want to analyze land use processes as an interplay of relevant resources and strategic capabilities (De Toni and De Zan 2015). In order to curb greenhouse gas emissions and successfully adapt, we must break down the glass ceiling that reduces climate change to an economic opportunity (Hausknost 2020). As mentioned by Boldo and Valentinelli (2023) environmental issues are a consequence of social issues. To break down this climate change glass ceiling, it is necessary to analyze the various processes, issues, sectors, and stakeholder perspectives on traditional knowledge, to determine whether it is perceived as lost knowledge, or rather as a resource for human progress, in order to develop new strategies for addressing climate change. While I speak of a matter of perception, the factors of loss may be economic or legislative. In each case, however, it must be clarified, and problematized, whether the loss arises from the community or external factors. In this case as well as elsewhere. It is essential to understand these social issues, not just those that contribute to problems, but also those that have stood the test of time as contributing to solutions and may again contribute to the future. As Laureano (2001) points out, today's innovation will become tomorrow's tradition.

2. Literature Review

Several academic articles covering various areas and disciplines have been selected and reviewed, including environmental studies, cultural heritage, landscape planning, traditional knowledge, and water governance, among others. Since this thesis covers a wide range of disciplines, traditional water management must be analyzed as a whole, which is why the same literature review offers both opportunities and limitations. Although there are many and varied exciting, stimulating, and interesting authors and comments to follow, this is a master thesis that can be limited in scope. Following that, I review the main findings and contributions made by the articles and the gaps and limitations that my study intends to address.

This study attempts to utilize Dr. Fritjof Capra's concept of system thinking, which offers a contextual orientation that is essential for understanding it. Analytical thinking involves taking something apart in order to understand it, whereas system thinking involves placing it in the context of a larger whole (Capra 2021). It may also be important to discuss emergentism, cognition, and self-organization in this regard. However, these are beyond the scope of my investigation, so I will not pursue further, but I recommend his work to those who wish to explore these topics more in depth (see e.g., Capra 2021; Capra and Luisi 2014). In addition, I realize that some readers might have difficulty with this systemic approach, so I provide them with a linear list of topics that relate to different fields convergent in the traditional water management process: you can read the following paragraphs in either a linear or complex manner (see e.g., Capra 2016; *The Cynefin Framework* in Snowden 2010; Kurtz and Snowden 2003). For a deeper understanding of what I am trying to accomplish, I recommend reading it from a complex perspective.

2.1 Intangible cultural heritage

In spite of their complex interrelationships, water and cultural heritage are often approached from a siloed perspective (Hein et al. 2020). Water is generally considered within the context of science or engineering management, which is focused on specific sectors such as drinking water, hydraulic systems, and so forth (Hein et al. 2020). Although cultural heritage is often viewed as an assortment of isolated structures (Hein et al. 2020; Fabbricatti et al. 2020), it plays a crucial role in the development of spatial transformations, landscape design, and urban planning in integrating the past, present, and future. In relation to climate change adaptation, I argue that water, cultural heritage, water governance and traditions, ecosystem functionalities and rural land management are all interconnected and interdependent, and that they can mutually enhance each other. For instance,

cultural heritage can contribute knowledge and identity to the management and governance of water, as well as provide cultural values and meanings to the landscape and people. Because of this, living heritage or intangible cultural heritage can also be used to describe it (UNESCO 2019).

Cultural heritage and cultural landscapes are integral to our understanding of societies' pasts and their interactions with the environment (De Pasquale 2020; UNESCO 2019). They encompass traditions, practices, places, objects, artistic expressions, and values. This heritage is not only a legacy from the past but also a resource for the present and future, contributing to identity, social cohesion, and sustainable development. Cultural heritage and cultural landscapes become living heritage, integrating into our understanding of societies' pasts and their interactions with the environment. They explain those socio-ecological relations that can be found in traditions, practices, places, objects, artistic expressions, and values (Berkes 2008; Laureano 2001).

In traditional knowledge, there is both practical and normative knowledge concerning the environment, social structure, and culture (UNCCD 1998 and 1999). The knowledge consists of systems (inter-sectoral and holistic), experiments (empirical and practical), handed down from generation to generation, as well as cultural values. This knowledge contributes to the enhancement and reproduction of local resources as well as supporting diversity (Laureano 2001 and 2008). Laureano (2008) describes it as part of an extensive system of sharing knowledge, whose proficiency and evolution are observable over a long period of time (Tusa 2017).

This thesis intends to demonstrate that understanding the logic of traditional land and water management approaches, as well as their successful implementation over long periods of time, is crucial not only to safeguard a vast cultural heritage but also to establish a new paradigm for reappropriating traditional techniques for modern times. Applying traditional knowledge does not mean reapplying past techniques, but rather understanding their logic (Mattila et al. 2022; Laureano 2001). By managing ecosystems in their dynamic environmental balance, societies were able to produce outstanding technical, artistic, and architectural works that are universally admired and have always been able to adapt and renew themselves to changing circumstances. To achieve local and environmental sustainability, traditional knowledge is thus a dynamic system that incorporates and tests innovation over a long period of time (Laureano 2001 and 2008).

For instance, this approach can be found in adaptive management (Berkes 2008; Olsson and Folke 2004), which allows traditional knowledge to be integrated into climate change strategies. Historical knowledge is used to inform current practices, emphasizing the importance of learning from

experience and adapting accordingly (DeSilvey et al. 2022; Sendzimir 2022). Adaptive management is a relevant method aligned with traditional knowledge applications in modern times. It provides a framework for applying traditional knowledge in a way that respects the past and responds to present and future needs (Daly et al. 2022; Sendzimir 2022; Olsson and Folke 2004). Thus, adaptive management involves adapting strategies to changing conditions, similar to how traditional knowledge has evolved to remain relevant.

2.2 Cultural landscape

A cultural landscape is defined as "a combined work of nature and man" by UNESCO (1992 in Pressouyre 1996), which reflects the projects of societies whose material and immaterial needs can vary over time in response to their needs. The landscape, in its inherent dynamism, can confront the future and adapt to it, to its inevitable unpredictability, to the questions that will arise, to the needs that will arise from the past and present history of the community through participation, sharing, and melting of different knowledges (De Pasquale 2020). According to the principles of the European Landscape Convention (ELC), signed in Florence in 2000, all landscapes deserve attention, no matter their value even if they are every day and degraded landscapes. Landscape "is an important part of the quality of life for people everywhere: in urban areas and in the countryside, in degraded areas as well as in areas of high quality, in areas recognized as being of outstanding beauty as well as in everyday areas" (Council of Europe 2000, Preamble). A paradigm shift underpinning this definition challenges the preservationist approach that still dominates landscape policies throughout Europe. As a result, the focus should shift from identifying, enhancing, and protecting "special" landscapes to recognizing the importance of ordinary, everyday, even degraded or stigmatized landscapes and their qualities. This means that the ELC democratizes landscapes by taking a social rather than an elitist perspective (Barbanente and Grassini 2022).

This stance does not oppose science and technology but instead suggests a new interface where cultural landscapes, traditional knowledge, and local communities have more political space. There is a co-evolutionary relationship between human settlements (organized on biological and cultural bases and timescales) and the environment (organized on biological and geological bases and timescales), based on rules designed to maximize the use of resources in ways that are reproducible over time (Magnaghi 2020). There is a strong emphasis in this approach on (re)claiming new rules of relations between human settlements and nature, which is why it refers to a socio-ecological approach to territory and coevolution.

In introducing the case of Pantelleria in this manner, I may be able to understand traditional techniques, which cannot be reduced to a list of isolated technical information for solving a specific issue. The full significance and importance of traditional techniques can only be understood when they are contextualized, not only within their local environmental context, but within a specific historical moment and the complex social construction that produced them (Tusa 2017; Laureano 2008). In research and ELC implementation in European countries, it has been demonstrated that local government systems and the traditions that dominate landscape protection and planning in each country strongly influence the implementation process (Barbanente and Grassini 2022). In order to achieve a sustainable use of landscapes, the ELC changed the notion of landscape by recognizing that every landscape merit consideration, regardless of its economic value, even if it is only for the value the landscape possesses as a historical product of environmental transformation. And above all by promoting public participation in landscape protection, management, and planning processes. This is a paradigm shift away from conservation policies towards a management approach to planning new landscapes through the promotion of virtuous relationships between the interests of people, places, the environments, and the economic activities (Barbanente and Grassini 2022; Aimar et al. 2022; Magnaghi 2020).

2.3 Water management and water governance

Given that background of the importance of the cultural dynamics of what landscape means, I need to talk about water and water management. Scientists consider water a key indicator of the possibility of life on other planets (Clarvis and Engle 2013), as it sustains life on Earth and supports the functioning of ecosystems. As a result of climate change, water is also a vulnerable and contested resource that faces numerous threats, including droughts, floods, and pollution (IPCC 2022b). The quality and availability of water resources are under threat, as are the resilience and vulnerability of social-ecological systems that rely on them. As a result, adaptation to climate change is primarily concerned with improving water cycle management and its interactions with soil (Clarvis and Engle 2013; UN-Water n.d.). A different perspective can be offered to reorient land management policies to address the increasing vulnerability of various territories and thus contribute to their adaptation to climate change. This approach's innovation lies in applying a systemic view of the territory rather than the study of individual species or techniques. This way is possible to view the territory as a mosaic of modern and traditional approaches, not always clearly distinct, but rather layered, reflecting the contemporary landscape's physiognomy in their intertwining, and overlapping (Barbera and Biasi 2011). As a result, paying attention to the traditional landscape in its forms, meanings and environmental resilience plays a strategic role in land management, focusing on areas where problems

are present and increasing, but also offering potential multifunctional solutions. Through this approach, Pantelleria can be studied for its multifunctionality, particularly in regard to the preservation of environmental resources, agro-ecosystem functionality, landscape diversity, and cultural memories, which illustrates why it is important to preserve and valorize these productive landscapes as well as the traditional techniques used to maintain them (Barbera and Biasi 2011).

Consequently, water management is essential for ensuring the sustainability and availability of water resources, especially in arid and semi-arid regions where desertification is becoming a reality rather than merely a potential issue (IPCC 2019; Corona et al. 2006). In those regions, the effects of climate change intensify desertification, necessitating effective water management to support ecosystem functions and the ecosystem services that communities rely upon. While these regions are at immediate risk of desertification, other areas have also been identified as vulnerable and need to take preventative measures (IPCC 2019; Karousakis and Koundouri 2006).

In cultural landscapes, as opposed to intact natural landscapes, the concept of water management and water governance is required to highlight human intervention and decisions that have a significant influence, which effects cannot be disregarded. There is a fundamental distinction between viewing nature as separate from us and recognizing that cultural landscapes are shaped by the interactions between people and their natural environment (see e.g., Oliver 2024), where human intervention and decisions play a crucial role. The European Environment Agency (EEA) also states (2023): “Our societies need to govern themselves in a way that aligns the needs and concerns of humans with other organisms that are currently ‘left behind’. We should switch from the ‘us and them’ mindset to a relational concept of ‘all of us’ to unlock new motivations to protect biodiversity, rooted in a wider sense of responsibility”. This statement is based on the concept that cultural landscapes have great value, and our society’s political choices have consequences that cannot be ignored. Sustainability and resilience are determined by the choices made, which influence how different areas can adapt to climatic and social changes. Recognizing that the choice of human society is influential and is a matter of responsibility is essential to developing adaptive management strategies that are culturally sensitive and ecologically sound. These traditional landscapes are not static relics of the past but dynamic living spaces that continue to evolve as societies develop. They are often living examples of how traditional land use and human habits create unique ecological patterns (O’Donnel, 2023; Farina 2022).

Consequently, effective water management and governance are pivotal for the sustainability of our planet’s most vital resource. The development and management of water resources consists of a

combination of political, economic, social, and administrative systems essential for ensuring equitable access to clean water, promoting efficient use, and protecting the environment (UNEP 2012). Managing water is one of the most important aspects of climate change strategies, and Walker et al. argue (2004) that there is a need to give space for systems that can adapt to future climate uncertainties not only by being robust against current variability, but also by being flexible and innovative. Societies can better prepare for and respond to the challenges posed by climate change by integrating resilience, adaptability, and transformability into water management strategies. As a key connector in climate change adaptation, water management is vital to reducing climate impacts on the water cycle and avoiding dangerous consequences for human health, the economy, and even cross-border relations (UNEP 2022).

Adapting to climate change requires effective and adaptive water management and governance (Pintér 2017), again and again. In order to address the impact of climate change, water resources must be carefully stewarded. By ensuring a reliable supply of water and reducing the risks of water-related disasters, participatory cultural-based water management can assist regional communities in becoming more resilient to these changes (Mauroner et al. 2021). According to the scientific literature (see e.g., Petzold et al. 2023; IPCC 2022a; Berrang-Ford et al. 2021), individuals and households are the main actors involved in adapting to climate change, while governments are primarily involved in planning and funding adaptation. The findings of this study and the interviews presented in this thesis underscore the importance of assessing global progress in climate change adaptation and suggesting that climate actions should be distributed fairly among various actors to achieve policy goals in this area, making consequential decisions regarding water infrastructure with significant long-term lock-in. A wide range of societal actors are involved in adapting to climate change, including state and non-state entities. Understanding these actors' roles is crucial for identifying different types of adaptation responses (Petzold et al. 2023).

2.4 Traditional knowledge as science

I consider traditional knowledge in water management to be traditional ecological knowledge since it implies time-tested and wise knowledge, as well as ecological knowledge since it accounts for the living environments around it (Berkes 2008). For me, understanding the landscape entails more than just knowledge of the land (Berkes 2008); it extends to an awareness of the ecological functions of the surrounding ecosystems. Whether this traditional knowledge and its management action are conscious or not, Berkes (2008) describes it as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about

the relationship of living beings (including humans) with one another and with their environment" (7). It is an agglomeration of knowledge that is enriched, multiplied, diversified and consolidated until it becomes scientific (Tusa 2017). Berkes (2008) quotes Apffel Marglin as stating that Western scientific knowledge is "characterized by disembeddedness; universalism; individualism; nature/culture and subject/object dichotomy; mobility; and an instrumental attitude (nature as commodity) toward nature" (11). In contrast, traditional knowledge is conscious of its context, it is characterized by a deep integration with the local environment, recognizing the uniqueness of each cultural practice rather than trying to standardize it (See *Table 1* in *Introduction 1.2*). A significant characteristic of this approach is its collective approach, a holistic understanding of nature and culture as a unified whole, a strong sense of place, and a reverent relationship with nature. The traditional knowledge approach is based on the belief that nature is not just a commodity but is an integral part of society (Berkes 2008).

Although I agree with Berkes explanation, I believe it is related to the Cartesian break, because the knowledge we use today is explained linearly based on that Cartesian cultural background (Capra and Luisi 2014). Similarly, Berkes states that "Maori science, or any indigenous knowledge system, is not necessarily inconsistent with all of Western science. It is, however, definitely inconsistent with the positivist-reductionist tradition in Western science, and the assumption that the professional expert knows best" (258). This is an important cornerstone, which is emphasized several times in my thesis, that our scientific knowledge does not solely depend on what is considered mainstream in our society at the moment. Whether consciously or unconsciously, I believe we describe our modern knowledge with this scientific Western paradigm, but this knowledge is not solely derived from that paradigm.

As an example, there is a system of knowledge in Pantelleria that, albeit unconsciously, has reference to the fundamental cultural assumptions of the science of agroecology, which was established in the 1980s in order to apply the concepts of ecology to agriculture (De Pasquale 2020; Pérez-Vitoria and Guzmán 2017). Yet what distinguishes Pantelleria agriculture and beyond is not the individual farming technique, but rather the underlying system. There are many definitions of agroecology (see e.g., Capra and Luisi 2014; Pérez-Vitoria and Guzmán 2017), and the one that in my opinion, reflects the perspective of this thesis is La Mantia's definition (2023) of *agrosystems* as those portions of agricultural land where human influence on natural balances prevails but where, over millennia, the human population's actions have established stable and dynamic relationships between biotic and abiotic components at the same time. Ecology is defined as the study of the relationships between living organisms and their natural environment, and the ecosystem is the fundamental unit in ecology,

so the study of agro-ecosystems must necessarily be conducted using an ecological perspective (La Mantia 2023; Pérez-Vitoria and Guzmán 2017). La Mantia (2023) utilizes a concept that respects the definition of traditional knowledge, paying particular attention to ecosystem functions as explored in this thesis (Haq et al. 2023; Terra Stori et al. 2019).

However, it is important to remember that not all Western scientists do not recognize traditional knowledge as a legitimate source of information. As there are scholars (see e.g., La Mantia 2023; Capra and Luisi 2014; Laureano 2001), there are also tools that recognize traditional knowledge as a valuable resource. For example, in terms of landscape-level focus and science-based tools in the direction of traditional knowledge, there is the Integrated Water Resources Management **(**IWRM). This instrument is important for different reasons; one is that IWRM is a dynamic and adaptable process that requires continuous learning and adjustment (Global Water Partnership 2020 and 2010). This concept recalls the characteristics of traditional knowledge and adaptive management mentioned before (see *Literature Review 2.3*). The UN Environment Programme (UNEP) also supports IWRM as a cross-sectoral policy approach, highlighting that it requires shifting from traditional water management practices to more adaptive, inclusive, and environmentally sound strategies (UNEP 2024). Second, the IWRM approach acknowledges the artificiality of separating water management from land management, recognizing that decisions made on land, regardless of whether explicitly labelled as water management, invariably impact water systems (Van der Zaag and Savenije 2015). IWRM therefore, calls for an integrated approach that sees the landscape as a coherent whole, where every action can affect the entire system (Global Water Partnership 2020; Van der Zaag and Savenije 2015). This lens supports traditional knowledge, ensuring that water management is not an isolated practice but an integral part of a larger environmental context, which is essential for the sustainable management of natural resources.

In combining scientific and traditional knowledge, this synthesis emphasizes the need for integrative approaches that cross conventional management boundaries to ensure the resilience and sustainability of water resources within a landscape. In other words, this approach advocates for a science that is innovative and participatory, that involves all stakeholders, and that considers not only productive functions, but also environmental, cultural, and social factors. It ultimately concerns the complex relationship between man and nature.

2.4.1 Traditional knowledge and local knowledge

In this thesis, I refer to traditional knowledge (TK) and local knowledge (LK) interchangeably; for the purposes of the thesis, there is no real distinction between them. As discussed in the previous

sections (see *Introduction 1.2*), there are different ways to define traditional knowledge, ranging from Berkes (2008) as traditional ecological knowledge to weaving knowledge (see e.g., Pintér 2023; Tengö et al. 2017). The following are my reflections on the characterizations of traditional and local knowledge and what I found to be overlapping between the two definitions in the case study of Pantelleria.

Traditional knowledge refers to the long-standing traditions and practices of specific regional, indigenous, or local communities. Traditional knowledge is often oral, collective and culturally embedded. Knowledge is not only the content of knowledge itself but also the processes of knowledge acquisition, which are intergenerational and culturally specific (Williams et al. 2020). Local knowledge is a set of understandings and skills developed by individuals and populations living in a particular area that guide their decisions regarding different activities, from agriculture to forestry to health. While local knowledge often overlaps with traditional knowledge, it is often more individualistic and less structured (Williams et al. 2020). In my opinion, it is difficult to distinguish between the two since neither knowledge is standardized and systematically collected. However, for the scope of this thesis, it is not necessary to separate the two when it comes to management and the development of adaptation strategies. They should be included in any plan or strategy, regardless of their differences.

In general, TK tends to be older, with roots that can be traced back many generations, whereas LK may be more contemporary, but other authors indicate that whereas LK is an older concept, TK has become more common in the literature (Onyancha 2022). Nevertheless, they are often intertwined and build on one another (Onyancha 2022). Cultural and spiritual practices are usually deeply rooted in TK, whereas this may not be the case in LK. There is little spirituality in the practices I studied in Pantelleria, if any. The transmission of TK takes place orally and through rituals over generations, while LK transmission may occur more informally within local communities (Onyancha 2022; Williams et al. 2020). As, in my view, they intertwine, I do not have any data from my case study to support the claim that TK is more rigid than LK and that LK is more open to contemporary influences (Lovren 2021).

Knowledge, in general, is intertwined between different approaches and wisdom, so it is challenging to draw a definite line between TK and LK. For example, indigenous communities may retain some elements of traditional practices and beliefs, especially in areas such as agriculture, where ancient methods may still be used but adapted to current conditions (Lovren 2021).

With the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), there is a direction towards an enrichment of knowledge, combining indigenous, local, traditional knowledge with scientific knowledge. Among the challenges that IPBES is attempting to overcome is the divide between the scientific knowledge system and local indigenous knowledge systems, raising practical issues related to power, participation, communication, ontology and epistemology (Tengö et al. 2017). IPBES is an example of a third knowledge possible space (Paracchini et al. 2018; Löfmarck and Lidskog 2017). All forms of knowledge rest on assumptions about who to trust and what should count as evidence: embracing the messiness of different knowledge systems is necessary for collaboration between them, but this is easier said than done. In a third space, multiple rationalities can coexist, and the power and antagonism of different rationalities are acknowledged. This consideration is essential because attempts at universalization imply denying, erasing or suppressing other ways of knowing (Löfmarck and Lidskog 2017; Tengö et al. 2017).

2.4.2 Traditional knowledge and ecological compensation

In the context of climate change adaptation, Ecosystem-Based Adaptation (EBA) and Payments for Ecosystem Services (PES) are strategies that utilize biodiversity and ecosystem services as part of an overall adaptation strategy in order to assist populations in adapting to the adverse effects of climate change (Colls et al. 2009; UNEP n.d.) Because of this, they are a useful lens and tool to integrate with traditional knowledge, and they can serve as a foundation for further development. EBA is based on the use of biodiversity and ecosystem services as a buffer against the impacts of climate change (Nalau et al. 2018; Colls et al. 2009); Payments for Ecosystem Services (PES) are mechanisms that provide financial incentives to landowners or communities members for managing their land in a way that provides ecological services (Vatn 2010).

There is potential controversy in paying for traditional knowledge, as it may be argued that this goes against the very spirit of that type of knowledge being held collectively and culturally (Andanda 2012). The scope of my thesis does not touch on the nature of intellectual property rights of traditional knowledge (see e.g., World Intellectual Property Organization 2024 and 2023; Andanda 2012) but rather advocates a new interface between knowledge and political strategy (Colls et al. 2009) in light of contemporary challenges, including but not limited to climate change. I am referring to indirect compensation that might be achieved through involvement in education, consulting, advisory work, or ecosystem services management. Through the valuing and use of traditional knowledge in ways that go beyond direct financial compensation, there is an opportunity to create synergies

between cultural heritage, modern political and environmental objectives (Nalau et al. 2018; Wegner et al. 2016; Colls et al. 2009). This could lead to more sustainable, inclusive and innovative policies (Paracchini et al. 2018).

Through the lens of social-ecological system (SES), by integrating financial and environmental services for adaptation with a traditional and local understanding approach, communities can develop more robust adaptation measures that are both culturally appropriate and environmentally sustainable (Paracchini et al. 2018; Wegner et al. 2016). Ecosystem-based adaptation strategies and payments for ecosystem services are examples of strategies that could integrate ecosystem dynamics with traditional knowledge practices (Nalau et al. 2018; Wegner et al. 2016; Colls et al. 2009), as well as a powerful approach to combating climate change and preserving traditional knowledge throughout the world. EBA, PES, and IPBES serve as examples of a bridge to the incorporation of marginalized knowledge into the capacity of planning and managing scarce resources, such as water, and enhancing and learning from the contextual cultural heritage.

There is a clear ability to select the processes and techniques most beneficial from the community on Pantelleria, so much so that many signs of these approaches are still visible on the landscape. A multifaceted integrated approach would develop the idea of PES schemes designed to support EBA initiatives by respecting local cultures and ecosystems while providing economic incentives (Wegner et al. 2016). With the ability to maintain a connection to traditional knowledge despite the challenges of globalization, a laboratory can be developed in which existing tools from other global agencies can be refined and utilized (Paracchini et al. 2018). Through the use of EBA and PES principles, governance actors would be able and required to participate in the design of the proposed schemes.

2.5 Socio-ecological system

For this thesis, the Social-Ecological System (SES) framework (Herrero-Jáuregui 2018; Ostrom 2009; Berkes and Folke 1998) provides a multidimensional lens for examining the intricate interplay between human societies and their surroundings. Specifically, it emphasizes the importance of local governance and common property resource management, challenging traditional views that advocate either private ownership or government intervention as the sole means of preventing resource depletion (Berkes 2008; Laureano 2001). As with the different approaches to traditional knowledge, SES is a tool that complements the understanding of the intricate and reciprocal relationship between human societies and their natural environments (Herrero-Jáuregui 2018). When aligned with SES, traditional knowledge can help formulate holistic and effective management strategies sensitive to

cultural heritage and ecological factors. A social ecological framework can help to inform the adaptation of management practices to changing environmental conditions, thereby ensuring a sustainable ecosystem and the welfare of the communities that rely on it (Adamo and Willis 2022; Fisher et al. 2015). Moreover Walker' et al. perspective (2004) further enriches this understanding by examining the characteristics of SES that determine their future trajectory-resilience, the ability of a system to withstand disturbances and reorganize while maintaining its core functions and identity; adaptability, the ability of actors in a system to manage resilience; and transformability, the ability to create a fundamentally new system when the existing system is no longer feasible. As a result of these attributes, SES is dynamic and governance must be capable of anticipating, addressing, and shaping change in the face of complex social and ecological challenges (Walker et al. 2004), again in alignment with adaptive management (Sendzimir 2022; Olsson and Folke 2004).

In my own words and based on my reading of various academic articles (see e.g., Farhad and Baird 2022; Salgueiro-Otero and Ojea 2020; Colloff et al. 2019; Coldin and Barthel 2019; Fischer et al. 2015), adaptation can be viewed from a socio-ecological perspective which recognizes the interdependence and co-evolution of human and natural systems. Based on this perspective, adaptation involves the managing and using resources, such as soil and water, which are essential to the livelihoods and well-being of people and ecosystems. Nevertheless, there are many competing and conflicting demands on these resources, as well as overexploitation and degradation (Colloff et al. 2019; Herrero-Jáuregui 2018; Laureano 2001). It's a support to understand how humans have historically chosen to utilize water flows in a way that respects the ecology of the water cycle rather than overexploiting it (Laureano 1999 and 2001). It's a framework that may help me and the readers to understand the logic of traditional techniques, as well as their successful implementation over long periods, which is crucial not only to safeguard a vast cultural heritage but also to establish a new paradigm for reappropriating traditional techniques into modern times and practices.

There are several solutions that can be used to implement this framework, including adaptive co-management (Amitage et al. 2009; Olsson and Folke 2004), which involves the development of trust, institutional development, and social learning. As competing interests and values are the norm, creating the social and institutional space for such interactions can be a daunting task. It is not possible to go into great detail, but it would be fair to have a smattering, keeping in mind that complex systems have multiple scales, and the "correct" perspective will vary depending on how the system is analyzed. Conservationists focus on different levels of biological organization, and different agents hold different perspectives on conservation problems (Berkes 2008). Due to non-linear social-ecological feedback and cross-scale interactions, multi-level governance is necessary. By Olsson and

Folke (2004), effective linkages between social actors allow for regularized flows of information, shared understanding, and problem articulation, enabling governance to move beyond simplified network perspectives. Therefore, adaptive co-management entails more than individual learning, as it requires the ability to identify, explain, and facilitate effective cross-scale institutional arrangements. This reflection enables us to gain a better understanding of Berkes' perspective on TEKs and their relationship to the collective "memory" of groups engaged in deliberative governance (Berkes 2008). As a means of resolving conflict through linking and learning, adaptive co-management addresses bureaucracies' inherent tendency to fragment interests, values, responsibilities, and authority into separate departments that do not communicate, partition information, engage in dysfunctional learning, and compete rather than cooperate (Olsson and Folke 2004).

Through the lens of SES, I am able to analyze water management practices in South of Italy, specifically in Pantelleria, which involves an analysis of the historical, cultural, and environmental factors that have shaped traditional water management practices in the region. By delving deeper into the socio-economic dynamics and the ecological impact of these practices, I can gain a more nuanced understanding of how traditional systems have evolved and how they continue to influence water management decisions today. Additionally, exploring the role of local community participation and traditional knowledge in shaping water management practices will provide valuable insights into the effectiveness and adaptability of these systems in the face of contemporary challenges such as climate change and increased water scarcity.

2.6 Traditional water management

In this thesis, traditional water management is highlighted as an important component of ensuring the sustainable use of water resources. Several authoritative individuals (see e.g., Shiva and Cummins 2020; Capra and Luisi 2014; Tengö et al. 2017; Laureano 2001), in addition to the literature already mentioned in the previous paragraph (see *Literature Review 2.3* and *2.4*), support this statement, including Pedro Arrojo-Agudo, the Special Rapporteur of the United Nations, who advocates the integration of these time-tested approaches with modern approaches to address current water challenges (UNESCO 2009). Overall, the studies on traditional knowledge highlight its importance in sustainable water management practices and the need to preserve and integrate such knowledge into modern approaches. Among others, Malley et al. (2009) emphasize the importance of integrating local knowledge with science and technology for the management of soil, water, and nutrients in sustainable soil, water, and nutrient systems. Canavas' research (2014) examines the challenges and

conflicts associated with conserving traditional water management knowledge in the Xinjiang region of China. Remmington (2017) discusses the *aflaj* system as an ancient method of water management emphasizing collective resource management. In their work, Asad et al. (2021) addresses the issue of traditional water knowledge loss and advocate for the inclusion of that knowledge in efforts to reduce urban flood hazards in the Global South. While there is a predominance of non-Western experiences among the studies, this does not mean that there are no examples of traditional knowledge in Western societies (e.g. Pantelleria; Matera in South Italy; La Geria in Lanzarote, Spain; Hortobágy National Park in Hungary; see the UNESCO Intangible Heritage List). This illustrates precisely how modern science has neglected to consider such an approach in the planning of its water management plans.

It has been found (Zvobgo et al. 2022) that when African communities apply Indigenous Knowledge (IK) and Local Knowledge (LK), this leads to behavioral and cultural changes in the way water is used, managed, and conserved, which are essential for the adaptation of climate risk, particularly during droughts and floods. Many farmers utilize indigenous knowledge to apply traditional irrigation techniques during the dry season or when there is a shortage of water. Water harvesting has increased communities' resilience to water stress conditions, but some technologies are seasonal, and some practices have not yet been established for scalability (Zvobgo et al. 2022).

Scaling is another important topic in socio-ecological systems and ecosystem services (De Vincente Lopez and Matti, 2016; Scholes et al. 2013), but I cannot delve too deeply into it. One study I really appreciate that complements the work by Scholes et al. (2013) is the one by Wigboldus (et al. 2016), which proposes a method that connects the multi-level perspective on socio-technical transitions with a philosophical modal aspects framework to describe the connections between technologies, processes and practices involved in scaling. According to him, rather than actively attempting to scale something up, we should focus more on creating the conditions for scaling. There may also be a range of potential leverage points (entry points) in terms of possible places for intervention (Meadows 2009). Here, back to Walkers' perspective on resilience, adaptability, and transformability in social-ecological systems (Walker et al. 2004). De Vicente Lopez and Matti (2016), for example, present a very compelling approach to scaling in their work: *Visual toolbox for system innovation*. One of the key aspects of the book is the development of new ecosystems and the connection of people and resources in new and innovative ways to scale change. By mapping out the actors, structures, and dynamics of the system, the tools mentioned in their work seek to assist practitioners in making a holistic inquiry, which is crucial to understanding how to effectively scale solutions.

Back to the importance of traditional water management, in synthesis, many local communities around the world have developed sophisticated systems for managing water, based on centuries of observation, trial and error, and adaptation to local environmental conditions (Ananga et al. 2021). Traditional practices encompass an understanding of water cycles, conservation techniques, and the sustainable use of water. Incorporating traditional knowledge into water resource management strategies allows us to benefit from the wisdom and insight of these communities, promoting a more holistic and sustainable approach to water management. However, the question arises: why has this approach been actively eradicated if it is such a brilliant approach?

The answer can be found by archaeologist Pirenne (mentioned by Laureano 2001), who in recounting her research of the Sabataean civilization tells us how the way in which the land was traditionally used and read has always been uncaring about a wide variety of signs on the land: "epigraphists and archaeologists themselves do not pay much attention to practices; art, architecture, and worship come first for them" (94). They ignore the ecology of arid countries, resulting in the classification of water-use systems as temples, towers, or military installations (Laureano 2001). In contrast, if one change perspective, and examine the land without an agenda or prejudice, for example, consider the dew instead of military purpose, they will realize that many stone buildings often serve as water collecting devices, not mounds or towers with a protective purpose. Instead, they were designed as structure for condensation and a whole structure around stone buildings for water collection (Laureano 2001). This perspective is a disciplinary approach that can now be identified in environmental archaeology (Riede and Mannino 2024).

In my thesis, I will not explore this issue further because of the scope, but I believe that a few words should be said on the topic of colonization with regards to traditional knowledge. Recognizing the importance of local knowers in the dynamics of "discovery" is not simply a methodological preference, but rather an important historical dynamic that must be taken into account (see e.g., Ottinger 2024; Morel et al. 2023). Explorers and scientists engaged in study investigation have been and continue to be responsible for creating paradigms based on Western dominance. In reality, their findings would be impossible without the assistance of indigenous guides, who are often not mentioned in study reports. For example, Hayym Habus (1893, mentioned in Laureano 1995), a Yemeni blacksmith who accompanied the archaeologist Joseph Halevy, without whom he would not have discovered Yemen's magnificent epigraphs. In most circumstances, unlike this case, we only have one source to compare. It is the vision created by Western thought that eliminates local interpretations and conceptions of reality by creating the cultural prerequisites of subordination and unequal economic exchange (Abdul Manan Cheema et al. 2021; Schiller 1975). This dynamic is

present not only in countries far from us, but also within European communities. As a consequence, I have endeavored to recognize these power imbalances in my work in Pantelleria, giving space to and giving contrary testimony to these dynamics when they have been exhibited to me.

As a result of the asymmetry of power and lack of reconsolidation, traditional knowledge has fuzzy logic (Berkes 2008) in that it has the power and ability to know and do the right thing, but often has no or little power to decide what to do, as according to Angioni (2015), the "bearers" of indigenous or native knowledge are excluded from the economic means wielded by others. In this regard, I appreciate the reflections of the architect Pietro Belluschi (cited in Rudofsky 1964), who defined collective architecture as choral art produced by a whole population, not by a few intellectuals or specialists, but by the spontaneous and continuous activity of a whole society operating on the basis of a commonality of experience. The builders who are "uneducated" in time and space show a remarkable ability to adapt their works to the natural environment. There is much to be learned from those who live and build on land. As opposed to our attempt to "conquer" nature, they are willing to accept the vagaries of the climate and soil as they are (Rudofsky 1964).

2.7 Pantelleria

Braudel (1972, in Tusa 2017) describes the Mediterranean as "a thousand things at once. Not one landscape, but countless landscapes [...] Not one civilization, but a series of civilizations piled on top of each other" (170). Tusa (2017) quotes him, saying: "Travel in the Mediterranean means encountering the Roman world in Lebanon, prehistory in Sardinia, Greek cities in Sicily, the Arab presence in Spain, Turkish Islam in Yugoslavia [...] It means encountering very ancient realities, still alive, alongside the ultramodern: next to Venice, in its false immobility, the imposing industrial agglomeration of Mestre; next to the fisherman's boat, which is still that of Ulysses, the fishing boat ravaging the seabed or the huge oil tankers" (170). Therefore, Pantelleria is perfectly situated, closer to African territory than European territory, as a crossroad and reference point for anyone who sails the Mediterranean, which Evans (1977, 13) defines as "steppingstones on the sea-routes which have traditionally linked sections of the coastal lands". Before tourists began to visit the island, Pantelleria was home to obsidian traders, conquerors of empires, tree raiders, farmers, exiles, as well as scholars from all disciplines. As a result of the economic, military, or cultural interests directed to Pantelleria, everyone left a reprint of themselves on the island, which, in turn, left a mark (De Pasquale and Barbera 2020).

2.7.1 Abiotic characteristics of the island

Pantelleria (36º 44' N, 11º 57' E), under the province of Trapani, is the largest of the Sicilian islands. It is the fifth largest island in Italy after Sicily, Sardinia, Elba and Sant'Antioco. About 67 kilometers from Cape Mustafa in Tunisia and 95 kilometers from Cape Granitola in Sicily, it represents the emergent part of a volcanic edifice emerging from the Sicilian Channel. The morphology of the island territory has a lithological nature, exclusively volcanic, which originates from several lava masses that have succeeded one another over time and overlapping each other to the point that some of the many eruptive centers scattered throughout the island have been covered (Barbera and La Mantia 1998). Most of the surface rocks on this volcanic island are acid-reacting siliceous volcanites (pantellerites and trachytes), while basalts of the alkaline series with low silica content are found on smaller surfaces (Civetta et al. 1988). The soils consist of Lithosols, Regosols, or andic brown soils (Fierotti 1988). In Pantelleria, the main lithologies are primarily acid and basic volcanites (Villari 1987 in Gianguzzi 1999). Among acid volcanites, sodatrachitic and sodariolitic rocks dominate, and these rocks are called Pantellerites due to the presence of a mineral named Cossyrite. *Cossyra* was one of the names by which the island was known during the classical period (Olivetti 2019; D'Aietti 1978). Regardless, Pantellerite rock is prominent and of equal importance as the volcanic aspect, as they are part of black landscape, and the soil is fertile, due to the importance of both phenomena on the land and its appeal. The central part of the island is dominated by *Montagna Grande* – Big Mountain – (836 m above sea level), which was raised by tectonic volcanic uplift at the southeastern edges of which there rises *Monte Gibele* (700 m above sea level). *Kuddia Mida* (551 m above sea level) and several minor volcanic cones (locally referred to as *kùddie* or *cùddie*) represent ancient eruption centres of the explosive type, which are currently inactive (Fig. 4 and 5).

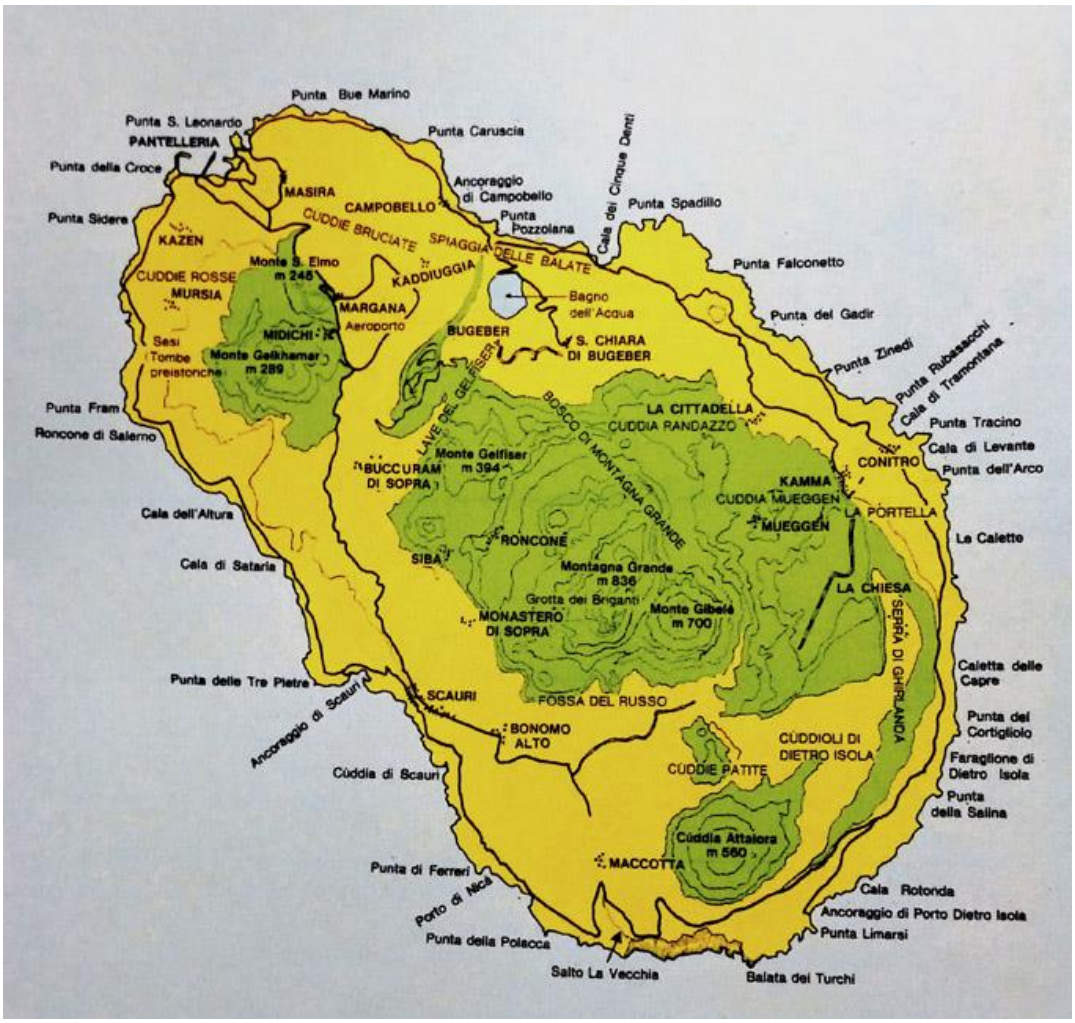

Figure 4: Map of Pantelleria with district names, mountains, and vegetation zones. *Evergreen woods (green) and Mediterranean scrub/garrigue (yellow) highlighted (Map courtesy of Gruppo Micologico Milanese)*

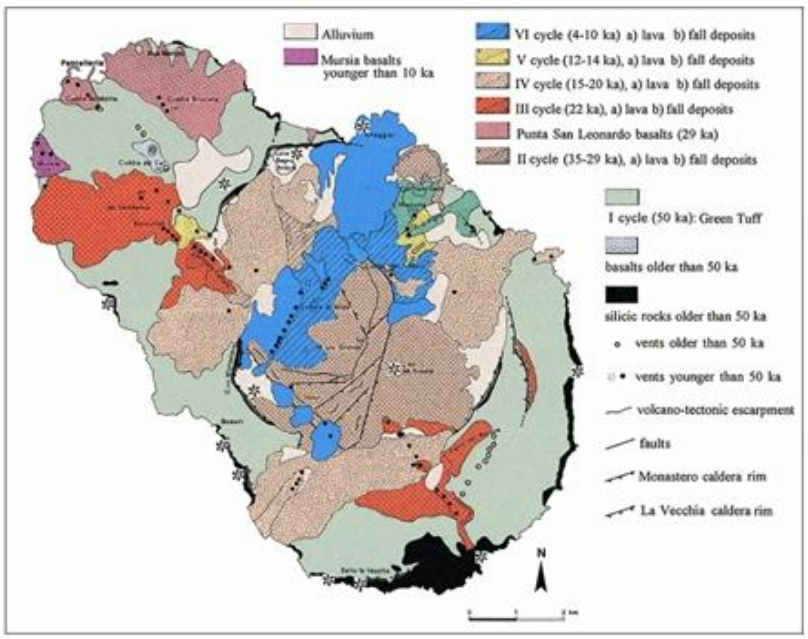

Figure 5: Geological map of Pantelleria. *From a volcanological perspective, Pantelleria is the expression of an apparent paradox, since the existence of this volcano is due to the presence of a continental rift (the Pantelleria Rift), which is a geodynamic context characterized by collisions between the Eurasian and African plates and whose bottom contains continental crust, which is only 20-21 km thick (Map courtesy of Istituto Nazionale di Geofisica e Vulcanologia - INGV)*

Since there is limited precipitation and the substrates are permeable, the hydrographic profile of Pantelleria consists of small seasonal flows, formed by occasional torrential creeks. According to Gianguzzi (1999) the only freshwater spring with very limited seasonal flow located on the southeastern slope of *Montagna Grande* is called *Li Funtani*. A caldera depression in the central-northern part of the territory contains the lacustrine basin of the Mirror of Venus, also known as the *Bagno dell'Acqua*, which is fed by meteoric water – from the atmosphere, specifically from precipitation – and thermal springs. In several other parts of the island, there are also thermal springs of the same type, with water temperatures ranging from 40 to 90 degrees. There is also secondary volcanism on Pantelleria, characterized by several fumaroles called *favare*. These are scattered along the main active tectonic structures, emitting a gaseous, steaming component from rock crevasses at low temperatures.

In terms of precipitation, the island receives 409 millimeters of rain per year, and its average monthly temperature ranges between 11.7°C and 25.6°C (Gianguzzi 1999). Winds blow almost recurrently; in the period 1959-1969 an average of 337 windy days per year were measured with an average annual speed of 12.47 m per second. According to several authors, Pantelleria's climate is classified as a transitional zone between North Africa's northern coast and Sicily's southern coast. However, Gianguzzi (1999) asserts that the *Montagna Grande* relief dominates the island area and determines local microclimatic conditions that are different from those found on the other Sicilian Channel Islands. With the lack of adequate thermopluviometric monitoring, the Mediterranean xerothermal climate is considered to be exclusively representative of the climatic conditions of the coastal and sub-coastal belts. In spite of the high values of solar radiation from relative sunshine, the proximity of the sea influencing the wind regime still results in a particularly mild climate on the island (Gianguzzi 1999; Barbera and La Mantia 1998).

2.7.2 History

One important morphogenetic factor of the island of Pantelleria is anthropogenic activity, which has been ongoing since ancient times (De Pasquale 2020; Pasta and La Mantia 2003; Barbera and La Mantia 1998). It may have appeared to be a chaotic mass of lavas due to its origin and geological characteristics, something that can still be observed in the non-anthropized areas of the island. The oldest descriptions confirm this impression, which depicts a region that was unsuitable for agriculture due to its geological and morphological characteristics. *Cossyra*, for example, is referred to as "desertus et asperrimus locus" - *deserts and most rugged terrain* - by Seneca (Olivetti 2019; Barbera and La Mantia 1998). The persistent conflict between humans and rough terrain has significantly

reshaped the landscape. The characteristics of rainfall and wind made it necessary to cultivate drought-tolerant species and adopt suitable farming methods to minimize wind damage (Barbera and La Mantia 1998). As a result of this necessity, the landscape has developed distinctive elements, including a dense network of dry-stone walls and terracing, a method of making the land flat, preserving its agrarian character and facilitating rainwater penetration, as well as removing rocks from the surface. As a result, stones have become a limit and an opportunity for the inhabitants. They are not only used to construct terraces but also built houses and other artefacts or simply remove rocks from the land.

In fact, Pantelleria has a rich and varied history (Deguillame 2022; De Paquale 2020; Mantellini 2015; Marazzi and Tusa 2007; D'Aietti 1978). I like to quote D'Aietti (1978) who argues instead that Pantelleria's history remains an "inafferable Red Primrose that no one will ever catch" (107). As far as he is concerned, chronicles are more accurate, as at the time of the *Sesi* – the first known human presence on the island dates back to the late Neolithic period – writing did not exist, and we know only what the Romans have recorded about the Phoenicians and Carthaginians. In its own way, he confirms the antiquity of Pantelleria's history, which is supported by several archaeological discoveries (Marazzi and Tusa 2007). For example, Mursía, the island's main protohistoric village with an area of just over a hectare, has been characterized by its high wall and monumental necropolis, which indicate that the island of Pantelleria had a community that controlled its resources beginning in the Bronze Age (Giglio in Marazzi and Tusa 2007). From the fortified village of Mursía, built during the Bronze Age (18 cent. XVI B.C.), we move on to the Phoenicians, for whom Pantelleria was renowned because it was located at the crossroads of ancient trade routes between Africa and Sicily (Deguillame 2022; De Pasquale 2020). According to some scholars (Giglio in Marazzi and Tusa 2007), Pantelleria was the bridgehead of the Punic expansion from Carthage to western Sicily and Sardinia, fully operational by the end of the fifth century B.C. There is archaeological evidence relating to the Punic and especially Roman periods, with marble portraits of Julius Caesar, Antonia, and Titus highlighting the importance of this location (Marazzi and Tusa 2007). The reflections of Tusa (2007, 13-16) regarding the late Roman era are interesting in light of the fact that in spite of an international framework that was characterized by winds of war and impending ethnic, political, and social upheavals on a global scale, a Mediterranean island like Pantelleria achieved an absolutely successful and profitable exploitation of local resources. In fact, the island is devoid of mineral resources except for obsidian, which was an attractive feature only in prehistoric times (Marazzi and Tusa 2007). According to Bocquet (2016), obsidian from Pantelleria was found in prehistoric Tunisian sites dating back to the fifth millennium B.C.

However, what characterized the island after the prehistoric age was its agricultural potentials, exploited and exploitable to make contact with the outside world only within a framework of Mediterranean stability that did not exist at the time, apparently. Despite this conflicting historical period, Pantelleria experienced significant economic development: thanks to clay, volcanic sand, vegetable fuel, water, and manual skills and resourcefulness, *Pantelleria ware* was developed (Marazzi and Tusa 2007). The result was a ceramic production with low typological characterization, an artistic product of no value, but functionally valuable for human activities. Unlike many similar products, this pottery is highly resistant to abrupt temperature changes. The secret of this quality was based on making a mixture of different clays. Rather than dwell too much on this, I wish to emphasize how the development of knowledge in the face of scarcity is an important constant for the Pantelleria people. The island, however, fell into a profound crisis that caused its almost total depopulation after the fifth century B.C. (Marazzi and Tusa 2007). Unfortunately, the causes of this event are unknown; one possibility is related to Pantelleria's harbor, whose construction difficulties are also contemporary and may recall and explain the same ancient problem (Marazzi and Tusa 2007). The difficulties of landing and turbulence in the sea may have contributed to the disruption of the smooth operation of the main production activities, and the movement of people and goods would have been slowed down (Marazzi and Tusa 2007).

However, the traces left by the Phoenicians and Carthaginians are important as they are credited with the first dry-stone water collection cisterns, recognizable by their typical shape and *cocciopesto* waterproofing, which indicate an early understanding of water capture and distribution in order to compensate for the lack of freshwater. Currently found at Pantelleria's Acropolis of San Marco, they demonstrate the profound impact of the Phoenicians and Carthaginians on the island as well as their influence on contemporary history (De Pasquale, 2020; Mantellini 2015; Marazzi and Tusa 2007). In addition, the island is able to maintain an important trade network not only with Sicily, but also with North Africa, and provide adequate water for the needs and sustenance of a large population in spite of the absence of springs and rivers. It is also evident from these cisterns (Mantellini, 2015) that human settlements have been present throughout the territory since ancient times, which largely mirror the urban centers of the present. Besides being the center of trade across the Mediterranean, the island was also a place of permanent settlements associated with agriculture (Deguillame 2022; De Pasquale 2020; Barbera and La Mantia 1998). As a result of the Punic Wars, the island was annexed to Rome in 217 B.C. and given the name *Cossyra*. In 440 A.D. Pantelleria was occupied by the Vandals, who established a small community whose remains can be found at Scauri; the

Byzantines occupied it in 533, but they suffered numerous attacks during the 9th century from the Arabs, who won and seized control of Sicily and Pantelleria (De Pasquale 2022).

It is worth noticing that during the three centuries of their presence on Pantelleria, there was a continual exchange between local and Arab practices, which gave great importance to water (Tramontana 2014) and the method of conveyance. Several district names reflect this presence, including Kanía, Trácino, Khámma, Muēggen, Bugeber, Monastero, Scauri. Many Arabic terms are also incorporated into the dialect, as well as some aspects of agricultural methods, utensils, and food preparation. It should be noted, however, that these Arabic terms are not assimilated by the inhabitants as Arabic, but rather as words from their own dialect (Deguillame 2022). Arabic gardens are seen throughout the world, but they are not directly linked to them; they are structures that can be found in the Middle East as well as southern Italy (Laureano 2001). In the opinion of Angelo D'Aietti (1978), historian of the island, they were brought by the Arabs, who were inspired by the Persian culture. However, other authors argue that the term "Arab garden" is assumed to have originated during the Arab period, a belief that has not been proven, since the earliest gardens that remain are those that were erected after 1400 (Legambiente 2021).

History brings the Normans to Pantelleria in 1123 (Deguillame 2022). In 1361, the Aragonese occupied the island and introduced feudalism. The island underwent a sustained Christianization effort during this period, which likely marked the end of the coexistence between Muslim, Jewish and Christian populations that had existed under Arab rule. Between 1550 and 1556, a series of raids, particularly pirate raids, dramatically reduced the population, affecting spatial planning since the population fled inland, abandoning the coastal areas (Brignone 2012). As a result of these events, the Spanish became the occupants and protectors of the island until the dissolution of feudal rights in 1845 (Deguillame 2022). After the Unification of Italy in 1861, the economy opened up to the continent, until the fascist era, when Mussolini built a number of public works, including roads and a military airport. The war also affected Pantelleria, culminating in the American bombing of the city center in 1943, for military purposes (Deguillame 2022). A NATO headquarters is still located on the island. As a result, in the postwar period, here as elsewhere in Italy, there was a great migration period, in which a substantial community of Pantelleria people, still existing, relocated to Latina and Aprilia, not far from Rome, where they specialized in agriculture due to their expertise. During the 1970s and 1980s, tourism became a significant source of income for the island (Deguillame 2022; Tusa 2022).

Clearly, water plays a crucial role in defining choices and constructing the landscape in this historical context. The following section illustrates this point.

2.7.3 Main features of the rural landscape

Most ancient Mediterranean sites are characterized by terraced and water systems (Mantellini 2015; Laureano 2001 and 2008). Among the techniques they employ are rainfall harvesting, protecting vegetable gardens, producing humus from organic waste, passive architecture, climate control techniques, recycling of food waste, and recycling of productive items to conserve energy (De Pasquale et al. 2018). It is particularly evident from the long effectiveness of traditional techniques and the search for symbiosis and harmony inherent to local knowledge that these ancient towns possess aesthetic qualities, natural beauty, comfortable architectures, and organic relationships with the landscape (De Pasquale et al. 2018). In order to survive, ancient societies throughout the Mediterranean had to manage their natural resources efficiently and accurately. Because traditional farming techniques and settlements are closely related, traditional historical centers play a significant role in preserving the environment. In the Mediterranean region, which is characterized by intense historical land use, each part of the environment is not only the result of natural processes, but also represents a cultural landscape where historical centers are the crystallization of knowledge appropriate to correct environmental management and maintenance (D'Ascanio et al. 2021; De Pasquale 2018 and 2020; Laureano 2001 and 2008).

Similarly, tracing stone and water can reveal the history of Pantelleria's rural landscape. As mentioned several times (see *Literature Review 2.7.1*), since there are no accessible aquifers on the island, water collection has always been of foundational importance: terracing, *buvíre* (brackish water wells that date back to the 2nd century B.C.), with the advent of the Phoenicians (Mantellini 2000), cisterns, Pantelleria gardens, vaulted roofs, *kannalláte* (external downspouts that transport water to the cisterns), are all devices capable of collecting, storing, and distributing dew and rainwater capillary, supporting domestic and agricultural activities. These systems are used to collect rainwater, and capture condensation water, forming an integrated water management system on the island. To achieve an extensive water catchment system, these points are integrated in a perfect manner both functionally and aesthetically. It would be possible to discuss all the elements studied and presented for hours, but I will leave that responsibility to the interviews, and here I will focus on what study I conducted based on the literature before going into the field.

Due to the particular characteristics of the climate on Sicilian islands, island agriculture has had to deal with high solar radiation, low rainfall, and constant wind. As mentioned earlier, the permeability of the island's rocks contributes to the aridity of the climate. The high average relative humidity of 76-78%, however, allows the use of dew, which, according to Pantanelli (1938 in Barbera and La Mantia 1998), can reach considerable levels. As a result of the high atmospheric humidity, the proximity to the sea as well as the clarity of the air, Pantelleria in its arid environment enjoys favorable conditions (Barbera and La Mantia 1998). Occult water is a fascinating phenomenon (Table 2), which refers to the water contained in the atmosphere. It is also known as Non-Rainfall Water (NRW) or hidden water, which does not come directly from clouds, like rain, but derives from contact with the earth's surface. This process can include dew, fog, mist, and water produced by sublimation or condensation.

The concept of occult water is a key-theme in this thesis. Specifically, I am referring to the water carried by the wind, which is the reason it is called hidden or occult water. This water cannot be observed. The Emerald Table (see *Introduction 1.3*) states that "the Wind carries it in its womb": the wind contains water. During a sunny day, the wind, which contains traces of moisture, blows through the spaces between the dry-stone structures, which have a lower temperature than the exterior. A decrease in temperature causes water drops to condense, and, in the case of dry-stone walls, they are absorbed by the ground; in the case of cisterns, they precipitate into the cavity. Through the accumulation of water itself, the condensation structure provides additional moisture and coolness, enhancing its efficiency. Nighttime, the process is reversed, with condensation occurring externally. This is the phenomenon of hidden water collection. For this reason, cisterns can store 15,000 m^3 of water per year (Bonasera 1965 in Barbera, La Mantia and Quatrini 1997). The water in question is not just rainwater; that would not be possible. Instead, it is water that has been collected by condensation on the ground's surface. By constructing appropriate devices, such as dry-stone walls or other dry-stone buildings, it is possible to collect water in all its forms, vapour, dew, fog, or moisture, from the air and store it in the subsoil, in cisterns, or in the ground before it disappears with dawn. For this reason, Pantelleria's humidity and wind rate are called "favorable" (Int. 4). Non-Rainfall Water (NRW) plays an essential role in the hydrological cycle, especially in arid regions where it can represent the most significant water source (Wang et al. 2014; Laureano 2001).

From a microclimatic perspective, because of the wind loaded with moisture above the sea, and condenses on rocks, mosses and lichens can be seen above the plants in *Montagna Grande* (Fig. 6 and 7). The same condensation phenomenon makes possible to increase the heating of the rocks

during the day, which are black in color, and irradiation at night, which together with the porousness of the rocks and **dry-stone structures**, allows occult precipitation to be enhanced (Barbera and La Mantia 1998; Table 2). Therefore, dry-stone walls and garden walls maintain a higher level of humidity at their base, which explains not only the direction of root growth (Laureano 2001; Barbera and La Mantia 1998), but also the ability to grow citrus trees without irrigation. Additionally, climate conditions explain the choice of aridity- and wind-resistant crops such as grapevine, olive, caper, cotton, and barley, as well as the development of useful technical arrangements to increase their tolerance (Deguillame 2022; De Pasquale 2020; Pasta and La Mantia 2003; Barbera and La Mantia 1998).

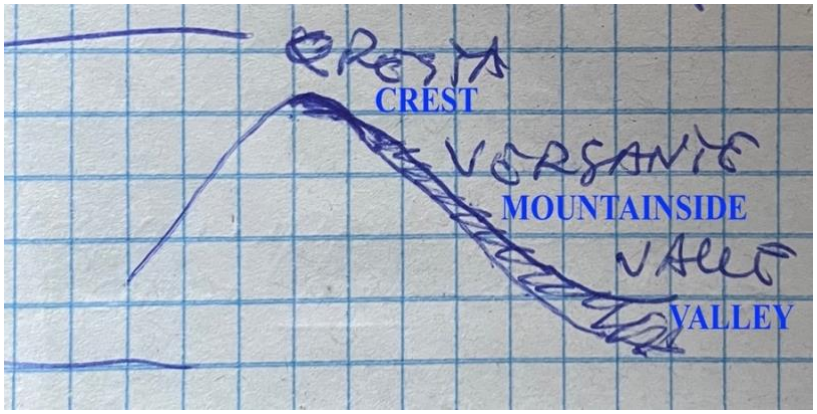

Figure 6: Interviewee no. 5's description of Pantelleria's landscape. *Sketch of interviewee no. 5 noting that there is more soil (colored part) and more water in the valley, which adds to the average precipitation plus water on the slopes. The mechanism is also emphasized by Int. 1 "it's a volcanic island so water goes downhill" (Author's notebook, 2024)*

Table 2: Process of occult water collection in dry-stone structures

How dry walls act as condensers and water reservoirs.
In addition to storing rainwater during the winter months, dry-stone walls work also as condensers of atmospheric vapor during the hot, dry season, capturing a small amount of water each day, which, when transferred to the soil, nourishes neighboring plant species. The phenomenon of condensation of water vapor in the air is based upon the principle that, as the air temperature increases, the amount of water vapor contained per unit volume increases. During the day, as solar heating proceeds, the proportion of vapor in the atmosphere increases, which penetrates the rocks, which are themselves heated, to saturation point. Once daytime heating has ended, cooling of the air begins, resulting in a gradual condense of small droplets that fall back to the ground as a result. As water is absorbed by the soil, it is redistributed to the roots of plants, which reach under the walls to replenish themselves.

Figure 7: Montagna Grande habitat: ferns and lichens. *The Montagna Grande is home to ferns and lichens. A fern's tendency to thrive in moist environments suggests and confirms that this area has higher humidity levels (Photo by the author, 2024)*

The method is to grow plants in low and non-expansive ways with plagiotropic canopy patterns, in which plant organs are arranged obliquely or transversely in relation to external stimuli such as light or gravity. Unless abandoned, all plants on the island are low and not extensive in order to minimize exposure to the wind and evaporation of water. Stone walls and wind-breaking arrangements such as Prickly Pear cladodes and barley intercrops still perform the wind-protection function on small plots planted with vegetable gardens or citrus gardens. It is known as arid-culture (Barbera and La Mantia 1998; Barbera, La Mantia and Quatrini 1997) and aims to maximize the reservoir capacity of the soil, thereby reducing surface runoff and evapotranspiration losses, using terraces, hollows, preparatory surface tillage, organic matter from widespread, even small animal herds, rotation of improving crops, organic mulches, and animal husbandry (Pasta and La Mantia 2003; Barbera and La Mantia 1998; Barbera, La Mantia and Quatrini 1997). This implies that terraces and dry-stone artifacts have multiple functions. In addition to containing and creating flat areas, walls have anti-erosive properties, help the soil become more compact and fertile, protect vegetation from fires, act as a

firebreak, shelter newly sown land from wind, store stones encountered while working the land, allow rainwater to penetrate, and promote the condensation of atmospheric moisture at night.

As a result of this inherent relationship between dry-stone and water, the most representative elements of the landscape are in fact dry-stone walls (Table 2), that are used to construct a variety of landscape structures, such as terraces and gardens on Pantelleria, as well as houses that are known as *dammusi*. They too are constructed of dry-stone, with a domed roof, which collects rainwater in a cistern, which provides the only fresh and readily available water. An estimated 15,000 m^3 per year can be collected by the cisterns (Bonasera 1965 in Barbera, La Mantia and Quatrini 1997).

One of the most famous elements is the **giardino pantesco** (*u jardínu* - Pantellerian garden). According to D'Aietti (1978) "they have the primary function of reclaiming the soil from excess stones and also the obvious one of protecting the trees they enclose from the wind. Thanks to their cylindrical shape, the wind, finding no foothold to linger and scourge, passes over, leaving the garden alone" (35). It is an enclosure built entirely of dry-stones, usually circular in shape, that has been erected for centuries on the Island of Pantelleria in order to create a climate conducive to citrus cultivation (Fig. 8). Throughout the day, Pantelleria garden creates a different climate than outside, keeping the soil and trunk of trees in shade, allowing only the sun's rays to penetrate the leaves. Temperature differences between day and night are reduced as a result of this effect. According to Francesco Brignone's research (2012), the difference between minimum and maximum temperatures inside and outside a garden is on average 3.9 degrees, while the difference outside is 6.7 degrees. Because volcanic stones are capable of storing heat during the daylight hours and gradually releasing it at night, the minimum temperatures inside the garden are on average 1.7 degrees higher than those outside. Citrus trees have a significant advantage in this regard, since they are not well adapted to low temperatures. By contrast, the maximum temperature inside the garden is on average one degree lower, due to the high walls that provide protection and shadow. During the summer, this is an obvious advantage. Aside from sheltering the citrus from the wind, the garden also provides it with water, which is accumulated between the stones by condensation, allowing it to survive even during the summer months when there is no rainfall.

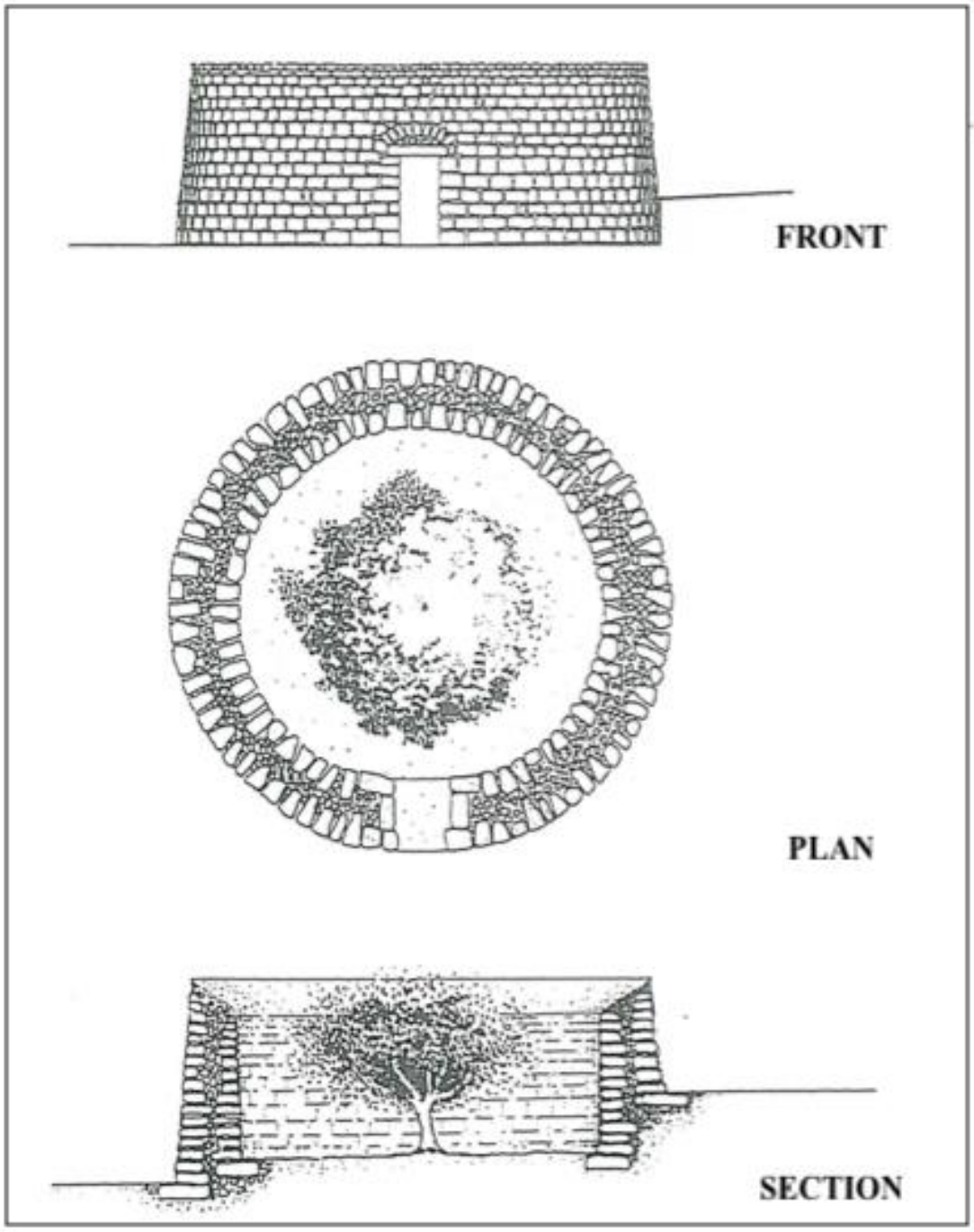

Figure 8: Giardino pantesco. *Front, plan and section of the most representative "giardino pantesco" typology (Sketch based on the draft by Barbera and La Mantia 1998 with the authors' permission)*

Another important element of Pantelleria's rural landscape is the **dammuso** (*ddammúsu)*: a rectangular or square volume made with thick dry-stone walls and a vault, barrel or cross vault covered with pumice batten (Fig. 9 and 10). Undoubtedly, the *dammuso* was the outcome of a slow process of co-evolution and adaptation of humans to the site, morphology, climate, settlers, prevailing winds, and available materials (De Pasquale 2020; Brignone 2012). Rather than responding to a defined spatial or building typology, the *dammuso* adapts to the nature of the stone, the direction of the winds, and the slope of every corner of the island (De Pasquale 2020; Brignone 2012). No two *dammuso* are the same. From the ages of cereal cultivation on the island one can find small mills characterized by arches on the outer walls and a threshing floor, a structure with a round bottom made of lime and *lapilli* mixed together. It can be seen even today how vegetables, and a few fruit trees were grown at the back of the *dammuso,* where water from the cisterns was captured.

Figure 9: Abandonded dammuso complex in Serraglia district. *Here, one can see simple dammusi next to each other, which together created a dwelling and smaller one for the animals to the left (Photo by the author, 2024)*

Figure 10: Inhabited dammuso between Bukkuram and Siba districts. *In this view, the formation is more articulated and more modern. It is easy to see the white roofs and the cultivated fields, and the fields use a mix of traditional and modern method (Photo by the author, 2024)*

Consequently, to understand the Pantelleria rural landscape (Fig. 11), it is necessary to view the dry-stone wall as a system, an incentive for the organic reconstruction of soils, and a device for retaining moisture and promoting water supply. Generally, stone walls are used to connect and divide small plots of land according to a logic that follows the flow of water and opposes maximum slope (De Pasquale 2020 and 2018). Using this elaborate land organization, condensation or collection from rainfall occurs by gravity. Hence, the present morphology is not as random as it might appear but responds to a rigorous system in which crop and soil techniques, orientation and the exposure of slopes are equally important as relief.

Figure 11: Pantelleria rural landscape from the area between kuddia Pattite and kuddia Attalora
(Photo by the author, 2024)

2.7.4 Community of Pantelleria

The fact that Pantelleria is one of the most fertile Sicilian islands can be attributed, in part, to the nature of its volcanic soils, but also to man's tireless efforts (Barbera and La Mantia 1998). Here I find myself having to follow the rules of literature review and provide the reader an understanding of the academic assumptions regarding the island society. One should not interpret the term rural or peasant as a better or worse status than others. The meaning of the term peasant is often culturally loaded and carries a negative connotation of being low-cultured and non-innovative. In order to move beyond these preconceptions, one must be open to recognizing that knowledge and practices are often rooted in a deeper understanding of the interaction between humans and their environment.

Pantelleria is a peasant society, which has based part of its market economy on the *Zibibbo* grape and capers. The success of viticulture is linked to the *Zibibbo*, which should be emphasized as an integral part of society, equipped with a triple aptitude: raisins, wine, and table grapes (De Pasquale 2020). There have always been three destinations in Pantelleria's viticulture, but they have played different roles over decades: wine production, which seems to be growing in importance, is flanked

by raisins production until about 1920 and, from 1930 on, by table grape production (De Pasquale 2020). Muscat and *passito* wines are produced for export. In the early 1960s, this production system remained in equilibrium until a shift in society and culture, high production costs caused mainly by time-consuming terracing, fragmentation of areas, and inadequacy of mechanization led traditional Pantelleria agriculture to become economically unsustainable. Furthermore, due to transportation costs and the lack of product qualification and promotion, many cultivated areas have been abandoned. Due to the success of the caper in specialized cultivation, some of the effects of the economic crisis have been masked. However, Pantelleria's economy has now become largely dependent on public assistance and tourism, for a few weeks in the summer (De Pasquale 2020; Barbera, La Mantia and Quatrini 1997). In addition, mutual aid in Pantelleria, as elsewhere, has become illegal according to labor law since it falls under the undeclared work section, as there is no contract or pay (CGIL Pesaro 2015). As Bevilacqua (1997) relates in the crisis of the welfare state "the bonds of social solidarity, codified in laws, are thus pushed to turn into mercantile relations" (81). The mutual assistance system that existed at that time was characterized by a constant and global exchange that included the performance of all tasks, including the construction of houses and dry-stone walls.

The fact that one must cultivate the land in a certain way, regardless of the fertile soil, and that different traditional methods are required to utilize the current limited water, Pantelleria does not qualify as a massive productive agricultural area (Barbera and La Mantia 1998). As with small Sicilian islands, this is a low-impact agricultural system that increases floristic diversity, among other things, resulting in complex agroecosystems with diverse species and varieties, which are gradually disappearing as a result of abandonment (Pasta and La Mantia 2013), a phenomenon not only in Italy but also on the Greek island of Lesvos, for example, as indicated in the MESPOM studies of 2023 (Galanidis et al. 2023). In other words, if before the economy consisted of self-production, exchange of goods based on individual needs and which, at least in terms of food, did not necessarily require money, now with industrialization and globalization, along with changing lifestyles, the island is particularly susceptible to the abandonment of the land (Fig. 12) and search for alternative employment, not necessarily on the island itself (Deguillame 2022; Tusa 2022; De Pasquale 2020). As a result of mechanization attempts, working animals have been abandoned; the famous Pantelleria donkey has now disappeared completely (La Mantia 2018). Tudisca and colleagues (2011) report that there were 997 farms on Pantelleria in 2000 (ISTAT, in Deguillame 2022), which covered an area of 1,340.02 hectares. Between 1990 and 2000, the island experienced a significant reduction of agricultural areas (-42.7%) and farms (-37.6%) due to the abandonment of agricultural

activities. In 2000, properties characterized by the planting of vines accounted for 892 farms (89.5% of Pantelleria's farms), of which 923.63 hectares were used for vineyards (68.9% of the agricultural area used), and second by olive growing (134.08 ha). It should be noted, however, that 95.7% of the farms are smaller than 5 hectares, and farmland of the same owner is often spread over several plots (Tudisca et al. 2011).

Figure 12: Abandoned landscape. *This area is currently undergoing renaturalization of abandoned plots. Due to the lack of roads in the area, mechanizing or bringing a tractor is difficult here. It is also the reason why there are no houses to be found. it is also evident that the island was once all terraced (Photo by the author, 2024)*

Consequently, farmland was reorganized and *dammusi* were used to accommodate tourists who have become increasingly interested in the island since the late 1960s. As a result of the development of tourism, and the failure of the wine cooperatives that emerged over time, as well as the gradual centralization of the conferral of the wine product into the hands of two large Sicilian companies, Pantelleria's economy and social structure have been profoundly altered in recent decades (Deguillame 2022; De Pasquale 2020; Tudisca et al. 2011; Barbera and La Mantia 1998).

The data encapsulate and narrate an event not only related to Pantelleria, but also relevant to a wide range of rural realities. I would like to cite Ramella's reflection through Valentinelli (2021), "between

the two wars, there was widespread so-called pluriactivity within families. There was a combination of jobs in family economies which alternated and intertwined both at the individual and household levels" (41). This characteristic has exhibited itself in rural communities throughout history, and it is precisely because of this multi-skilled ability that rural communities have adapted to change, especially through emigration and tourism today (Valentinelli 2021; Ramella 2009). I believe that this resourcefulness and adaptability, a key point related to resilience and robustness, are not only a result of "heroic" agricultural work but also of the adaptability of the communities themselves.

2.7.5 Landscape governance in Pantelleria

Regarding landscape governance, Pantelleria has several institutional (De Pasquale et al. 2021). The Municipality of Pantelleria is part of the Sicilian province of Trapani that adopted an official Landscape Plan and a Territorial Plan. The second one coordinates public works that affects several municipalities within the province. In Pantelleria's case, it is useful for transportation, such as ferry services. The main instrument of urban planning is the General Regulatory Plan (PRG), which specifies the areas and quantities of building transformations, public services, and infrastructure. PRG also embeds the Recovery Plan for the Historic Center approved by the Municipality of Pantelleria, to provide special protection for building and site conservation. At the provincial scale the Landscape Plan (PTP) refers to the national Code of Cultural and Landscape Heritage (2004-2008) which provides protection both to historical monuments and to environmental assets. A key component of Trapani's Landscape Plan is the management plan for areas part of the Natura 2000 European Network. Land planning is finally flanked by the plans of sectoral authorities such as the Hydrological Structure Plan (PAI), which identifies flood-prone areas, by Parks management tools and by a multiannual plan for the forecasting, prevention and active suppression of forest fires (AIB) and for managing pre-forest and forest areas sustainably. Finally, since 2016, the Park has also implemented its management tools, a crucial component of the island's landscape. Specifically, the Park territory is divided into three zones according to their respective levels of human settlement. Zone 1, "of significant naturalistic, landscape, agricultural and/or historical-cultural interest, with no or minimum degree of anthropization"; Zone 2, "of naturalistic, landscape, agricultural and/or historical-cultural value, with a limited degree of anthropization"; Zone 3, "of landscape and/or historical-cultural value, with a high degree of anthropization" (2016, art. 1).

In Pantelleria, these instruments are also accompanied by the directives coming from the inscription on the UNESCO Intangible Heritage List of both the agricultural practice of the Pantelleria

community's tree-trained vine (2014) and the Art of Dry-Stone Construction (2018), as well as the inclusion of the territory on the National Register of Historic Rural Landscapes.

The governance of Pantelleria is subject to the Italian political system and operates within the same administrative framework as other Italian municipalities. The residents elect mayors and councils, and the municipal council enacts local legislation. In terms of environmental governance, specifically on the island, there is the National Park of Pantelleria, established in 2016.

During 2016-2018, an interesting participatory governance process took place to complement the Park's birth and preserve the island's environmental and cultural heritage. This long and complex process was coordinated by a social promotion organization called "Invisible Cities", interested in social research and video production, and the civic committee "Tutela Pantelleria", no longer active due to inadequate funding, played a central role (Tusa 2022). The bottom-up governance process, guided by the demands of the "Tutela Pantelleria" committee, nonetheless resulted in the following two articles in the Park's Statute:

Art. 25: Participatory Processes

1. The Park Authority recognizes sustainable development, the active participation of its citizens, the practices and methods of the local Agendas 21 and the contents of the Aarhus Convention as fundamental references for its action to build a shared vision of the future of the Park with the full involvement of the Pantelleria community recognized as the guardian of the traditional knowledge that has shaped the specificity of Pantelleria's socio-ecological system.
2. It enhances free forms of association and voluntary organizations and promotes citizen participation in shaping the decisions of the Park Authority's administration.
3. The Governing Board approves the Regulation on Participatory Instruments to regulate the institutes of participation and allow the population to be involved in the Park's decision-making processes.
4. The modalities of convocation, arrangement and functioning of the institutes of participation envisaged in this Statute shall be established by Rules and Regulations approved by the Board of Directors; such Rules and Regulations shall ensure the full respect of the principles of participation.

Art. 26: Park Forum

1. The Park Authority shall promote and support consultation forms to safeguard collective and widespread interests.
2. To this end, the "*Forum del Parco"* is established as a consultative body that brings together in public assembly the representatives of the organizations of economic and productive, social and cultural categories actually operating in the Park's territory.
3. The Regulation referred to in Article 25 regulates the modalities of composition and functioning of the Forum.

By involving the local community in the governance of the Park, this participatory process was a successful experimental project that sought to enhance the local community by utilizing traditional local ecological knowledge (LEK) as a basis for thinking and managing an area. Due to the inability to hold its activities voluntarily, the "Tutela Pantelleria" committee dissolved after about two years, as the Park decided to grant funding to another association. This issue would require further investigation, beyond the scope of the thesis. Based on my research and interviews, the participatory process seems to have reached its maximum by including these two articles in the Park statute, as confirmed by some respondents (Int. 48 and 49).

On the other hand, regarding civil society forms of governance, the overall picture is more complex. There are districts as described in section 2.7.4, and each district has historically had an informal cultural association, which has remained active in some cases. Aside from churches, cultural circles are the only places of social gathering in Pantelleria that have survived, albeit with some changes, the impact of modernity and the processes of cultural homogenization triggered by globalization (Tusa 2022). Today, "there are 18 of them" (Int. 71). Nevertheless, there is no explicit informal governance regarding water or traditional water management. Cultural circles constitute a form of community governance that is restricted within the community itself, are not explicitly political and are not in dialogue with the more formal bodies. Institutional representatives do not attend these meetings, and no one seems to advocate for their participation. Thus, they are of vital importance to the communities, they do not bring specific pressures or demands to the political table.

There is a sensitive issue raised by this lack of reciprocal attention. Several informal activities are conducted, such as discussions about Pantelleria's history and lectures on traditional methods. Furthermore, there are meetings with outside experts, talks are held, and they are open to the public, and there are no restrictions of any kind, not even financial ones. The feeling at these

meetings is one of sharing, openness, and others have confirmed this perception to me as well (Int. 12). However, no one from this meeting advocated for recognition as active participants in governance, thus limiting their participation in the exchange meeting. The result is neither an enrichment of the institution nor a political outcome. Pantelleria lacks direct participation in policy-making processes, even though raising awareness and providing services contribute to governance by definition (see e.g., Ricciardelli 2018; Klijn 2012). As a complement to formal governance structures, they may be able to resolve gaps or draw attention to specific issues (Klijn 2012). In light of this, many organizations have shifted their focus to projects with schools and occasional municipal meetings (Int. 11 and 41).

The most recent research and my interviews suggest that despite the presence of a board of directors in the Park, a top-down direction is perceived (Tusa 2022; Int. 25, 49 and 69). As I did not need to investigate the efficiency of the Park structure, I did not have any particular oppositions to my interviews, as other researchers might have had: "In this top-down, elitist, closed-door vision, researchers are required to be service providers, or at least be controlled by the institution itself" (Tusa 2022, 197). However, regardless of this specific position, as I wrote in the following sections (see *Results 4.1* and *Discussion 5.1*), the institutionalization of centralization through the Park compounds the feelings of uncertainty and mistrust towards institutions. This sensation is aggravated by the increase in bureaucracy, perceived in terms of overlapping of bodies and regulations: on the same territory, there is the municipality's Land Plan, the province's Landscape Plan, and the Park Plan. The situation is not problematic from an environmental standpoint, except that farmers are entirely unaware of the specific restrictions in the protected area, such as the species that cannot be cultivated there (Tusa 2022). They lack pieces of information. In a place such as Pantelleria, where the landscape is dynamically composed of inhabitants and environment, the lack of information can result in friction, as Tsing (2005) describes it: "I call "friction": the awkward, unequal, unstable, and creative qualities of interconnection across difference" (4). As a metaphor, this phrase perfectly describes the diverse and conflicting interactions that characterize the production of cultures and the contemporary world in general (Tsing 2005).

In terms of tourism, the issue is reflected similarly (Deguillame 2022; Tusa 2022; De Pasquale 2020). The Park is a member of the European Charter for Sustainable Tourism (CEST), which recognizes the efforts of protected areas and tourism enterprises to achieve sustainability in tourism. On its website (Parco Nazionale Isola di Pantelleria, n.d.), the Park describes CETS as a participatory governance method for promoting sustainable tourism and structuring the tourism activities of protected areas and for developing a tourism offer that is compatible with the needs of biodiversity

protection in protected areas through greater integration and collaboration with all stakeholders, including local tourism operators (Parco Nazionale Isola di Pantelleria, n.d.). However, on the same website, there is no data with which to compare this participation, and from my interviews, it appears that the only dynamics participation was in opening courses to Pantelleria residents and in becoming certified park guides (Int. 42 and 75).

The insistence on the role and participation of farmers and the community in active enhancement and protection policies has yet to be translated into any concrete policy on the territory to support farmers and small family farms (Tusa 2022; Int. 7 and 25). On the contrary, in the view of most of the farmers with whom I have had the opportunity to speak, the Park constitutes a further source of bureaucratic constraints and, thus, a further obstacle to doing business in the area (Int. 49 and 59).

While it is evident that it is not possible to involve the entire Pantelleria agricultural sector, it would be necessary for the farmers themselves, as the holders of traditional knowledge and practices, and the players in the tourism market, as well as the institutions to make use of civic committees, or in any case of representatives of the local community, in collaboration with interdisciplinary research teams, such as those that travel through or have collaborated with the Park. There should be greater openness to the community. On Pantelleria, by community, I mean not only the farmers but also civil society groups such as the local associations (Tusa 2022). "At the heart of cultural processes [...] the use that social and political actors make of international conventions reveals their potential as an effective tool for claiming cultural rights. Some case studies make it possible to overcome a vision that tends to make international conventions coincide with standards imposed on local and national heritage regimes" (Parbuono and Sbardella 2017, 22-23). There is also a need not to underestimate the importance of local observatories in Pantelleria, as Quaini (2014) argues, emphasizing the importance of the landscape in achieving the European Landscape Convention's objectives: "The participation of local actors and citizens must cover the entire process of landscape identification, protection, management and planning: from knowledge and in-depth studies on the whole territory (and related fields of awareness-raising, education and training at all levels) to the formulation of landscape policies, which must always be accompanied by identification and qualification measures" (11-12).

2.8 Summary of literature review

Various studies and scholarly works related to traditional knowledge were reviewed in the literature review. Throughout the investigation of intangible cultural heritage, cultural landscape, and water management and governance, this concept reflected the nuances addressed in this thesis. As a result, traditional knowledge is explained as a science with the need to be integrated into our modern territory management strategies, as a complementary tool. In order to accomplish this, it was necessary to discuss traditional water management and the biases that accompany it. As a final point, I addressed a key theme, namely the socio-ecological system, which is critical for understanding the traditional knowledge system and developing strategies to adapt to climate change.

Within the scope of the thesis, I examined traditional knowledge and local knowledge concepts, highlighting their complexities and overlaps, highlighting their importance in developing adaptation strategies. To address ecological and societal challenges effectively, it is imperative that these knowledge systems are integrated with scientific understanding, as promoted by IPBES. Therefore, I provide frameworks that integrate traditional knowledge into climate adaptation strategies and ecological compensation strategies, such as Ecosystem-Based Adaptation (EBA) and Payments for Ecosystem Services (PES).

A special focus was given to the description of the case study of Pantelleria, placing it within the context of cultural heritage and traditional knowledge, along with information that will provide the reader with a better understanding of the socio-political context of the island, as well as some insight into the landscape governance system.

The findings of this comprehensive analysis emphasize the importance of navigating the intricacies of traditional water management while recognizing its multifaceted nature and dynamic interconnectedness with cultural heritage and landscape (Fig. 13).

Overall, the literature suggests that Pantelleria serves as a model to demonstrate how similar regions experiencing water-related issues may benefit from its solutions as well. As part of the literature review, I examined the barriers that prevent the integration of traditional and modern water management systems based on political, cultural, and institutional factors in order to enhance water management and governance in similar harsh environments.

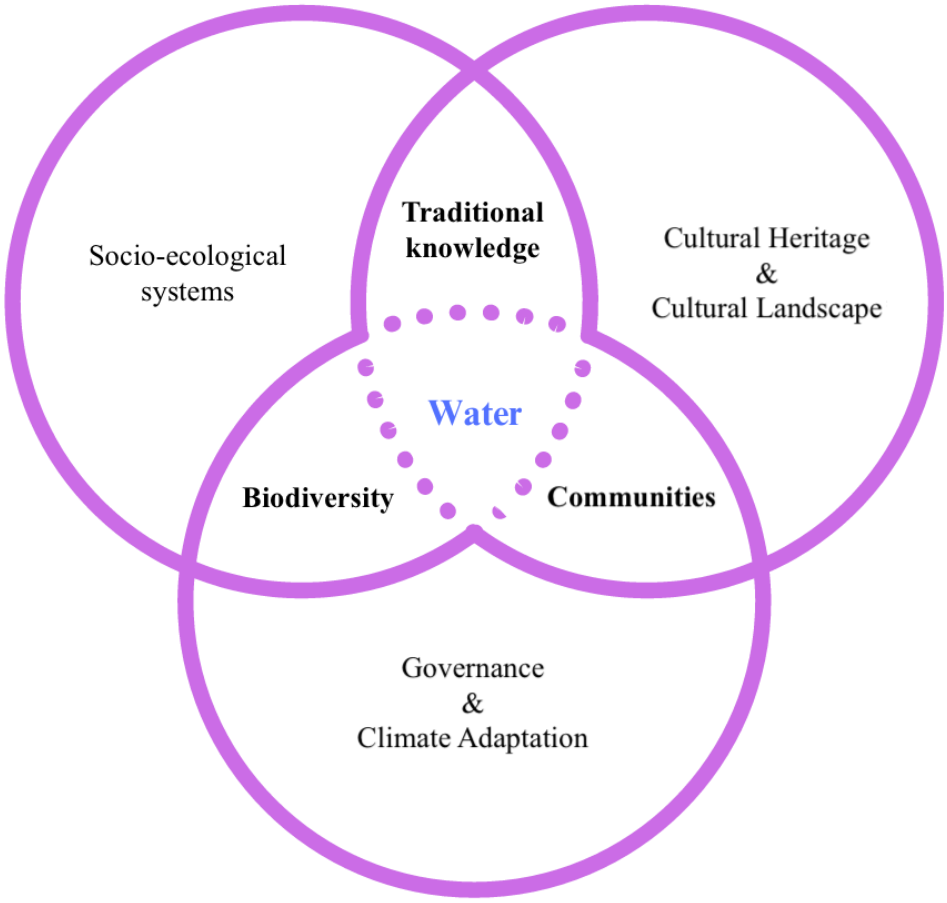

Figure 13: Interconnections among key concepts in the literature review. *Diagram illustrating the interconnections between the concepts discussed in the literature review. It is important to highlight that biodiversity here refers to ecosystem services and ecosystem functions, which have been mentioned several times in the literature review (Graph by the author)*

3. Methodology

As part of this study, data was collected through semi-structured interviews, which used the appreciative inquiry (AI) method to explore the positive aspects and potential of the topic under study. I chose this method because AI's constructive approach enabled participants to engage in open-ended discussions, allowing them to freely share their experiences and perceptions (Bushe 2007; Elliott 1999). In this case study context, the interviews were conducted in order to identify and understand best practices and successful elements. By using this approach, not only were rich qualitative data obtained, but participants were also engaged in a process of reflection and envisioning positive futures (Zandee 2013; Boud and Hager 2012). After collecting data from these interviews, meticulous analysis was conducted to uncover themes and patterns that align with the principles of AI, emphasizing strengths and opportunities for innovation and improvement. "Rather than establishing and verifying conventional truths about what currently exists, the idea is to interrupt habitual practice by exploring and inspiring innovative alternatives" (Zandee 2013, 70).

Throughout the whole process, the questions were open-ended and followed the methodology described in the following sections, but they also served to facilitate my understanding of the context and perspective of other people. People who knew the other well could only provide context concerning the other's life background. This contextual information was certainly helpful in understanding more or less delicate situations. As part of the interview process, I always specified my research, introduced myself, and explained my interests (Creswell and Creswell 2018). The majority of interviewees began answering the questions on their own, but I sometimes had to narrow them down and address them towards my research endeavors, to avoid the answer becoming too broad. Others preferred to answer specific questions one by one. There was an average time between 15 minutes and more than one hour for my interviews, and more than two hours for those I met on the agricultural field. When faced with collective situations, I was dependent upon them. During the interviews, the pattern of questions changed not in content, but perhaps in order or specificity because of the variety of personalities of the individuals. One of my favorite questions was "who taught you this skill?" or "how did you end up on the island?" or "why did you stay?". It provided insight into whether Pantelleria is still a living heritage, whether generational factors are important, how much people communicate with each other and how much ancestors are carried within them, and finally, what are the island's strengths, what aspects attract or cause distress for the island's inhabitants.

3.1 Overview of research methods

As there are several approaches to research and methodology, there are also many different approaches to inquiry. According to Wall, Beck, and Scott (2020), inquiry can be viewed as both a stance and as a project. With the guidance of my supervisor, I decided to adopt an appreciative approach to inquiry, which straddles both of these definitions. In order to build upon what is already working well, I decided to implement an appreciative stance, or approach, toward practices in a continuous process of identifying areas that can be enhanced (Wall, Beck and Scott 2020). With the same concept, I developed the questions I asked my sample of people, which are the same questions that were asked in the research.

Throughout the preceding paragraphs (see *Introduction 1.2* and *Literature Review*), I have questioned certain modern paradigms, choosing to employ appreciative inquiry (AI), which shares the values and uses of traditional knowledge. According to the problem-focused approach to inquiry, success is defined as the ability to identify deficiencies or problems, to understand the problem (why it occurs, what factors intersect with it), and then to find solutions to these problems, resulting in a plan of action (Cooperrider, Whitney and Stavros 2008). This type of approach is certainly appropriate in some situations. Such inquiry approaches posit that organizations, as well as the practices of the studied organizations, are problems that need to be resolved (Cooperrider, Whitney and Stavros 2008). The AI literature argues, however, that this problem-based approach to inquiry creates a deficit model in which the focus is always on what skills, knowledge, or understanding is lacking or needs to be corrected (Scott and Armstrong 2019).

By asking the reader to make a system thinking effort, I have placed myself in a challenging position with an appreciative approach to inquiry, which requires me to think differently, to change my perspective on the "problems" as Ghaye et al. (2008) suggest. A strong narrative may already exist around a specific issue, and this can be particularly relevant during research. In Bhaskar's words, this is about starting "from what is actually happening – not what appears to be happening or what our limited understanding leads us to believe is happening" (Ghaye et al. 2008, 371). This problem-solving, deficit-oriented approach to inquiry is challenged by appreciative inquiry. Rather than identifying what is lacking or inadequate, it identifies practices that are positive, life-affirming, successful, and full of opportunities for building, growing, and improving. It is only through looking beyond dominant narratives or images that we can begin to understand issues related to power, politics, and resources that limit, but may also provide opportunities for future action (Bushe 2007

and 2013). As mentioned in the previous paragraphs, the same thing occurs when traditional knowledge is underestimated as being backwards and remote from modern knowledge.

By refocusing our gaze on appreciating a positive and different future instead of being problem-oriented, we can see the inquiry from a different perspective. As a result, "problems" become creative spaces that can be used to generate and act toward a different future based on a solid foundation (Zandee 2013; Bushe 2013; Elliott 1999). In order to emphasize the positive aspect of the approach, I would like to point out that it does not simply refer to beautiful things. Some authors who have written about appreciative inquiry have suggested it be renamed as *generative inquiry* (Zandee 2013; Bushe 2013), realizing the risk of focusing solely on the positive aspects of the approach and neglecting real-life challenges. An appreciative approach, according to Bushe (2013), should be concerned with future-making, which means generating new ideas, new thinking, and new practices. Instead of establishing and verifying conventional truths about what currently exists, the goal is to explore and inspire innovative alternatives (Zandee 2013). As described by Zandee (2013), one dimension of inquiry is building and maintaining connections with others which enable us to listen with a third ear and perceive with a third eye (Zandee 2013, 77). Dialogue is a critical component of establishing connections of this kind, which facilitates the emergence of new understandings and actions that can be generated through these connections. Within this framework of research approach, the question is *how traditional water management systems may contribute to adapting to climate change from a socio-ecological perspective?*

Adaptation to climate change would require considering expected future conditions, given that acquiring adaptive capacity and strategies takes time (Edelsparre et al. 2024). By the time they are available, the climate baseline will have changed. Consequently, I acknowledge that, as a limitation, I am addressing adaptive capacity from the perspective of the present climate.

By describing appreciative approaches as a praxis, Smith implies that they are more than simple reflection-based actions, it "embodies [...] a commitment to human wellbeing and the search for truth, and respect for others. It is the action of people [...] who are able to act for themselves and are always risky" (Smith 2019). According to Carr and Kemmis (1986), we must make a wise and prudent practical judgment regarding how to proceed. As a result, praxis is performative, generative, lived, messy, improvised, and ethical, leading to a relationship between theory and practice (Smith 2019; Carr and Kemmis 1986). According to Zandee (2013), by recognizing the reality of the inquiry we embody and live it, thus creating spaces for "new insights and competence" (80).

The diagram below (Fig. 14) describes the framework and questions developed for this thesis. It has been determined that the answer lies in a series of AI questions posed openly to interviewees.

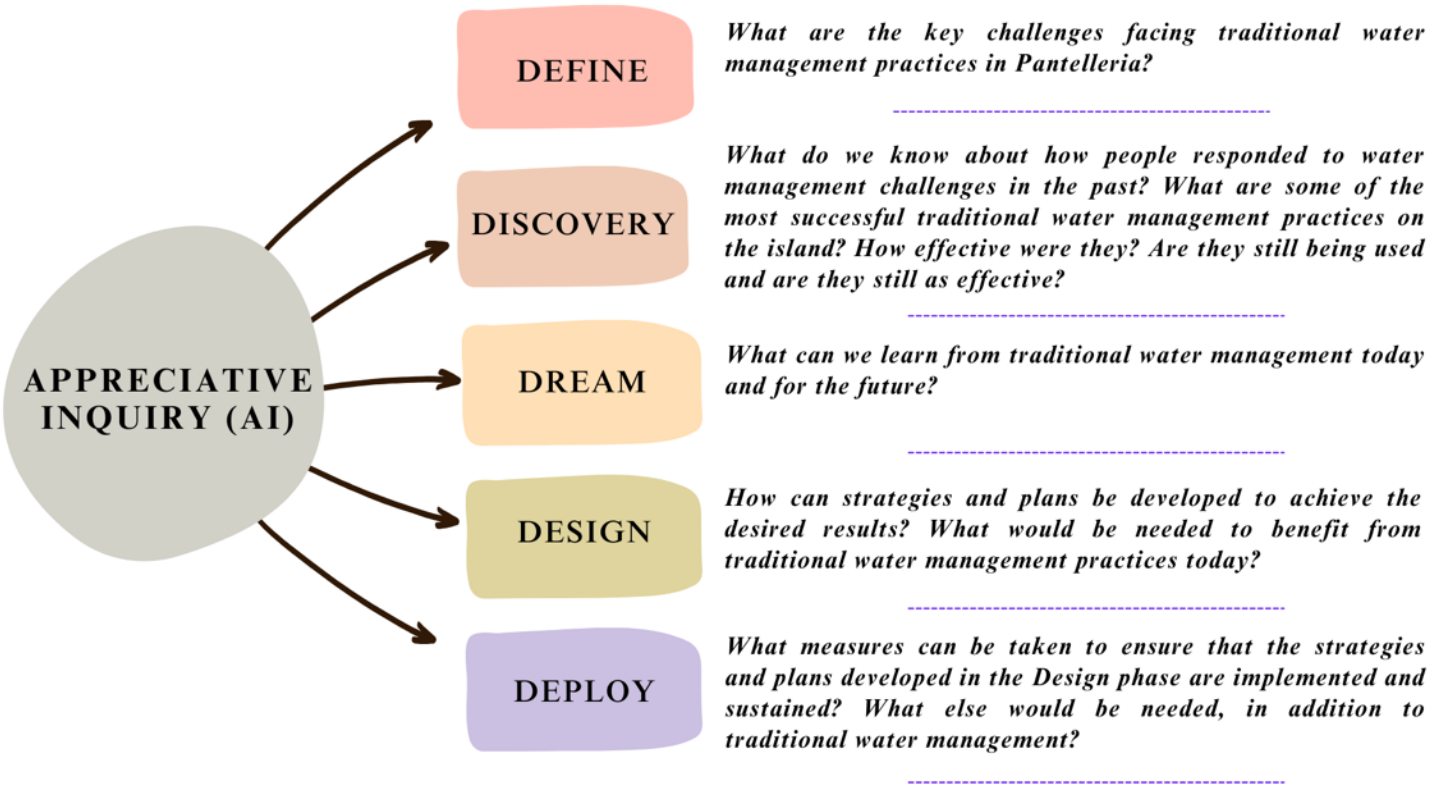

Figure 14: AI methodology and 5-D inquiry framework. *Graphs that follow the AI approach and a 5-D question set that guides the research for the thesis and the open-ended questions (Graph by the author)*

3.2 Data collection

As part of this study, 79 interviews (see the *Appendix*) were conducted with a mix of purposive and snowball sampling of individuals from diverse backgrounds and experiences, providing a foundation for narrative inquiry analysis of the data (Eleanor et al. 2020; Green and Thorogood 2018; O'Brien 2014). In this case study, participants were recruited from a variety of locations, primarily Palermo and Pantelleria. A further interview was conducted in Aprilia, near Rome, among the emigrant population of Pantelleria. A snowball sampling technique was used to identify individuals with significant and relevant experience related to the research topic (Parker et al. 2019). These contacts served as gateways into the broader network of participants. In addition, door-to-door visits were conducted in select areas to reach individuals who were inaccessible by phone, email, or already known contacts.

In this study, the data was collected through a case study approach and narrative inquiry methodology (Green and Thorogood 2018), as well as semi-structured interviews using appreciative inquiry (AI).

The semi-structured interview format provided flexibility in questioning and ensured consistency across interviews, in keeping with the narrative inquiry methodology (Eleanor et al. 2020; O'Brien 2014; Green and Thorogood 2018; Elliott 1999). Interviews were conducted individually, in couples or in groups according to the participants' preferences and availability. Through the use of both individual and group settings, a comprehensive understanding of the research topic was obtained from the viewpoints of various members of the community, contributing to the depth of the case study analysis. Throughout the data collection process, efforts were made to establish rapport and build trust with participants, thanks also to the AI principles (Mohr and Watkins 2002). A narrative inquiry approach was used to create a conducive environment for participants to share their stories and experiences openly and authentically (Zandee 2013; Mohr and Watkins 2002). As a result of meaningful interactions, personal connections were developed, and sometimes friendships were formed! It should be noted, however, that not all interactions led to the formation of close relationships, as the primary focus remained on gathering valuable insights relevant to the research objectives.

To avoid recording interviews that would not be accepted in most cases, interviews were conducted with paper and pen. In addition, given the large number of participants and my interest in taking advantage of every opportunity, paper and pen provided easy accessibility and ease of use. Thus, ensuring efficient data collection without reliance on the telephone in very windy and chaotic and noisy situations, where it would have been difficult for the phone to record with good quality (Tate and Smallwood 2021). As a matter of language, the phone transcription cannot recognize dialects and other unconventional forms of speech. Due to the reluctance to sign or be recorded, this approach facilitated the development of trust and rapport through natural, conversational interactions. In fact, using paper and pen respects participants' comfort and confidentiality, mitigating concerns about data security and ensuring cultural sensitivity (Namey et al. 2022). Apart from this choice, ethical guidelines were strictly followed throughout the collection process. All participants provided oral informed consent, and confidentiality and anonymity were maintained (Wynn and Israel 2018). During the study, participants were assured that their participation was voluntary and that they could withdraw from the study without consequence. In addition to minimizing any potential risks associated with participation, appropriate measures were established to address any concerns or discomfort expressed by participants. The data have been encrypted and secured to ensure confidentiality and integrity.

3.3 Data analysis

As part of the data analysis for this qualitative case study, a thematic analysis approach (Kutsyuruba and Stasel 2023; Mitton-Kükner 2019) was utilized within the framework of AI and consistent with the narrative inquiry approach (Kutsyuruba and Stasel 2023; Green and Thorogood 2018; Bushe 2007). In qualitative data analysis, thematic analysis is used to identify, analyze, and report patterns or themes. Through this approach, the narratives and experiences shared by participants were explored systematically in order to uncover underlying meanings and insights relevant to the objectives of the 5-D AI questions (Mohr and Watkins 2002).

Even though the interviews were transcribed from the beginning, the analysis process still involved meticulously reviewing the field notes to ensure accuracy and completeness. In order to identify recurring patterns, themes, and narrative elements, all the collected material was coded. A creative coding process was employed, following Simons's (2009) advice to "dance with the data" (140). Simons advocates using creative forms of inquiry, including more tactile methods of working with data. Among these is physically moving data around, "positioning and repositioning them until they make sense" (140). It is a type of context-based analysis without models, in which different ideas, characters, and minor elements of the stories are brought into contact. I decided to use sticky notes or drawings to uncover patterns and connections between them by moving them around and joining them together (Simons 2009). A constant question on my mind has been whether there are core themes or clusters of themes that are beginning to emerge. Throughout all the question passages, this approach was adopted. As a result, initial codes were followed, and participants' narratives were grouped into broader themes and sub-themes, reflecting their interconnected nature (Kutsyuruba and Stasel 2023; Mitton-Kükner 2019). Following that, they were put together using sticky notes and placed on different pieces of paper. The principles of Smith (2009) and other AI scholars (see e.g., Zandee 2013; Bushe 2013; Elliott 1999) have been challenging, but they have helped me to understand how to follow the process of emergentism that is characteristic of systems thinking (Capra and Luisi 2014). This graphic work, which contains surnames and works that on a small island are quite easy to recognize even with a pseudonym, is not included in the Appendix due to my commitment to not sharing sensitive information with the public. The data collected was valid and analyzed, and permission was obtained from the individuals for me to use it for research purposes. Along with the thematic analysis, and as requested by the AI analysis, I also conducted a narrative analysis to examine the structure, content, and meaning of participants' stories (Sharp et al. 2019). Based on the Methodology, it is important to consider the construction of narratives as a means of sense-making and identity formation, which sheds light on the cultural, social, and individual

contexts that shape individuals' lived experiences, as well as facilitating AI analysis for generative results (Sharp et al. 2019; Zandee 2013; Bushe 2013). Using this lens, I examined how participants constructed and conveyed their narratives.

The interview findings were supplemented with observational data, field notes, and existing literature to corroborate and validate emerging themes (Jonsen 2009). During the data analysis process, I tried to remain reflexive, acknowledging and interrogating my biases, assumptions, and subjectivities. My privilege was to have very nice interlocutors who helped me to reduce my doubts about things and very patient friends who helped me to accept the complexities and paradoxes of Pantelleria. As a researcher I do not seek to extract information from the islands, but rather to enhance the amazing reality found there with some further meetings and experiences. In order to be reflexive (Creswell and Creswell 2018), I remained aware of my potential influence on the interpretation of data. To enhance the credibility and transparency of the findings, reflexive practices such as journaling and peer debriefing were utilized (Subrami 2019). In the following sections, the conclusions are summarized by addressing the questions. The findings are contextualized by what is written in the various sections and with the existing literature and theoretical frameworks (Creswell and Creswell 2018). This exercise provides an insight into the broader implications and significance of the research findings.

3.4 Limitations and challenges

As the study has been conducted in a case study and narrative design approach (Eleanor et al. 2020; O'Brien 2014), it provides the reader with a rich, contextual exploration of the subject matter, but the small sample size and the short duration of the study may limit the results. Furthermore, the qualitative nature of the research and the narrative method, while rich in personal experience, are subject to an inherent subjectivity that may affect the interpretation of the results (Green and Thorogood 2018). It is crucial to keep in mind that with any qualitative research and with the appreciative inquiry (AI) approach, there is a possibility for researcher bias in data collection, interpretation, and analysis (Galdas 2017). While I am aware that the specific context and dynamics of society cannot be generalized, my goal is to understand the principles that underlie their characteristics and the patterns that need to be considered in adaptation strategies. It is central and valuable to consider the particularities of different contexts as part of a case study, which, in my opinion, are not a limitation but rather an opportunity for reflection in other local contexts (Ruzzene 2023). However, I recognize that, for some, it might be a limitation; therefore, I mention it here, as the unique circumstances of this case study also challenge the transferability of the findings to other

contexts or populations. Due to the subjective nature of qualitative inquiry, different researchers may interpret the data in different ways. I consider this an opportunity at a time when among my proposals is the idea that in order to develop adaptation strategies, we need to bring together viewpoints, tools, and researchers from different backgrounds who have complementary perspectives.

The study also has the significant limitation of focusing exclusively on adaptive capacity from the point of view of the current climate. A climate change adaptation strategy should be developed based on anticipated future conditions, as building adaptive capacity and strategies requires time. When these measures are implemented, the climate baseline will likely shift (Edelsparre et al. 2024). There is considerable uncertainty associated with predicting future climate scenarios due to the complex interplay of climatic, socio-economic, and environmental factors. Current climate models must approximate many physical processes, such as cloud formation and ocean currents, which are neither fully understood nor computationally feasible to model at high resolution (Moseman 2024; Hayhoe et al. 2017). Furthermore, the wide range of possible future scenarios, influenced by the different pathways for greenhouse gas emissions and technological developments, further complicates the accuracy of predictions (Hayhoe et al. 2017). It is therefore evident that this study acknowledges that assessing adaptive capacity solely based on current climate conditions may have limitations and may tend to take things for granted that will not be the case in a future scenario, and that the interview answers themselves may not be aware of the uncertain future. As uncertainty is taken into account theoretically but without data, what is developed here are approaches that must be calibrated according to the present and future conditions and context. There is no intention in this thesis to underestimate the challenges of adaptation strategies or to overestimate the effectiveness of the solutions proposed. Here, only alternative traditional approaches are mentioned to stimulate discussion about the currently implemented methods.

Additionally, I am guided by my personal belief systems, which may be a limitation for some. My worldview is transformative (Creswell and Creswell 2018; Mertens 2003), pragmatic yes, because I enjoy finding a problem and proposing a solution to it, but primarily transformative because my belief is grounded in the fact that the research needs to be integrated with politics and a political change agenda in order to address social oppression at various levels (Creswell and Creswell 2018; Hausknost 2020). As described by Mertens (2003), the term transformative encompasses a person's worldview and implicit value assumptions. The underlying assumption is that knowledge is not neutral and is influenced by human interests. There are power relationships and social relationships within society that are reflected in knowledge, and the purpose of knowledge construction is to assist people in

improving society. As a result of critical theory perspectives, issues such as oppression and dominance become significant to examine (Hausknost 2020; Sweetman et al. 2010).

According to Creswell and Creswell (2018), my research is change-oriented, collaborative, and political. Consequently, my interpretation of the data may be influenced by my personal belief system and background in the research process, underlying assumptions, data collection, and interpretation of the data (Creswell and Creswell 2018; Strauss and Corbin 2008). As Kemp and Martens (2007) suggest, personal opinion is acceptable in sustainability science: sustainable development is based on social consensus on what is considered sustainable. Thus, sustainable development cannot be defined objectively and scientifically. Consequently, sustainable development requires a science that is able to deal constructively with the complexity, uncertainty, and ambiguity associated with it (Kemp and Martens 2007; Gramsci 1975). I support the Heideggerian distinction mentioned by Magnaghi (2020) between taking care of (*besorgen*) and having care of (*fürsorge*). The concept of taking care emphasizes the act of substitution of the other and thus creates a sense of dominance and dependence; the concept of having care emphasizes the recognition of the other and helps them to activate their own energies for their own care: not taking over the living but sharing it. There is no technocratic care of the land entrusted to large machines and large apparatuses, which does not further deprive the inhabitants of their capacity to protect their own environment, further increasing their dependency and domination. Having care of the environment therefore necessitates the development of forms of community awareness, participatory democracy, as well as the reconstruction of collective and traditional knowledge, as well as the appropriate application of technology in accordance with local communities' self-determination, self-government and resources (Magnaghi 2020; Beccattini 2015).

Another potential issue is that the scope of my thesis may be too broad. This has been pointed out to me several times by my thesis supervisor, and as I wrote my thesis, I found myself agreeing with his observations! The material collected is diverse and varied, and as far as I am concerned, volumes and volumes of research could be devoted to it; however, what the reader needs to understand in this master thesis format is that I will touch on topics in a sometimes non-exhaustive manner. I intend to provide a comprehensive description of the case study; however, I will not be able to include everything and everyone in it. As a result, both the reader and I must exert an effort to bring together a number of seemingly disparate topics as part of a system-oriented approach that transcends disciplinary boundaries.

This study follows the systems thinking approach (Capra and Luisi 2014), which is contextual in nature. An analytical approach is the opposite of this. Analysis means taking something apart in order to understand it; system thinking means putting it into the context of a larger whole (Capra 2023). This work on traditional water management practices involves the examination of seemingly distant issues, such as water governance, land adaptation, and cultural landscape, which make sense only when analyzed in conjunction (Kravčík et al. 2007; OECD 2015; Kates 2001). Likewise, the techniques listed from Pantelleria should not be viewed as separate entities, but rather as part of an integrated landscape system. Traditionally, management practices do not solve a single problem quickly; they are always elaborate, multifunctional methods that are part of a holistic, integrated approach to society, culture, and economy, closely linked to an ecologically sound and carefully managed conception of the world (Berkes 2008; Laureano 2001; Kates 2001). A better understanding of the context in which traditional management practices are implemented in Southern Italy will enable us to better bridge the gap between water governance and land adaptation policy. If so, the history and heritage of Pantelleria can provide valuable information, inspiration, and identity-building serving as a basis for redesigning, repurposing and adapting water management to the changing climate challenges (Barbanente and Grassini 2020; Hein et al. 2020; Laureano 2001 and 2008). This represents both a limitation and an opportunity in the study, which I wanted to embrace, and I invite the reader to consider my choices from a variety of angles. For this effort, I am already grateful to you.

In addition, time and resource constraints restricted the scope of the research. Despite its limitations, the study contributes valuable qualitative data and lays the groundwork for future research in a similar field, and it provides valuable perspectives and enables future research. I hope these reflections will be considered when interpreting the results and making policy recommendations based on them.

3.5 Reflexivity in research: my personal experience

As mentioned previously (see *Methodology 3.3 and 3.4*), qualitative research is interpretive research; the inquirer, myself, participates in a prolonged and intense experience with the participants (Creswell and Creswell 2018). In this way, qualitative research is impacted by a variety of strategic, ethical, and personal considerations (Locke, Spirduso and Silverman 2013). Therefore, my journey to Pantelleria was not only a geographical one, but also an in-depth exploration of cultural understanding and self-awareness. In my capacity as a researcher who has a keen interest in preserving traditional knowledge, especially regarding water management, I approached the island with an innate curiosity tempered by

my personal background in environmental studies, political science, ecology and as a woman raised in a capital city where there was access to water from the tap and other comforts.

Consequently, since I was born and raised in a region far removed from Pantelleria's rugged landscapes, my understanding of traditional knowledge has been shaped by academic theory, global environmental discourse, lessons from professors with these sensibilities, as well as my informal knowledge background. That is, people, books, workshops, theater, documentaries, informal meetings, and so on. Having been educated by a mother who is politically active as well as having a very culturally literate background, I am aware that my own cultural and educational experiences influence my viewpoint. In this way, I was able to develop an environmental, relational, and community sensitivity at an early age. I visited a number of ecovillages, became familiar with many different realities, and was never isolated from those from marginalized groups. As a result of my mother's influence, I have developed the opposite prejudice that those who live in the territory know it better than anyone else. Working as a facilitator of systemic thinking has also given me the ability to read complex situations more clearly and with less fear. However, I am aware that I am myself, I have my limits, and that my knowledge is constrained by the environment in which I live. According to my past and present, those views may differ from those of the residents of Pantelleria. As I conducted interviews with the local community, this awareness enabled me to approach each interview with an open mind, actively listening and seeking to understand rather than confirm my preconceived notions.

My methodological approach is based on qualitative research principles, with a focus on semi-structured interviews that allow for an organic flow of conversation. Throughout my research, I was mindful of the ethical implications, obtaining oral informed consent (Wynn and Israel 2018) and respecting each participant's privacy and autonomy. The rapport I built with the community was facilitated by my transparency in communicating the research objectives, my clear study intentions, and my adherence to CEU's Ethical Guidelines. I have always been open about my research and my doubts with anyone who was interested in discussing them. I am still in contact with several people, and all of the people I interviewed have my contact information in case that they wish to withdraw from the project.

Although I have not included all of the interviews in the following sections, that does not imply that they are not relevant, on the contrary, every interview was relevant and enabled me to enhance my understanding of the subject matter. The reason for this is simply that, for stylistic and research purposes, not all of the information was incorporated into the structure.

As an outsider, I cannot deny the potential influence I may have had on the participants. Even though I attempted to minimize this impact, my questions or even my demeanor may have influenced interviewees to respond in ways they believed were expected. It is important to note that this reflexivity is not an admission of failure, but rather an acknowledgement of the complex dynamics of qualitative research. The same is true for the interpretation of data. As I reviewed the narratives and testimonies collected, my interpretations were invariably colored by my academic and personal background. Moreover, appreciative inquiry requires a positive "bias" of reading the content in a regenerative manner (Zandee 2013; Bushe 2007). The purpose of this was to ensure consistency with my methodology and to maintain my intention not to focus excessively on problems. Nonetheless, I was aware of this influence and sought to mitigate it by engaging in peer debriefing and member checking to ensure that the themes I identified matched the lived experiences of the community.

As part of my reflection, I would also like to consider my future-oriented perspective, which might have influenced how I interpreted participant responses. My anticipation of future scenarios played a significant role in conducting my research and interpreting the results. In order to formulate my research questions, I considered future developments, guiding them towards issues that I believe will remain relevant in the future. Despite being trained in systems thinking, my way of thinking about the future implies some starting conditions that may have influenced my actions. In terms of climate change, for instance, I assume climate change issues are real and acknowledged, while my interviewees may not share this assumption.

Moreover, my position on climate change can be labelled by Clapp and Dauvergne (2005) as a mix between an Institutionalist and a Green Socialist. UNEP and Vandana Shiva can respectively represent the two viewpoints mentioned (Clapp and Dauvergne 2005): "institutionalists see a lack of global cooperation as a key source of environmental degradation" (7), and "social greens, drawing primarily on radical social and economic theories, see social and environmental problems as inseparable" (11). This attitude might have influenced my choice of topic for my thesis, research questions, curiosity, and interpretation of what I heard. Despite that, I gave space to the concept I heard the most, and I tried to speak with many different people to gain a deeper understanding of the topic. Recognizing subjectivity when choosing working tools, like the appreciative inquiry methodology, is equally important. I'm also aware that my mindset with this forward-looking approach also introduced certain biases. My interpretations were influenced by my projections and expectations regarding future trends, which may not be in accordance with the actual future developments. Due to this bias, some themes or potential solutions that I believe to be important for

the future may be overshadowed by other equally important but less obvious issues. While conducting fieldwork and writing, I recognized and acknowledged my bias in order to remain critical of my assumptions and open to diverse viewpoints. Again, this reflexivity of qualitative research in no way implies failure but rather the recognition of the complex dynamics involved in this type of study.

It was a constant exercise in reflexivity to balance my subjective perspective with the objective data. Thus, I am deeply grateful to the literature, as well as to the professors who supported me in my observations, and my *confidantes* on the island who keep me informed and assist me in my academic endeavors. Using Pantelleria's people's voices, I have attempted to paint a vivid picture of resilience and adaptation based on their intimate knowledge of traditional water management practices.

The ethical dimensions of my research were always present. To the maximum extent of my ability, I followed the ethical guidelines taught at Lund University and CEUs. While faithfully portraying the community's knowledge, I also had to safeguard their cultural heritage from possible exploitation. I did not take this task lightly; it was an important factor in every step of my research process. Occasionally, it was difficult for me to deal with those who had strong prejudices about the island, but I did my best to remain silent about my personal opinions in order to give everyone a chance to express themselves and understand all the nuances of the situation. It was a complex process, and I would like to thank those who helped me feel more comfortable about complementing the more speculative and extractivist views of the Pantelleria community (Fraser Taylor 2021). No one has ever been excluded from our conversation; I have no preferences, and I have attempted to recognize my biases so that everyone has the opportunity to speak to me.

In conclusion, my experience in Pantelleria was both a personal journey and an academic endeavor. As a result of the reflexivity that permeated my research, not only did I gather valuable data, but I also gained valuable experience as a researcher and as an individual. Most importantly, it was an experience that contributed to the enrichment of my political vision. Earlier, I mentioned that my worldview is transformative (Creswell and Creswell 2018), but it can be challenging to talk about change on a theoretical level and then claim it on a practical level. Through this experience, the friendships, discussions and reflections I have developed have helped me to understand this difficulty better and, hopefully, overcome it. I hope that this introspective account serves as a witness to the importance of reflexivity in qualitative research, particularly when it relates to traditional knowledge.

4. Results

I was on the island from February 2024 to March 2024, a period characterized not by tourism but by working the land, so my photos are limited to that seasonal period; therefore, there are no lush vines or flourishing capers, but the art of pruning is evident. My host was a brilliant person who gave me the opportunity to meet equally wonderful islanders. As part of the interview process, it was important to make small talk, which created a more welcoming atmosphere and often led to the identification of further interviewees. It has been an enriching exchange of relationships for me, and I intend to return and honor the community that has supported me by celebrating this work with them. According to me, this approach is part of appreciative inquiry (AI), as well as my own, as a researcher who believes that establishing lasting relationships makes more sense than passing on knowledge and then using it at will (Fraser Taylor 2021).

Although I have attempted to avoid bias, I cannot guarantee that the biases of all the people I encountered did not influence their responses. I am aware, however, that qualitative research is intrinsically subjective (Kemp and Martens 2007). From the first to the last interview, many people, particularly farmers, have offered me wine for several reasons, including acknowledging a ritual, building trust, or for polite reasons. Therefore, I can attest to the high quality of Pantelleria's wine and have had the privilege of tasting a various grapes and cultivation methods. In this regard, the Pantelleria community is equally generous; I could also taste raisins dried in the traditional manner, fresh cheese *ricotta* made with seawater, and many other delicacies that helped me more fully understand the interviewees' stories. There is truly everything on the island, as most people harvest from their gardens, as well as from wild fields. I recall spearmint, chard, and borage, to name just a few. Additionally, my experience with water was one of significant savings. I lived in a *dammuso* with a rainwater cistern that was constantly recycled, and shower water was collected in a basin and used for other purposes. My drinking water was sourced from a municipal drinking fountain, at a cost of 10 cents per liter. Many houses have a connection to a desalinator and then a water purifier. As one might expect, the costs are high. The island runs on fossil fuels, while some houses are equipped with solar panels. Up until the construction of the desalinizer in the early 2000s, water was imported from Naples by tankers (Int. 13, 45 and 67). Besides wells and *buvire*, it was reported that old people on the island drank rainwater from tankers and this is the reason for their toothlessness (Int. 12 and 24). However, there is one thing that remains, the water is no longer drinkable, because of the desalinizer, it must be purified before consumption. There is only one type of water that is considered beneficial for plants in agriculture, namely rainwater. Since desalination water is relatively devoid of nutrients, it is not used on plants.

A reader may perceive the interviews and the answers as somehow negative, and after the introduction of appreciative inquiry, a contradiction could be perceived. However, this is not the case, the interviewees do complain, but their complaints reflect a critical understanding of the problems. By doing so, they express a concern about perpetuating traditional knowledge instead. Nobody says no, everyone says it is challenging. There is suffering and difficulty indeed, but they are not disoriented; they experiment, they seek out solutions, they talk to one another, and there are conflicts, but there is no indifference or abandonment of traditional knowledge. A great deal of awareness exists regarding the problems and their causes. As evidenced in the interviews, there is a great deal of vitality in the Pantelleria community, and a strong interest in perpetuating and preserving local practices. Although there is no shortage of criticism, it can be seen as an indicator that demonstrates that there is an undergoing process, albeit a difficult one, but still in progress, can lead to positive change (Berggren and Bjørnskov 2022).

A small Italian enlightenment, *pantesco* (masculine) and *pantesca* (feminine) are the Italian words used to describe people living in Pantelleria or things originating in Pantelleria. As there is no English translation, the words *pantesc -a/ -o/ -che/ -chi* will sometimes appear instead of "from Pantelleria". The singular declensions are *-a, -o,* and the plural declensions are *-che* and *-chi*. I have attempted to translate dialectal ways whenever possible, as they have often been very helpful in understanding the context during interviews, but they are not always pertinent to answering the questions in this thesis, so don't worry, and if they are present, they are italicized.

To conclude, there should be an understanding of the differences between those from outside the island and those who live on the island to the interviews. There is a nuance that should be considered. Thus, there is the *pantesco,* who born and raised on Pantelleria. Then there is the *tourist*, who may be stable, who is not from Pantelleria, but who may have lived on the island for at least ten years – many have lived here forever, for upwards of twenty or thirty years. There is the *pantesco* who does not live permanently on the island, born there but raised elsewhere, who differs between those who have returned permanently and those who visit only occasionally. Some exceptions exist, such as those who were not born on Pantelleria but were born into a Pantelleria family that emigrated and returned. However, the distinction between the *pantesco* and the tourists (of any definition, whether occasional, stable, seasonal, recurrent, Sicilian or not) is very tangible. As other studies have shown (see e.g., Tusa 2020), but also and especially in many interviews, "the tourist came with the desalinator, s/he did not accept low water consumption" (Int. 13). Without any supporting evidence, this interviewee's statement captures this heartfelt difference perfectly. There is, therefore, a variable

degree of judgment in some interviews talking about people from Pantelleria, even when it comes to those who have lived on the island for many years.

To comprehensively understand the data analysis and results, I have organized this section according to the appreciative inquiry framework. This chapter is structured according to Mohr and Watkins' 5-D questions (2002) of appreciative inquiry: Define, Discover, Dream, Design, and Deploy. Each question is divided into a specific section related to the research objectives and the study context. This structure ensures a logical flow of information following the research questions, making it easier to understand the significance of my findings. In the last paragraph, the information collected on the island is supplemented by information about the Pantelleria emigrant community in Aprilia. Every step complements the previous one (Fig. 15).

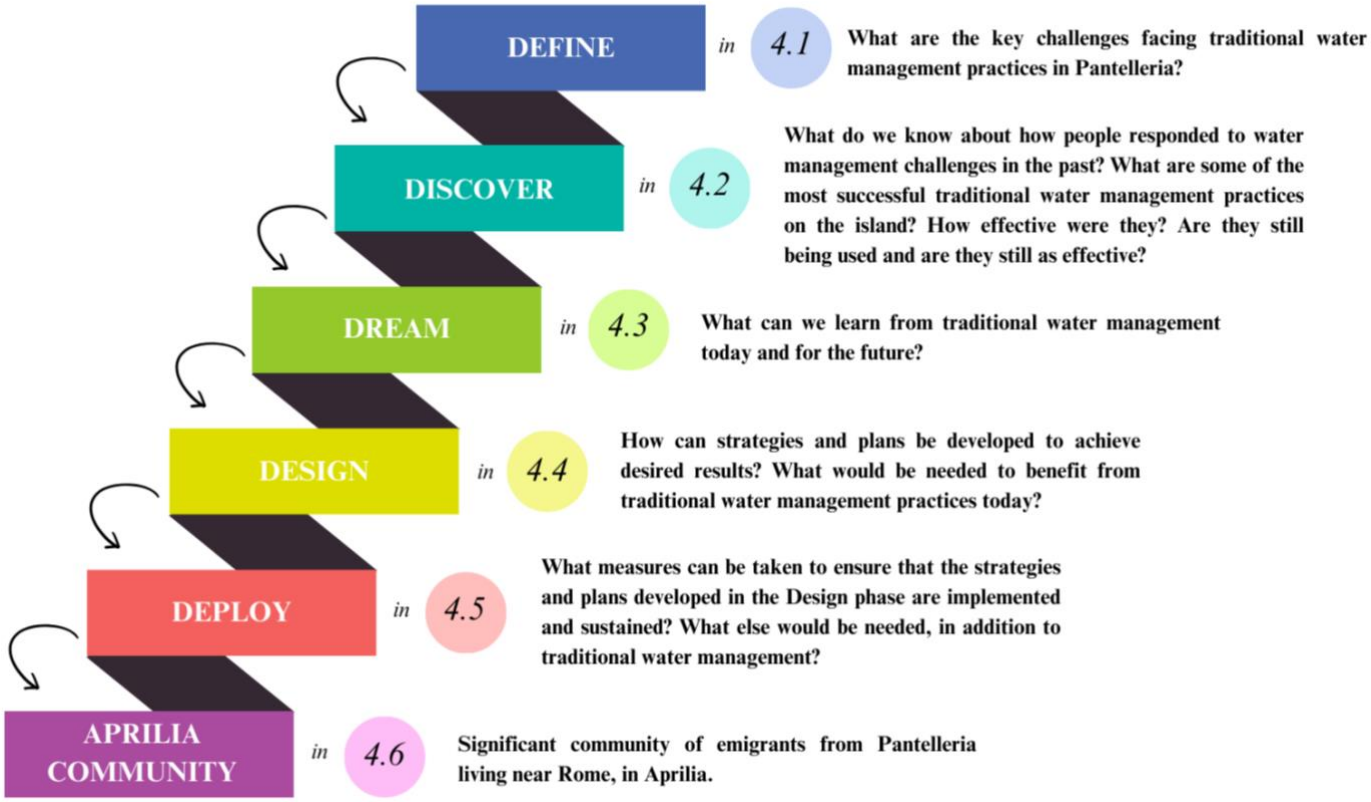

Figure 15: Overview of the chapter. *Diagram illustrating the various sections included in the Results chapter (Graph by the author)*

Each time is written "Int." plus a number refers to an interview (see *Appendix*). By giving voice to my interviewees while limiting my descriptive filter as much as possible, a narrative has been created, derived from the words and expressions of the *panteschi*, that guides the reader through the complexities of the data and provides insight into them. With this approach, the reader is asked to view the results with an appreciation-based stance and process-oriented perspective, aligning with the AI framework's purposes (see *Methodology 3.1*).

Many issues and problems are mentioned in a critical way related to traditional water management in Pantelleria. However, the appreciative approach to inquiry calls for a different gaze (Ghaye et al. 2008), resulting in a different way of understanding issues. This can be particularly valuable with this case study, where there is already a strong narrative surrounding the issue of traditional knowledge in contemporary. In the words of Bhaskar, this is about starting "from what is actually happening – not what appears to be happening or what our limited understanding leads us to believe is happening" (Ghaye et al. 2008, 371), by refocusing the gaze on appreciating a regenerative future. Following this approach, one can view the inquiry from a different perspective (Bushe 2007 and 2013). As a result, problems become opportunities where one can generate and act toward a different future within solid foundations.

4.1 Define

This section will address the research question related to what key challenges are facing traditional water management practices in Pantelleria. As a result of the interplay between literature and interviews, a consistent narrative emerges about the economic challenges facing Pantelleria's agricultural community and the traditional knowledge possessed by its people. Throughout the interviews, the participants discuss the complexity of the economic market, its entanglement with globalization, the rising cost of labor, and the shifting priorities of different generations. A poignant concern is emerging amid these discussions regarding the dwindling population of Pantelleria as young generations increasingly abandon traditional agricultural practices. Climate change is also a significant concern, as interviewees attest to its tangible impacts on agricultural patterns, ranging from a change in growing seasons to the proliferation of invasive species. Furthermore, institutional issues further complicate matters, with tensions arising between traditional practices and regulatory frameworks, particularly within Pantelleria's protected areas. The synthesis of perspectives highlights the need for a nuanced understanding of Pantelleria's economic and ecological landscape, one that balances preservation and adaptation in the face of broader socio-economic and ecological changes.

By examining the work of Deguillame (2022) and De Pasquale (2020), two researchers that have made progress in documenting traditional knowledge on the island, all interviewees have returned to the issue of the economic market, including its relationship with globalization, costs and labor, with perhaps different terms and descriptions. "Pantelleria's people are fewer and fewer, many have left, those who work on the land no longer desire to do so intensively […] People seek other jobs that are more remunerative and less labor-intensive" (Int. 33), claim the *panteschi*. Young people in a globalized world are always wishing to get away, it is also emphasized by those who are still living

on the island and, playing music in the 1980s, refers to the song: "*U Zulu* contains all the dreams of a young man who lived in Pantelleria [...] Run away!!" (Int. 58, see the song in the *Appendix*).

"I work on the land alone" (Int. 25), "we sometimes help each other, but it is not enough" (Int. 54), and so forth. It is explicitly stated without judgment by the new generations who live on the island and wish to work the lands of their families that the new generations (including them) (Int. 28 and 68) "have other needs". "You don't abandon the land because there is no desire but because there is no [economic] return" (Int. 69), their work differs, but is inspired by their father, they cultivate the land but more importantly, "I manage those who work the land" (Int. 28). "You lose the younger generation, [...] they are less interested [...] and [the work in the fields] not very mechanizable" (Int. 1); "traditions are fine, but if they are in conflict with the quality of life [a life that is less work-oriented and allows for more personal time], it is not good" (Int. 74). The intermediate generation, however, who sacrificed and followed traditional water management, asserts that: "the way water is saved and managed today is not the same as it used to be [...] more willingness is needed [...] One of my [younger] helpers left because it was too exhausting for him; that's true, it is as it is" (Int. 57).

It's difficult to find local and non-local labor due to lifestyle changes: "I have a few Romanians [...] most of them are in their 50s anyway, you can't find young people anymore, it's hard" (Int. 72), there is also the issue of the price of agricultural goods "farmers don't control prices, buyers do. They are compared with Sicilian prices, which are different" (Int. 4). Consequently, vineyard management becomes a cross-cutting issue "some Pantellerian vineyards have leases, so another large Sicilian firm manages them. For some it's fine, for others it's not, and certainly knowledge gets lost" (Int. 5). Continuing on the economic issue, tourism is of course another important consideration, "tourism does a lot, the economic system has changed" (Int. 10). For some, this means that their time is divided between "agriculture in winter, tourism in summer" (Int. 17). Regarding tourism, one issue that seems to bother everyone, yet is not brought up by farmers, is the "disproportionate" (Int. 38) use of swimming pools that are filled with drinking water from the desalinator. "They waste water" (Int. 13), "there is no water, and they buy pools" (Int. 36), "they do not respect the island [always about the pools]" (Int. 14). Water care is a matter of different mindsets: "they [the tourist] waste precious water for futile purposes" (Int. 17), "there are some who even have two pools [...] and obviously trucks go to them first [because they pay more for the driver] and leave others without [water]" (Int. 36).

The ageing of the population is also an important consideration. There is concern that this will result in the loss of embodied traditional knowledge, as no longer anyone will be able to perpetuate these

practices. The issue here is not a lack of theoretical systematization at play, but a practical fear of inadequate transmission that no one will be able to work the land in such a way in the future. It has been observed that more and more elderly people are passing away, resulting in the "imperfect transmission of knowledge" (Int. 1). "There is an erosion of language, the agricultural activity is changing, and the language [referred to it] is disappearing as well" (Int. 41), referring to the words, dialect, and traditions of the island. Some (Int. 42) have argued that this leads to the "loss of identity and language" (Int. 8), "there is no awareness of the heritage of the territory, there is a loss of dialect and therefore loss of knowledge of the territory" (Int. 41), this is especially apparent in schools, where there is a sense of "disconnection" (Int. 22) with the territory. The causes of this loss process appear to be related to other places subject to globalization, or at least none of the interviewees mentioned that this inadequate transmission was intended. There is such a high level of awareness of this knowledge that the problem is more evident among the people who deal with the younger generation and those who lack skilled labor, in the traditional sense (Int. 11, 41 and 72).

Thus, "agriculture has shifted to a speculative economy [...] there is no awareness of the environmental cost of this, we need a new paradigm" (Int. 41). Climate change is also an issue that emerges from the interviewees, as many of them observe seasonal changes and weather phenomena, in some cases through effects on growth and species, or loss of one or another crop. Differing viewpoints on this issue reflect the complexity of climate impacts on agricultural practices. Mushroom hunters have reported that the species and season of mushrooms have changed, "there are no longer the species that you were expecting" (Int. 15), "September used to rain, it was normal, now it is not so [...] in the last 3-4 years the species I was used to are no longer there" (Int. 16). According to some, this is a constant complaint of farmers, "we are always complaining that it does not rain enough" (Int. 54). Others, associate climate change with drought, "the drought is a problem that both Sicily and Pantelleria experience [...] Despite being in the sub-humid zone, Pantelleria is still in a border zone, and as climate changes, the border shifts [...] The problem is not just the island's climatology [...], but we have no idea whether that boundary [with climate change] will be to the south or to the north" (Int. 4). It is evident that with the issue of climate change and land management, the issue of herbicides also arises, and for a professor (Int. 5), "the problem is herbicides and the invasive plant *pennisetum setacieum*". "We have lost [the traditional operation of making] the *conca* (hollow) around the plats, which [time-consuming process] is incompatible with modernity" (Int. 49), "lifosate dominates, an herbicide" (Int. 6), "using herbicides is a solution/necessity, resulting in less work and lower quality for soil management" (Int. 7). It is true for everyone, "soil and dry-stone walls have to be managed. Herbicides somehow eliminate this management cost" (Int. 55).

There is also the issue of institutional problems, which are reported mainly by those who have difficulty adhering to protocols or by those who follow them but criticize those who do not. There is a challenge to Pantelleria's traditions in that many "practices [are] incompatible with legislation" (Int. 4), and from this comes the issue of the Park's top-down institutionalization and centralization. Some argue that "National Parks do not protect traditions, regardless of how much they promote them" (Int. 8). Social criticism is strong as "the protected areas sometimes conflict with the use of the land and the community of Pantelleria people who work on the land within the protected areas" (Int. 49), "the Park should have a greater impact on social and agricultural dynamics" (Int. 7); "while the park claims to protect the man-made landscape, it does not" (Int. 60). Obviously, this relates to the issue of land abandonment and re-naturalization of the island, as well as the safeguard of traditional techniques in supporting ecological services, which, in turn, implies recognition economically, or at least support for advertising and Park brands.

4.2 Discover

In this section, I will analyze the existing knowledge about historical responses to water management challenges, identify the most successful traditional water management practices on the island, and examine their current use and continued effectiveness. There are several answers to this inquiry. However, I decided to make a list of the practices (Fig. 16) I have been told about many times, eliminating the exceptions or niche practices, despite their appeal, trying to provide an overview of the contemporary situation. Some of these have already been reported in the literature (Deguillame 2022; Legambiente 2021; De Pasquale 2020). A key purpose of this section is to understand how some practices have been preserved, while others have been repeated and are still being repeated. The choice of crops, for example, is influenced by a longer-term dynamic of comparison that impacts the crops selected today. I have developed an outline for the reader to browse the section easily. This allows the reader to discover and learn about these long-term interactions and what is chosen to be maintained. An arrangement like this requires a variety of skills that articulate the landscape, and in its way illustrate what may be repeated elsewhere (e.g., pluvial pipe) and what is site-specific (e.g., *favare*) as well as those that are similar (e.g., prickly pear blades) that can be reproduced elsewhere – or they maybe are already used in the same way. In doing so, I have been able to provide an insightful understanding of the landscape and its practice within its systemic context.

Fixed infrastructure elements on the land:

Dry-stone walls

Pantelleria Garden

Buvira

Favara

Architectural solutions:

Cistern

Dammuso

Vault roofs

Kannalláte

Soil tillage:

Hollows

Pruning

Prickly pear shovels

Prepare the soil

Species selection:

Vine

Olive

Caper

Lemon tree

Figure 16: Overview of Traditional Practices on Pantelleria. *A graphic summary of traditional practices on Pantelleria (Photos and graph by the author, 2024)*

The findings during interviews and field observation suggest that the community has selected and preserved traditional methods over time due to their proven effectiveness, their continuing use and the ongoing discussion about these practices underscore their enduring value. However, even though most practices are still in use and their effectiveness is recognized, the *buvira* is no longer an active custom; however, it continues to be studied and preserved as a witness to the community's

commitment to maintaining its traditional knowledge. The landscape reflects these commitments: the dry-stone walls are still used for different purposes, the Pantelleria gardens are being restored, the local species are used, and the houses continue to be *dammusi*. The interviews indicate that there has been an evolution and change, but that this has been in response to new needs while preserving the traditional effectiveness as much as possible. As a result, some methods are no longer used as they were, such as thermalism for personal washing or condensation on favors for watering animals. There are, however, still those who repeat them, leaving behind traces of their actions (Fig. 23). Through these expressions of traditional knowledge and the awareness that emerged from the interview, the community demonstrates its adaptive strategies and living heritage.

***Fixed infrastructure elements on the land*:**

<u>*Dry-stone walls (Fig. 17):*</u> Dry-stone walls have been discussed a lot (see *Literature Review 2.7.2* and *2.7.3)*, and they are certainly a characteristic of the island. It should be noted that in my interviews, the notion that "dry-stone walls enhance condensation water phenomena" (Int. 4) is particularly apparent to a professor or researcher such as myself. During interviews, it is not something that spontaneously emerges, but I chose one opportunity to ask about it explicitly, and the answer concerning dry-stone walls was not about water but about taking stones out of the field: "you have so many stones to put away, and dry-stone walls are so long, do you see how long they are? You have to place small stones somewhere, then you cut [build] a wider wall - look at this wall- the wall doesn't fit the idea of property because from there to here, you can jump in without a problem, so why? The walls were unified, and there are few large stones and many smaller stones [...] you place them in the wall while you are out in the field" (Int. 57). Stones are named based on their shapes, such as "*mazzacane*", "*passo*" and so on. One of the purposes is then to remove the rocks from the field. However, there is still an awareness that fruit trees should be planted near the dry-stone walls, for example, "since they will grow better there" (Int. 25). In this case, they are also able to utilize occult water. However, one researcher emphasizes the lack of research on this topic: "there are no experimental data on the measurement of soil moisture as a function of the different techniques applied" (Int. 7).

Figure 17: Dry-stone wall system. *It can be seen in this image that the dry-stone wall system is not only an infrastructure but also an integrated system that contributes to the creation of an organic landscape (Photo by the author, 2024)*

Pantelleria Garden (Fig. 18, 19 and 20): Even though the garden is not much used any more, it is still there, and some people maintain it. Some who use it for events, concerts (Int. 36) or exhibits, but the garden is no longer used for agricultural purposes or garden pleasures. Many of them are abandoned, but citrus trees still grow there. As a former mostly self-consumption agriculture, everyone has a citrus tree, but it is not always possible to consume it all! In relation to the Pantelleria garden, during the interviews the wind is mentioned rather than water. From the discussion (see *Literature Review 2.7.3*) concerning occult water and non-rainfall water (NRW), it is evident that wind is the primary carrier of water in the arid climate of Pantelleria and has a greater presence than rainfall. This capacity to retain water has been further enhanced by the resident's development of condensation structures on the island. Thus, residents of Pantelleria have designed a garden structure that serves as a source of water and rainwater for the plants. Since they receive more wind than rain and occult water and wind are as valuable as rain, stones in Pantelleria's garden are placed appropriately for the maximum benefit of the plant: "they are made with the stones facing that way so [...] water does fall down, but you don't collect much of it [...] but made like this [with the stones facing that way] on windy islands, if [the wind] finds a square, it will bang, but if it finds a vector to the outlet, it will come out, and the fluids will end up better for the plant" (Int. 57; Fig. 18), "the wind comes out amazingly" (Int. 27). Consequently, it is an effective practice, but it is not as

widely implemented as it once was. Indeed, the upper edge of gardens is one of the most distinctive garden elements (Legambiente 2021; Fig. 18). Compared to the flat upper edge, the one sloping inwards dampens the effect of the wind and, when plastered or covered with tuff, also channels water inwards. Rarely is it possible to find the upper edge with an outward slant (Legambiente 2021).

Figure 18: Sloped top edge detail. *This photograph clearly illustrates what is meant by an inwardly sloping edge that can dampen wind effects and protect the plants inside the garden (Photo courtesy of Legambiente)*

Figure 19: Pantelleria Garden: front view.

Figure 20: Pantelleria Garden: aerial views.

A view of the same garden from the front and a view from the top. In particular, this one has been restored. Generally, there is no road leading to the door and no officinal plants. In most cases, there is only a citrus tree inside (Photos by the author, 2024)

Buvire (Fig. 21, 22 and 23): This is a context-specific natural system that the people of Pantelleria have always used to store water in natural wells, "back in the day dug by hand to take advantage of surface water tables" (Int. 6). In order to understand this, it is essential to keep in mind Archimedes' principle of buoyancy of bodies. Because of this principle, humans can stay afloat in seawater better than in freshwater. This is because saltwater weighs more than freshwater, which is the basis for the *buvira's* mechanism. *Buvire* are also "very old" (Int. 61). Sources reporting different periods confirm this vagueness (Mantellini 2015). Some evidence suggests that *buvire* used as wells date back to the late Bronze Age, between the mid-eighth century B.C. and the beginning of the fourteenth. Thus, they were constructed before the arrival of the Phoenicians in the mid-eighth century B.C., who brought cisterns with them. Nevertheless, some sources state that they date from the Punic period, which followed the Phoenician period (Mantellini 2015). Whatever the case may be, they are very ancient.

Figure 21: Buvira *(Photo by the author, 2024)*

Figure 22: Open buvira *(Photo by the author, 2024)*

The *buvire* tend to be built on the coasts, so at the bottom of the *buvira*, there is seawater, which is salty when it rains, and thanks to the percolation within the rock "because of the tuff rocks, even that little bit of rainwater goes down" (Int. 24), the method involves "catching a lens of [fresh] water floating over salty water" (Int. 44). As a result, thanks to Archimedes bodies mechanism, fresh water remains on top (Fig. 23). The people of Pantelleria have always been able to drink it, draw it and drink it, there is some mixing, but they also drank it as "salsa water" (Int. 39). There is a particular fascination for this *buvira* phenomenon among geologists (Int. 6, 9 and 73). However, it is also of interest to the general public more for curiosity than anything else. Everyone knows what they are, which is no small matter given that "they are no longer used. Some put pipes in them [...] but most have been buried and disappeared" (Int. 6).

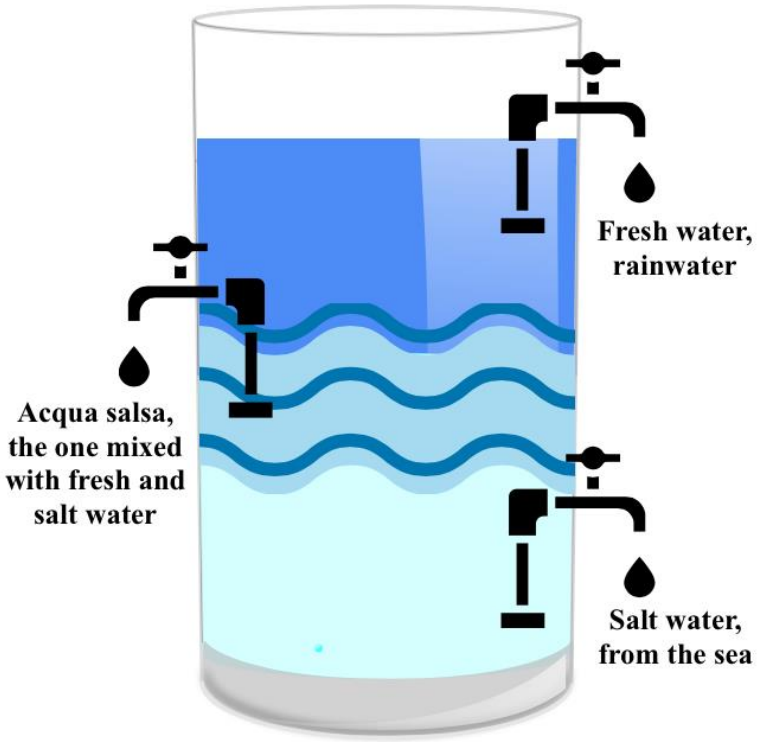

Figure 23: Buvira scheme simplified. *This diagram shows water stratification, with salt water with greater density below and fresh water with lesser intensity above. After pumping the water, the one above can be consumed as fresh water, but the one in the middle, called "aqua salsa" (Int. 49), has a salty taste due to the combination of the two liquids, and the one at the bottom is seawater (Scheme by the author)*

<u>*Thermalism (Fig. 24 and 25)*:</u> Thermalism can be divided into two categories: saunas and using the condensation from the *favare* to feed animals. In some instances, there are also pipes that take advantage of it. Earlier in the discussion on the island's characteristics (see *Literature Review 2.7*), I mentioned that there are several hot springs located in the water basin and that the *favare*, which are fumaroles scattered along and steaming volcanic grounds of the island, are the main active tectonic structures that emit gaseous, steaming gases from their rock crevasses. With this phenomenon, which is a recurring feature, when you go around the island, you understand what a volcanic island means, "it's really true that this is a breathing island" (Int. 40). In terms of saunas, thermalism serves both as

a tourist attraction, “you absolutely have to go there at night” (Int. 26), and for health purposes, “there was a gentleman who had a *favara* near his house and built his own sauna” (Int. 51). In both cases, according to some, as a water saver, “people used to wash themselves there” (Int. 36), “this was back in the 40s and 50s when it was more commonly used” (Int. 6). At one time, the *favare* were used to collect water and give water to the animals, but since the animals are less and park rules have changed, it is still done, but less frequently. In any case, less explicitly. As in this case, “take the branches and place them on top so that the water condenses and collects” (Int. 30). There is still this practice of covering the terminal mouths with reeds and dry branches. Then the water is collected in a basin dug into the rock, “there are gutters that bring the water down” (Int. 37). It is a genuine catchment system.

***Figure 24:* System along the favara.** *System on the favara to feed the animals (Photo by the author, 2024)*

***Figure 25:* Condensation collection.** *Raising the condensation with branches and collecting water in the reservoirs in fig. 24 (Photo by the author, 2024)*

Architectural solutions:

<u>*Cisterns (Fig. 26)*</u>: Cisterns are the most frequently cited element. Water in Pantelleria refers to rainwater and, consequently, cisterns. Everyone then discusses other practices they prefer or have experience with, but the cistern is the undisputed star of most of my responses. Many people up to the age of thirty-five tell you they used to drink cistern water when they were children, “eels or lime

rocks were placed in the cistern to oxygenate the water" (Int. 13). "Nowadays, people drink plastic water" (Int. 45). However, many tell you that their parents, the previous generation, accustomed to "drank *buvira* water [...] a little salty but you drank it" (Int. 45). Older people can tell you easily, "I used to drink *buvira* water" (Int. 12), and then "until a couple of decades ago, it was free, it was brackish, but I drank it" (Int. 24). "Instead, now they are all squeamish about rainwater" (Int. 45). Most people who have cisterns live in the countryside, "in the city there are few of us who have the cistern [...] there is the desalinator anyway" (Int. 67), "it's always been like this, here in the centre [i.e. in the town] we used to go and get it from the well [...] it was brackish [the water], some drank it, others didn't" (Int. 45), "in the post-war period, we had a shared cistern and some of us bought the truck [...] the water came from Messina every 15 days" (Int. 12). The size of cisterns varies in the countryside; some have large cisterns while others do not wish to be connected to the aqueduct. If they require water, they ask the truck to bring it. "I did not attach to the aqueduct" (Int. 37), according to one respondent, also without an attachment to the aqueduct "as I look at the 2019 net change line, I am increasingly concerned about my cistern's capacity to accommodate my consumption" (Int. 45). "Cisterns are required by the territory plan [...] otherwise it would have been lost and who knows what would have happened" (Int. 36). The method of making it "has been altered [...] it used to be made of stone, and it was dug [into the ground], now it is made of metal" (Int. 43).

Figure 26: Cistern. *At the bottom right, you can see the cistern; the one on the left was my dammuso, and the one on the right is a dry-stone wall. Again, you can see that everything is close together and connected and valuable for water collection (Photo by the author, 2024)*

Vault roofs (Fig. 27, 28, 29 and 30): Most people refer to the *dammuso* in terms of the cistern first and then to the "*damusati* roofs," which are vaulted roofs. It never goes any further than "[on the roof] water is collected from the roof and goes into the cistern" (Int. 25). They do not emphasize water, they worship the *dammuso* and speak of the *dammuso*, and how it has evolved over time, "now they look to the sea [...] the original *dammuso* looked at the mountain" (Int. 34). However, there is no mention of the inherent aspect of water, but only "roofs collect rainwater and small terraces collect water [...] and then into the cistern" (Int. 62). Although everyone is aware of the passage, the vaulted roof is not highlighted more. Certainly, it is important, "once it was all built [and maintained] by hand in the family" (Int. 58), and it is always mentioned in relation to the cistern, "[how much water you collect] depends on how many roofs you have and the size of the cistern" (Int. 71).

The essence of *dammuso* architecture is not just the vaulted roof, cistern, or dry-stone construction but the seamless integration of all these strategies (Fig. 30). The art of channeling water combines all these strategies into a storage cistern. As varied as the methods of channeling water are, also the dry-stone construction serves as a means of collection, and the use of lime on the vaulted roof ensures the water's journey to the pipes, underground or outside, and then to the cistern.

Figure 27: Dammuso. *A dammuso with a vaulted roof with white lime stripes is one of the most renowned. It is considered to be a symbol of Pantelleria (Photo by the author, 2024)*

Figure 28: Vaulted roof. *Every dammuso or small building has a vaulted roof, there are very few exceptions, any such roof implies water collection (Photo by the author, 2024)*

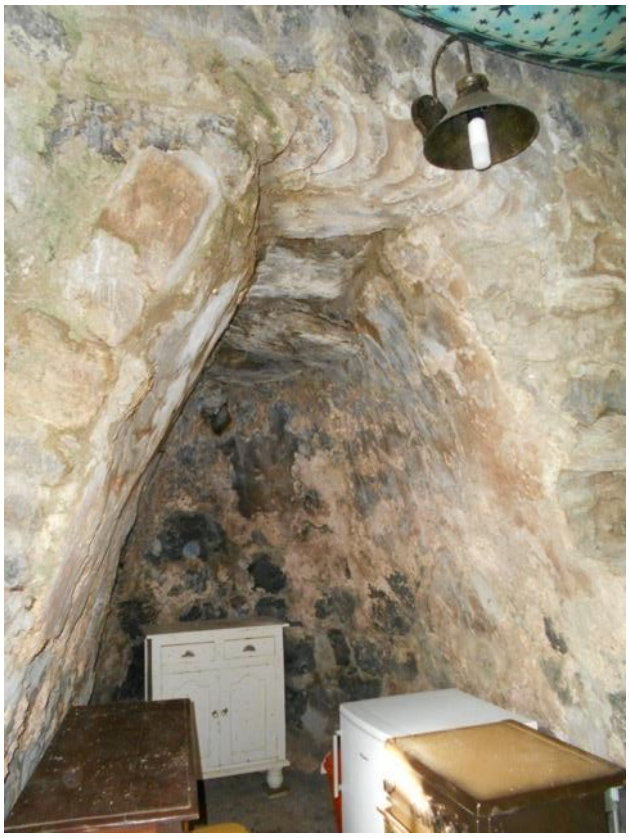

Figure 29: Interior of a vaulted roof. *Here you can clearly see the vault and the construction going on inside (Photo by the author, 2024)*

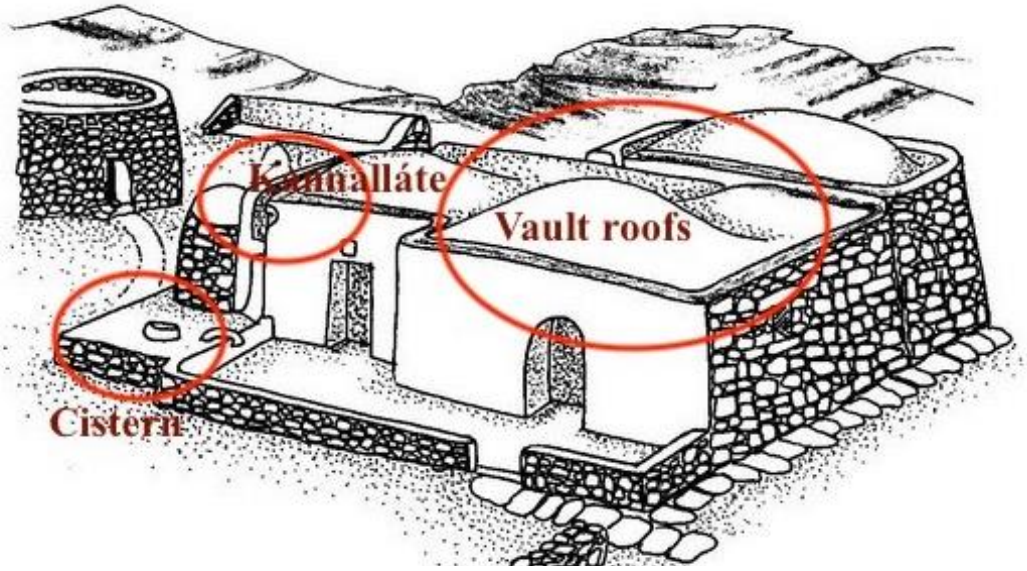

Figure 30: Water collection systems in the dammuso. *It can be seen in this picture how the housing system is interconnected, and every detail is intended to maintain a microclimate and collect water. Rainwater collected in the vault fed the cistern, and the vault served as slits for water to flow to the nearby underground cistern. This structure is designed to maintain a constant microclimate, which is warm in the winter and cool in the summer (Sketch courtesy of Pangea Project Ancient Techniques Research Center; modified with circles by the author)*

Kannalláte (Fig. 31 and 32): They are the external downspouts that carry water to the cisterns. They are not mentioned in the interviews, except in a cross-descriptive way, "the water runs down this way [*pointing me to the gutter*] and comes to the cistern" (Int. 59). It is just that they are an interesting fact, they can be found anywhere, in a variety of forms, currently they are more and more plastic, sometimes it is more or less concealed, but they are everywhere. Although they are not explicitly mentioned in the interviews, they must nevertheless be included because they are essential and taken for granted, not because they are not useful.

Figure 31: Kannalláte. *It is possible to see here the channel that brings the water down, and it is the same in many cases. It was also intended to water the animals, otherwise, it would not be open (Photo by the author, 2024)*

Figure 32: Another kannalláte. *The case in this photograph is more clear, and there is a plastic tube inside, which is covered with another material to conceal it. Nevertheless, it is present in every home, more or less explicitly, even today (Photo by the author, 2024)*

Soil tillage:

Hollows (Fig. 33 and 34): "Previously, the vines came out of the hollow very little, they were sunken. Now, they are out of the hollow and the hollows are very small to prevent the berries from touching the ground and [...] to channel water into the plants when it rains" (Int. 16). "[This process]

stopped with the new facilities [...] to work more easily" (Int. 72). There are those who obviously care about making these hollows, also to recall a tradition. However, everyone, without exception, acknowledges that "they are shallower [...] the workforce is fewer and it [the hollow] is tiring to do" (Int. 25). Now the land "is plowed [mechanically], it used to be hoed" (Int. 15), although some elders still do it, "see what a beautiful field he has [pointing to a neighboring field]" (Int. 56), "you should go and see this old man's field [...] he's bent over cleaning the ground [...] but no one does that anymore" (Int. 58). Although the practice remains scattered and limited in its original form, it has left a legacy that has been re-proposed and has developed (Fig. 35).

Figure 33: Hollows in the past. *Historical photos of how hollows were made in the past (Photo by the author in Donnafugata archive, 2024)*

Figure 34: The hollow now. *Here the hollow is explicitly less shallow and wide than it used to be (Photo by the author, 2024)*

Figure 35: The process of soil tillage. *The process of soil tillage. However, even if it is not a basin, everyone digs the soil and works it before planting. There has been a change in the method of creating space for water; it is not an abandoned method. With the green on the right, you can see that this is effective (Photo by the author, 2024)*

Pruning (Fig. 36 and 37): "There is a very clear physiological interpretation of the plant" (Int. 4), the people of Pantelleria know how to manage their plants very effectively. I have had the pleasure of pruning several vines with several different farmers whom I thank. Crops are cultivated through a series of specialized agricultural adaptations designed to limit their exposure to the wind, as well as their loss of moisture through evapotranspiration. It is essential to understand that canopy confinement is not the result of wind shaping but is instead the result of the grower's careful and "well-defined pruning and canopy management practices" (Int. 4). "Every farmer prunes in his way. I will show you mine" (Int. 25). "Every two buds you cut ... like this [and show it]" (Int. 25), some prefer plants to grow upwards rather than wide, "we used to go wide, but there was a hollow [...] fewer bunches, but better bunches" (Int. 37). It is evident that preference plays a role, "the vine is made to grow wider [...] the creeping olive tree is part of our heritage" (Int. 35). However, pruning does not make the plant tall, "you must still protect the stump from the wind" (Int. 40). The abandonment of the hollow and the spread of mechanization have led to the raising of the plants to a higher level than previously.

As a result of this strong pruning, old wood is often retained, but paradoxically, the vine regenerates and growth are balanced, proportionate to the limited resources of the growing environment

(Deguillame 2022). The physiological implications of this pruning model involve the functionality of the vascular system and the hydraulic architecture of the entire vine, so that the development of a moderate water deficit contributes in a sophisticated manner to establishing the balance between vegetative and reproductive growth (De Pasquale et al. 2021). This particular training system has been recognized by UNESCO (2014) as "Intangible Cultural Heritage" due to its particularities and the traditional agricultural knowledge it embodies.

Figure 36: Pruning an olive tree.
(Photo by the author, 2024)

Figure 37: Pruning a vine. *Pruning a vine with hand shears. While electric pruning shears are becoming more prevalent among younger generations, older generations do not find them suitable. This illustrates how pruning involves careful and deliberate attention to the plant lymph (Photo by the author, 2024)*

Water in crops: In Pantelleria, "everything revolves around water" (Int. 4) but "everything [is] in the dry" (Int. 1); "there is still no irrigation, except for vegetables" (Int. 27). Water is used when transplanting, "Water only when transplanting, for the roots" (Int. 37): "you make the hole, then you put in the water and then the soil" (Int. 34); "in this way, there are no air spaces left" (Int. 72). I find it interesting that all of them are keen to emphasize the fact that this process "works only with rainwater" (Int. 61), "water from the desalinator causes problems for leaves" (Int. 62), "I've tried [water from the desalinator], but nothing grows" (Int. 36). "In the specification, water is not allowed

on vineyards" (Int. 28), "only during transplanting" (Int. 43). This remains the case today. "You water something around the house [...] in the *magnano* [...] a small vegetable garden in front of the house, [...] summer plants you water with rinse water" (Int. 44).

Prickly pear shovels (Fig. 38 and 39): Prickly pears (*Opuntia ficus indica)* are used in several ways, the most common being to "defend small tomato plants" (Int. 25): they are cut (not too much) in half to form wedges that shade tomato plants during their early growth, as well as keeping them hydrated as cactus blades lose water slowly as they dry out. And there was a time when prickly pear cactus leaves were used for animals, "when there was little water and usually there was a need to hydrate [...] they would cut all the prickly pear leaves [...] and with a little bran [...] you basically put 10% fibers, 50% of the liquid on it" (Int. 57). Furthermore, "so many other situations you use to treat tomatoes, capers [...] there are days when it's not expected to be hot or windy [...] you put the cactus leaves on the growing plant" (int. 56). Interestingly, some people explain that "when you have to take it off [he was cutting the cactus shovel into a lot of pieces] Do you get it?" (Int. 56), in order to place it around the plant to keep it hydrated. Use every part and don't waste anything, similar to the eel we discussed in the cisterns, where "before it dies and became too old, and to prevent it from rotting, you eat it" (Int. 45). Each component of the system is always used in a way that supports the benefits and distributes them throughout.

Figure 38: ***Multifunctionality of the prickly pear shovel.*** *It is here that the farmer shows me one of the uses of the prickly pear shovel: cutting it, and placing it in the ground, which hydrates the plant, since it is filled with water (Photo by the author, 2024)*

Figure 39: Prickly pear shovels and tomato plants. *One of my farmer friends sent me this photo of prickly pear blades covering tomato plants to protect them from the wind and also to hydrate them. The practice has not changed over time (Photo courtesy of G. B. 2024)*

Species selection:

Choice of crops (Fig. 40, 41, 42, 43 and 44): Grapevines (Fig. 42), olive trees (Fig. 43 and 44), and capers (Fig. 41) are the most commonly discussed crops. There are also tomatoes and Pantelleria zucchini, but since I was not in their growing season, they mentioned them to provide me with the information that "you've got to try them, they're delicious!" (Int. 75). As for the vine, while "it is not only *zibibbo* [...] before there were table grapes" (Int. 71), *zibibbo* remains the undisputed leader in the interviews. It is used to produce *passito* and *moscato*, some of the most "prestigious" (Int. 68)

wines. The *zibibbo* grapes produce both types of wine; *moscato*, a light and delicate wine made from freshly harvested *zibibbo* grapes. For *passito*, a longer and more refined process is followed: the harvested fruit is first placed in wooden crates, then dried in dry rooms, in sunny and well-ventilated conditions, and turned over several times to achieve a homogeneous drying process. However, that does not mean that there are no other species, "the wine that its plants produce is not consumed by farmers" (Int. 11), and most *zibibbo* products are marketed. Olive trees have a bush-like appearance, and their growth is oriented more in the direction of width than height. The olive tree "is more for personal use [...] I don't make enough to sell" (Int. 24); "I have my own olive trees [...] for us" (Int. 25). As a final note, the caper, a domesticated plant on the island, despite it being wild, is very lucrative, but it is also tough to cultivate. The capers are the buds of the plant that "you pick them before they open and turn into flowers [...] you get up at dawn and pick the crunchy buds" (Int. 31). "I did it once with my mother-in-law and I fainted [...] they're all bent over all the time [...] it's exhausting" (Int. 11). In my interviews, there is no indication that farmers are shifting towards more drought-tolerant crops due to climate change concerns. There are, however, studies that examine local germplasm, the genetic makeup of a specific species (Sottile et al. 2013). There are also niche cases of farmers experimenting with the return of traditionally grown legumes (Int. 40).

Figure 40: Citrus plant. *They are usually located inside a Pantelleria garden, but not necessarily; they can also be found around other dry-stone structures that provide protection (Photo by the author, 2024)*

Figure 41: Caper. *The trunk full of small twigs is a pruned caper. They let capers grow without monitoring them as the vine, since they are domesticated but also wild (Photo by the author, 2024)*

Figure 42: Vineyard. *On the left, you can see a clean vineyard, and on the right, you can see a vineyard that is not clean, which illustrates how low the vines are (Photo by the author, 2024)*

Figure 43: Olive trees. *In this photo, you can see that they are wide and low, and as mentioned in the text, their branches point toward the dry-stone walls. Demonstrating the walls' ability to store water (Photo by the author, 2024)*

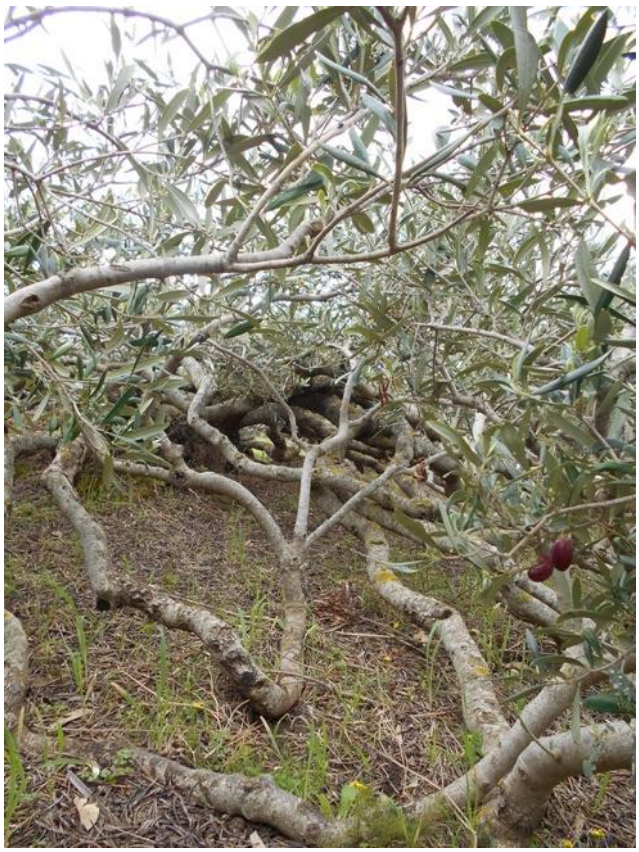

Figure 44: Under the canopy of an olive tree*. It can be seen here how the intertwining of branches creates a moister microclimate (Photo by the author, 2024)*

4.3 Dream

As highlighted in *Literature Review 1.1*, projections from the European Drought Risk Atlas (2023) indicate that European droughts are likely to increase in frequency and duration, spanning years rather than months. In light of these forecasts of escalating water stress as a result of climate change, traditional water practices and conservation efforts are becoming increasingly important. The implementation of such practices will play an important role in addressing increasing water stress and ensuring sustainable water usage in the future. This perspective aligns with the central focus of this section: to explore insights gleaned from traditional water management practices, both for present-day challenges and future sustainability.

Long-time residents of Pantelleria reflect on the Dream phase with a feeling of resignation and critique; despite efforts to preserve traditions and pass on knowledge, a pervasive sense of disillusionment and skepticism prevails regarding the island's future. Although, as mentioned at the beginning (see *Results*), this vision should not be viewed as negative, as my method is still the Appreciative method. Despite language's skepticism, this view reflects a precise identification of the causes of the problem (Berggren and Bjørnskov 2022), demonstrating an awareness of the community on the broader issues concerning their future. These interviews, as well as those in this section and the following ones, illustrate how the people of Pantelleria take certain practices for granted because they are simply part of their daily routine. After all, it is their work and how they learned it; thus overall, the problems they face are complex.

Moreover, Pantelleria's history illustrates resilience and adaptability amid this complexity, offering lessons in navigating change while preserving cultural heritage. What emerges from these complaints, from the frustration that seems to permeate, should be considered as an indicator that they are increasingly facing these problems in solitude, from the community, from the institutions, and from the Park itself. Through this reading key, it is possible to understand the underlying causes of the problem. Each of them is working on these issues in their way, as no one is really convinced of the superiority of the new techniques over the traditional approaches. Evidently, they are experimenting and changing, but this is not a reconversion to a new way of doing things, but a desire to complement their local knowledge with contemporary challenges and modern tools. This topic will be discussed in more detail in the *Discussion* chapter.

The answers to this question have been more focused on the shortcomings than the opportunities, as the residents of Pantelleria who have been living there for generations tell you, "it goes as it goes"

(Int. 59), “we adapt to the vintage” (Int. 68). They do not reflect on their own practices. “Basically, we say [things] have remained the same, they have changed a little bit, but the practices have remained the same, [...] the man has changed, [...] the system [of values], a new vision that puts tradition aside” (Int. 57). “I do not believe in us [...] today, people lack organizational capacity, a vision” (Int. 45), “The modern world will leave nothing behind, our materials will be nothing and only the older ones will persist” (Int. 43). Despite my attempts and AI approaches, the Dream phase is quite pessimistic, “it’s a disaster since the postwar period [...], where the cultural class went to study elsewhere and the aristocracy lost rents, while here the atavistic ignorant remained” (Int. 45). However, even though many people are engaged and talk about traditions and knowledge of the island in schools, there is a great deal of discouragement. “For three years, I’ve been telling elementary school children about the importance of bees” (Int. 48), “sometimes they ask me to go to school, so I go because they say I’m good” (Int. 25), “The participation of the local community is important [...] it needs participation [...] there is no awareness of the heritage [...] it doesn’t happen here” (Int. 49). “There is no awareness within [the island, the Pantelleria’s community] [...] maybe if someone explained it to them from outside, they might understand” (Int. 11), are the good intentions of some Pantelleria citizens who adore their island and wish for traditions to return as part of the cultural baggage of young people, which conflict, however, with those who claim ”Why did you not ask us who are from the island instead of calling someone from outside” (Int. 13). The situation is complex. “The people of Pantelleria lack planning capacity” (Int. 41), “it’s not enough to love the island to come back” (Int. 68). Despite the great discouragement, we can draw valuable lessons from Pantelleria “the complexity of the system and its dynamism [...] history shows a capability to change the system [...] versatility is apparent in the Pantelleria people [...] as a result of their cultural dynamics, they have moved from cotton plants to vine” (Int. 4), “they no longer reason on subsistence, but rather on the market” (Int. 10), thereby maintaining the surrounding landscape while adapting to it. Even so, there is always a comment that “the economic system has changed [...] the system [of traditions] is disintegrating” (Int. 8).

4.4 Design

This section describes strategies and plans for achieving desired outcomes and considerations necessary to benefit from traditional water management practices today. In Pantelleria, developing effective strategies for achieving desired outcomes requires balancing economic viability with environmental stewardship and cultural preservation. While discussing the tensions surrounding tourism and the viability of local products, a common theme emerges that involves navigating constraints and establishing viable cooperation models, such as the caper cooperative. At

the conclusion of these interviews, the task at hand is not only to identify obstacles but also to foster collaboration and innovation in order to leverage traditional practices in a contemporary context.

During the summer, those who make wine often deal with tourism, and they discuss "imbalances [...] It's a magic island [Pantelleria], but one should respect it [...] it was too generous, and some people exploited it" (Int. 69). "If you do not have an economic motivation, you abandon it [the land]" (Int. 25). As well as local products, which are not available in supermarkets or grocery stores, but are available only by word-of-mouth, and if you inquire as to why it is always because "there are too many costs [...] the rules are not designed to support the process that we have always had" (Int. 59). Therefore, strict restrictions represent a cost. That means each constraint, in its various forms, imposes a cost on those who must deal with it in the real world. About farmers and small businesses, the economic constraint is that "[farming] is not a paying job" (Int. 58), "I invest much money, but it takes a long time for it to pay off [...] Do you see this field that I am putting in place? It takes at least three years for it to pay off for me" (Int. 57). "To maintain traditions economically is a challenge [...] and exhausting" (Int. 55), "I work from dawn to dusk [...] at ten o'clock I just want to sleep" (Int. 54), "it would necessitate more subsidies" (Int. 56), "there is little cooperation [from the institutions]" (Int. 58). Moreover, mutual assistance has declined. Collective informal organizations help one another less (see *Literature review 2.7.4*), given the informality of something that might be regarded as illegal under strict controls (CGIL Pesaro 2015). However, it depends on whom you ask, "with the caper, it turned out differently [...] the caper cooperative works quite well [...] a potential model" (Int. 4). In terms of the answers, they are primarily centered around limits, the institutional or economic obstacles, and "you do what you can" (Int. 66).

4.5 Deploy

During the Deploy section, I will address the measures necessary to ensure the implementation and sustainability of the strategy developed during the Design phase and the required additional factors beyond traditional water management practices. A multifaceted approach is essential to effectively implement and sustain the strategy formulated in the *Design* phase.

Challenges and critiques that emerge here underscore the need for comprehensive economic support and the need to foster local cooperation networks. The people of Pantelleria play a crucial role in the success of these strategies. Their deep understanding of the economic issues they face is invaluable in devising policies appropriate to each stage of work and the processes and objects to safeguard. Their specific grievances, which are a conscious interpretation of the territory, should be a

vital component of opportunities that go beyond the specific complaint and should, therefore, be incorporated into policy development. Not being problem-oriented does not mean one should not discuss problems and their challenges (Bushe 2007).

I received a few practical examples, some focusing on schools "talking and taking kids out to the fields" (Int. 22), "the kids need to talk to their grandparents [...] they cannot lose their identity" (Int. Int. 41). "We must try to collect stories from the past for the future [...] starting with the young" (Int. 41). Some focus on tourism, which again calls for cooperation, "bringing together all of us entrepreneurs-as happened in Lampedusa-and paying ITA [the Italian airline] to increase direct flights to the island [...] we did it, we pulled out of our own pockets but not everyone wanted to participate [...] a greater level of cooperation is needed [...] social tourism must be the focus [...] but it can only start with us from the island" (Int. 69). This project also created some criticism since ITA Airways then requested that Pantelleria products be served in its VIP lounge (I went to a meeting about it, but you can find the information online at Murana 2024, it is all public). For some, this was a disappointing experience "do they realize how much work goes into caper pate?" (Int. 25). Also, since many of the investors in this project are winemakers, "we don't produce food, we make wine" (Int. 69) or others "and then what do they do they put the [air] company's label on it? [...] it's okay to advertise the island, but what about my company?" (Int. 49). As a result, strategies are in the works, as well as criticism.

As I reported earlier (see *Results 4.3*), the school project has some cons, "why do they bring experts from outside rather than taking us from the island?" (Int. 13). With any choice, there are pros and cons. There is, however, a lack of proposals for economic support, which would be necessary instead, "because making the hollow [...] costs me [money], and I make money by using weedkiller" (Int. 56). In general, there is an informal network of mutual assistance, "between us, we help one another" (Int. 61), "he'll lend me his tractor tomorrow" (Int. 25), and so on, "once I gave him a water truck, he will help me next time I need it" (Int. 58), "I want to stop having the truck because they all ask me to use it and I keep doing favors [...] I want to sell it anyway I don't need it anymore" (Int. 59).

4.6 Aprilia Community

As a result of interviewing several people, I discovered a significant community of emigrants from Pantelleria living near Rome, in Aprilia. As a result of the promise of a higher salary from industry, they left in the 1960s and 1970s (Int. 71). Several people in Pantelleria who know or are from Aprilia, are happy to talk about this place. "There the Pantelleria traditions are felt more than ever" (Int. 71), and "it is like being in Pantelleria, they welcome you as they would here" (Int. 61). In fact, there is a

street between Aprilia and Nettuno, in the Lazio region, half an hour from Rome, inhabited by individuals from Pantelleria's families who are glad to welcome everyone (Fig. 46).

Interviewing the community of Aprilia was important not only from a curiosity perspective but also from the scope of the thesis research. As a first point, the Aprilia community demonstrates that, although resource management methods may change, traditional practices and knowledge remain relevant. Consequently, this consideration confirms the argument of this thesis, which is that what should be understood about traditional practices is not the specific intervention itself but the logic behind it. As with other cases of emigrated communities (Ramella 2009; personal comment L. Pintér 2024), community cohesion is often a result of adaptation to the new context, the change of techniques, and the cultural attachment to the traditions of the community of origin. Furthermore, Aprilia confirms this as well.

There is a similar ability to adapt among the Pantelleria people in the Aprilia community. Even though the culture is very similar to that of Lazio, with grapes and kiwi, "we brought little from Pantelleria [referring to *zibibbo*]" (Int. 77), initially "we did what we knew how to do, which was work the land" (Int. 77). There is a strong community there, "everyone knows each other here" (Int. 78), "we all live on the same street" (Int. 76). However, the vineyards are different, "here in tents or rows [...] we adapted to the way it is done here" (Int. 78) (Fig. 45). All generations are involved in working or otherwise managing the fields and workers, "there are some young people, even though they may have other jobs" (Int. 76), similar to Pantelleria. Also, here, "we may have had 500ha, now we have maybe 300ha [...] with the change of generations there has been abandonment [by the people of Pantelleria]" (Int 78). As is the case in Pantelleria, "when needed, we help each other" (Int. 79). "When the *panteschi* arrived, they brought pride and a desire to work" (Int. 76). Such adaptability to change is not unexpected, as it is part of their cultural heritage (Fig. 47).

Figure 45: Vineyards in Aprilia. *It is noteworthy that the vineyards here are entirely different from those on Pantelleria since they are located in Lazio, near Rome, where they are planted as marquees and row crops (Photo by the author, 2024)*

Figure 46: Cooperative Pantelleria in Aprilia. *On the same street as the community's home and near the fields they cultivate, this is the headquarters of the Pantelleria Cooperative in Aprilia. There used to be a recreational circle, but now there are bureaucratic problems, and it has been closed (Photo by the author, 2024)*

Figure 47: Pioneers of Pantelleria*. A historical photo, below it states the Panteschi pioneers, which tells the story of the first four Panteschi who arrived in Lazio, and some of them started the agricultural cooperative, while others entered other trades (Caterina D'Aietti archive photo by the author, 2024)*

5. Discussion

Based on observing the area and examining their work, my insights are synthesizing my interviews, observations on the island and the literature review (see *Literature Review*). The primary objective of this study is to understand how traditional water management systems can contribute to the socio-ecological adaptation to climate change and using appreciative inquiry methods leads to several critical questions (Fig. 48): what are the key challenges facing traditional water management practices in Pantelleria? Historically, how did people respond to water management challenges on the island, and what were some of the most successful traditional practices? In order to evaluate their effectiveness, I asked and observed if these practices are still being used today and if they remain effective. Furthermore, what can we learn from these traditional water management practices for contemporary and future applications? Developing effective strategies and plans requires an understanding of what is required in order to take advantage of traditional practices today. What measures can ensure that these strategies and plans, developed during the previous question, are implemented and sustained? Beyond traditional methods, what additional actions are necessary to address the evolving challenges of water management? To answer these questions, traditional practices are integrated into modern frameworks through comprehensive planning, community engagement, financial and technical tools, and adaptive governance.

Figure 48: Outline of research questions *(Graph by the author)*

The *Define* section, the first component of the AI framework, with the interviews and the *Literature Review,* identified the main challenges facing traditional water management practices in Pantelleria (Fig. 49). To complement and discuss the results, it would be beneficial to investigate and reason about the other four sections of the AI framework, and to attempt to understand what regenerative actions are possible in *Design and deploy* (see *Discussion 5.2*). My position, and that of the *panteschi*, on the issue, is clearly expressed in what La Mantia wrote in 2009 (93): "This awareness (preservation of cultural and environmental values) must be accompanied by public initiatives, both in terms of services and economic support. It is important to remember that the preservation of traditional agricultural landscapes cannot be left to the shoulders of farmers because of the general benefits they provide. Rather, it is society that must take care of them, helping farmers to maintain their activities. It should be remembered that the landscape and the rural environment are collective goods from which everyone benefits but are safeguarded by the work of the few who bear the costs and the effort".

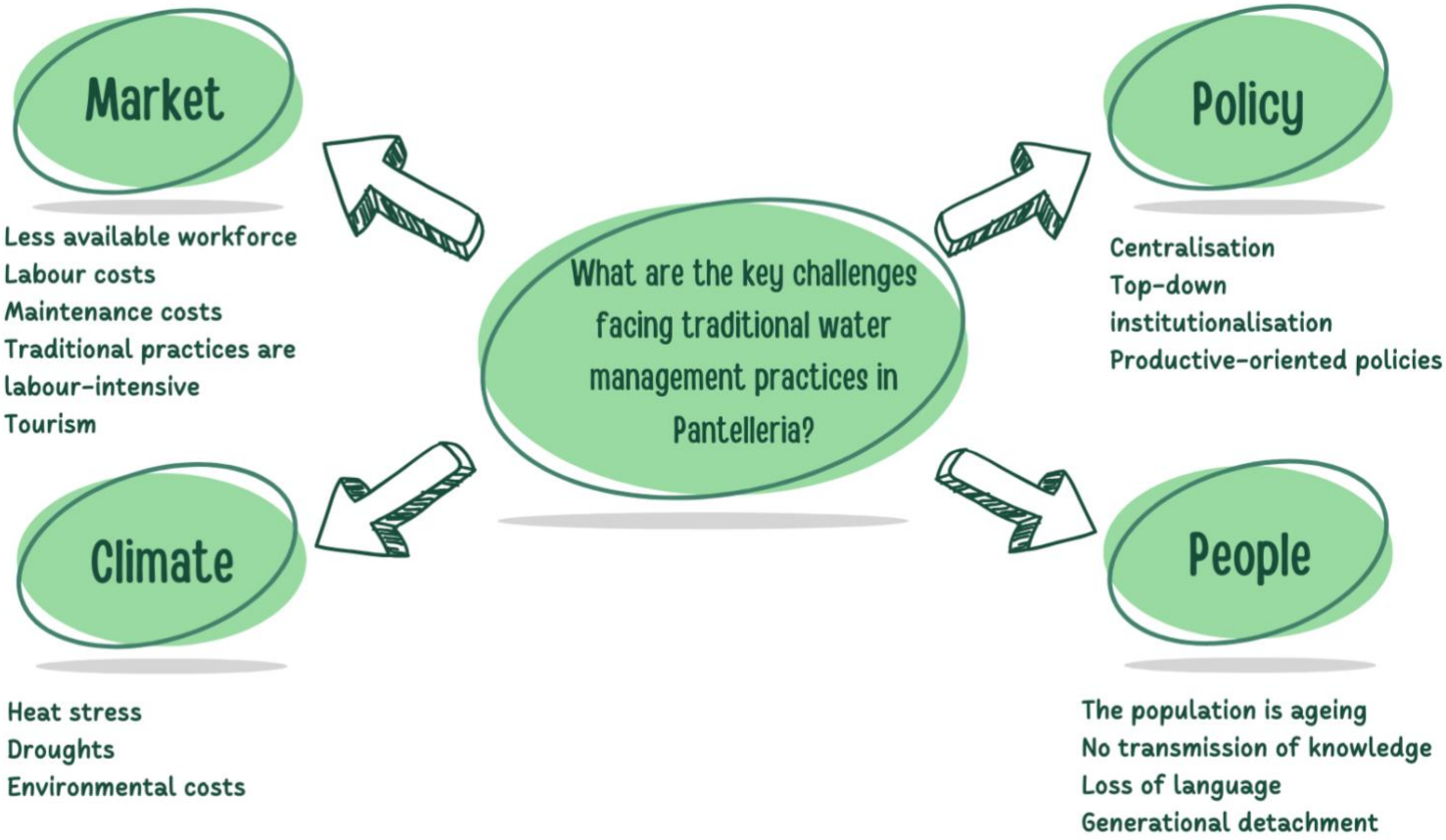

Figure 49: Key challenges of traditional water management. *Graph summarizing key challenges identified by respondents and literature. This results in land abandonment and the abandonment of traditional practices (Graph by the author)*

5.1 Define

Define: What are the key challenges facing traditional water management practices in Pantelleria?

In both the interviewees and the literature's descriptions, the problems are evident (see *Discussion Fig. 49*): the market is changing, and globalization has led to a series of changes that people on Pantelleria cannot cope with. Subsistence farming is being replaced by market-oriented farming, or at least by intertwining two farming activities, one of self-consumption and another of production. The younger generations are leaving the land, and as the population ages, many are passing away, taking traditionalknowledge with them. Rather than preventing and reversing this loss, the institutions appear indifferent; tourism is not a policy but is, as I have reported (see *Results 4.5*), paid for out of the pocket of the islanders themselves. As a result, there is no systemic view of the environment, such as the environmental functions performed by farmers and citizens. School outreach and awareness activities have been conducted, but those who lead them are not enthusiastic about them. Because, as the interviews indicated several times (see *Results 4.3 and 4.5*), they are fragmented, occasional, and often do not involve local participants as lecturers (Int. 13).

In this regard, it is important to examine the opportunities and capacities available to Pantelleria society in order to resist these driving forces. Traditions, it should be noted, still exist. As a result of their conscious work of the land, the people of Pantelleria, not just the older generations, are aware of what has been done before related to water management. Viewing these driving forces through the lens of appreciative inquiry and integrated water resources management (IWRM), I conclude that these forces are multifaceted. Water resources are an integral part of the ecosystem, and this is what respondents themselves recognize, regardless of where they live. "Water on Pantelleria is sacred" (Int. 13), "water is a precious commodity" (Int. 14), and "everything revolves around water on Pantelleria" (Int. 4).

Moreover, the key elements of IWRM are the same problematic elements that the interviewees identify. Create an enabling environment by establishing a supportive political, legal, and institutional framework (Global Water Partnership 2020 and 2010). "Many of these practices are incompatible with legislation" (Int. 4), as described in *Literature Review 2.7.5*. With the protection of the Park and the others territory plans, many interventions on the land, even those historically carried out, cannot be done anymore. In the most protected areas of the park, this man-environment interaction is therefore hindered (see *Literature Review 2.7.5*). "No, the products here are not in the supermarket, ask around" (Int. 58), "we do things this way [informally] because otherwise it costs too much [...] they excluded us" (Int. 59), "do you know how much it costs us? [...] but now we are in order, they

should check the others" (Int. 69). Involve all stakeholders and establish institutions to ensure effective water governance is a sensitive subject since some organizations from outside claim that "there is no planning capacity on Pantelleria" (Int. 41), "there is a lack of will to do" (Int. 21). Nevertheless, on the other hand, there are the people themselves: "I give lessons to the children [...] I tell them about the bees, maybe someone will want to take care of them" (Int. 48), "I have collaborated with the primary school, I don't like teaching very much, but they say I'm good, so I go" (Int. 25). Therefore, within the IWRM factors, management tools are also needed, both to facilitate participation and to enable informed decision-making. Lastly, funding is necessary to support IWRM initiatives in each area, ensure investments and financial mechanisms (UNEP 2024), and boost social engagement. "The costs are all on us [...] why do I have to build a wall like this? At this point, I do it the easiest way for me" (Int. 50). Here, the funding should be viewed in a broader context as a means to provide ecosystem services through cultural heritage infrastructures in the territory. Providing ecological compensation by improving the island's intangible and tangible assets (Zhang et al. 2013).

Changes occur, and they adapt. It is not easy, but times change, so if they are not making the deep hollow as they once did, it does not mean they have stopped making it altogether. People from Pantelleria are familiar with what their grandparents and parents used to do, in some way, in their way, every generation that grows in the countryside knows how to cultivate their own vegetable gardens, "it will be my granddaughter who will carry on the household [...], for now, she likes to come to the fields with me" (Int. 61). That is no small accomplishment. Regarding tourism, with the exception of some speculation, is based on the island's existing infrastructure. To put it another way, tourists sleep and stay in the *dammus*i. In some areas, some hotels clash with the landscape, but these are few and far between and have now been abandoned (Int. 26 and 32). Despite everything, the tourist has had to adapt to what is there, and Pantelleria has not succumbed to the pressure, yet which would significantly increase pressure on water resources. The only exception is the swimming pools.

Despite the absence of labor, not everyone has taken to using herbicides; some have chosen to prune differently, to enhance the ability of the plants to resist the heat (Int. 25). Although the situation is complex, some are willing and looking for solutions. There is knowledge available. As mentioned in the paragraph before (see *Discussion 5.1*), an interesting fact is that those who organize school programs for the transmission of traditional knowledge are not enthusiastic, but in talking to farmers who are more sensitive to the subject, I have found several people willing to speak with schools; there is no closed-mindedness, but rather an openness to sharing and transmit information, not just to schools but to everyone else as well, like me, which includes tourists as well. These are good

foundations upon which to build from the perspective of protecting the island's traditional knowledge. Learning how to utilize it in a manner that complements current climate change adaptation strategies is then a matter of organization and allocating funds.

5.2 Discover and dream

Discovery: What do we know about how people responded to water management challenges in the past? What are some of the most successful traditional water management practices on the island? How effective were they? Are they still being used and are they still as effective?

According to the interviews, the message is clear. There is still a system of traditional practices; they are evolving and can be seen in the landscape in the form of dry-stone walls, *dammusi*, and cisterns that must be maintained. These are important elements that the people of Pantelleria protect and identify with. The situation is different for practices that need to be repeated over time, this situation offers alternatives: "I'm experimenting with new species to see which one grows better" (Int. 59), "see up there? There is an important bee nest [...] that's why I put plants with flowers in these colors, so they come and pollinate me instead of them [indicating a field without flowers]" (Int. 48), "any fruit acquires another flavor here" (Int. 57). And some experiments, "we do organic culture [...] but we don't own a big farmland so it's easier" (Int. 60), or there are those who, for example, have come up with the idea, for years, of making wine in amphorae "the wine makes itself, you just have to accompany it and bottle it when it's ready" (Int. 54). Some people work hard and a lot, but the deep hollow as much as before, for instance, is a difficult process to reintroduce, "is too tiring, with modernity it makes more sense to experiment mulching around the trunk or over the potatoes [which helps retain moisture]" (Int. 25; Fig. 50).

Figure 50: Example of mulching. *Called the stone hollow experiment by those who made it (Photo courtesy of G. B. 2024)*

While many suggest a weakening of the transmission, between generations, I have personally encountered young people who take care of the land. And when asked why, they answer clumsily, "that's how I felt" (Int. 28), "I wanted to go back to my island" (Int. 68), or "I grew up in the fields, my grandfather taught me everything" (Int. 48). They are there, although there are not many for a large market, they are present, and they are learning the importance of preserving this traditional knowledge. However, it cannot be expected that they will restore the same traditional context as in the past as Bevilacqua (1997) stated, "certainly not the futile effort to return to the past, but the constant aim of reconstructing new balances on the basis of conscious projects […] It is the design of collective interests that is the political countermeasure to the technical" (27).

Nevertheless, in Pantelleria, I observed that the power of the modern state and the "force of industrial capitalism have resulted in a radical transformation of the landscape" (Boccaletti 2022, 15). In fact, their success has been so complete that the relationship between society and water has become invisible, hidden beneath the fabric of modern life (Boccaletti 2022). However, the residents do their best to preserve it as a living heritage. There is a sense of strength on the island that can be felt. The younger generation does not question the fact that there were no taps before, or that a *buvira* is a device, they are aware of these facts. Moreover, as some of them, "since I discovered I like walking, I am slowly rediscovering my island" (Int. 50), they will be curious about their island, as will the other students. Pantelleria does not lack problems for sure; many parents send their children from high school to other cities, far from home, and few manage to return because they have no clear alternative on the island. And for those who remain, the detachment from the land comes from the same school context since "most teachers are not from here" (Int. 14), "they come from outside [the teachers] [...] they know little about here" (Int. 48). Nevertheless, the system of traditional techniques on the island remains effective, it is changing, it is adapting. "Pantelleria people are stubborn" (Int. 11), and it is like this because everyone has something to say about traditions, water, resource management, "I have built my well" (Int. 34), "you should go and see how he still ploughs with horses" (Int. 25), "I am experimenting with our ancestors' lentil in the soil, the process is interesting, come and see me whenever you want" (Int. 40). On Pantelleria one still has the privilege of learning and intervening through the support of change, "innovation and tradition should be blended together with care" (Int. 74). The term "innovation" means successful practices that have found ways to support time-proven water-conserving infrastructure and related social and knowledge-systems with the active engagement of local people, such as the ecological restoration of the Kapiriggama Cascade Tank System in Sri Lanka (Herath 2020; IUCN 2015a and 2015b). As regards Pantelleria, the Municipality and the National Park must be used as an instrument adapted to the needs of the residents

that provides collective environmental services. In order for the legacy of this knowledge to continue to provide these services, they must become supportive entities rather than barriers.

Dream: What can we learn from traditional water management today and for the future?

My conclusion from this case of Pantelleria and the literature on traditional water management (see *Literature Review*) is that interventions should be balanced with the broader context of the environment. It is essential to adapt to the land and to the surroundings, where in a context of scarcity, contextual knowledge crucial for sustainable land and water management was developed in compliance with planetary boundaries (Richardson et al. 2023). Using local and traditional knowledge is essential for understanding climate processes and impacts, adapting to climate change, and developing sustainable land management strategies (IPCC 2019). Because of its active presence, Pantelleria is an ideal place for the study of traditional knowledge. It is known, talked about, and shared by the locals, and it can serve as a point of engagement even with external visitors. It is crucial to protect the anthropized landscape of Pantelleria in this context, as "the species at risk today are enhanced by the agriculture done in this [traditional non-invasive] way, [...] so this type of agriculture must be protected" (Int. 7). According to previous mentioned source (see *Literature Review 2.7*), Pantelleria has a rich biodiversity, which "is linked to man, and to a certain type of agriculture [...] if they use herbicide [does] not [provide the same results]" (Int. 7). With its traditional knowledge practices, Pantelleria's man-made landscape has been able to manage the water resources and enhance ecosystem services in connection with this land management practice for millennia. As a result of irrigation systems being seen as integral components of local culture and society, development experts must understand complex socio-technical systems before making suggestions for improvement (Groenfeldt 2019).

5.3 Design and deploy

Design: How can strategies and plans be developed to achieve desired results? What would be needed to benefit from traditional water management practices today?

I think it is a question of finding strategies to create space for dialogue, but in a context that is not imposed from outside, which is a concern very often mentioned in interviews: "the *panteschi* do not want to do ...," "the *panteschi* do not have ...". The system of the people of Pantelleria is various and contradictory and determines its own course of action. Among the town's residents are lifelong residents, tourists who have relocated permanently, returning artists, historians, professors, and so on. In my sample of 79 individuals, the personalities and professions are among the most diverse. If

organized, this is an excellent basis to build upon awareness; while it lacks the ability to network, the nodes for the network are still present. It is a matter of developing leverage points for possible intervention (Meadows 2009). Giving space to those who bear knowledge related to and who support ecosystem processes and services serves to redesign strategies.

Process facilitation requires the development of relationships rather than a top-down approach. The Pantelleria community does not lack openness and inclusiveness. For example, a Sicilian academic in forestry who, even though he is not a native of the island, is welcomed by the Park, the Municipality and non-privileged stakeholders. This person's effectiveness is because he listens, does not impose his knowledge, looks at the processes of the territory and its richness, learns, and shares his reflections. That is why the majority of the *panteschi* respects him. "I was talking to him just the other day, we were discussing how to prune this tree [...] he gave me some interesting advice" (Int. 25), but also, "of course I know him, we asked him to work with us on the project in the schools [...] he is very reliable and competent" (Int. 11). And so on. There is no problem with saying what one thinks about each other on Pantelleria, especially to those who are not from the island, which indicates openness for those with a genuine interest in the island.

It is necessary to learn from local and non-expert the traditional processes such as pruning or building *dammusi* or dry-stone walls following the fuzzy logic (Berkes 2008) of these non-standardized approaches in order to develop strategies, which involves a commitment toward a balance between different ways of knowing, readiness to accept broader epistemology that also integrates traditional knowledge and ways of observing and knowing (Tengö et al. 2017). In addition to including, listening to, and giving space to the bearers of Pantelleria's traditional knowledge in agricultural, environmental, and cultural planning, preserving these traditions also requires providing istitutional support to those custodians of the underlying ecosystem services.

Water management requires a holistic approach that integrates traditional knowledge with contemporary strategies, fosters community participation, and aligns with broader development goals. Based on these assumptions of dialogue, it is possible, among other things, to develop new water-saving facilities. There are plenty of ideas, "I'd like to build *warka towers* [from Ethiopia] that harvest water from the sky, providing an alternative [water] supply" (Int. 74) or "we experimented some fog catchers like in Chile [in Pantelleria], but we didn't go any further [with the study]" (Int. 7). These ideas are not based on new or unknown mechanisms but are intertwined with the capacity of the area that is already available, "my grandfather used to put a net vertically between two pipes where he would condense water and collect more [water]" (Int. 62). If these ideas are outlined in

detail, they will not necessarily occur in reality. For instance, it would be more beneficial to develop participatory moments to discuss the most effective methods and strategies for maintaining existing facilities or whether it would be more beneficial for the community to build new traditional water-saving facilities. It is only through collective dialogue meetings between different stakeholders that it is possible to determine what conditions and factors would make such a project feasible.

Magnaghi (2001) suggests that this implementation results from a bottom-up development effort to restore a sense of "place awareness" among residents, an essential element in nurturing community conviviality and preserving local and regional heritage in a sustainable manner. Initiatives promoting traditional water management at a grassroots level and the community level need space to empower themselves, develop self-sufficient economies, and manage their resources sustainably. This space requires collaboration across sectors and actors to be protected from current economic market priorities. This collaboration will require a systemic approach that involves reintegrating traditional knowledge and water management within the broader fabric of relationships**.** As Margiotta (2015) suggests, "the fundamental epistemological problem is not to find a moment of unification or pacifying synthesis, but to understand how different points of view are mutually produced" (16). This understanding can lead to a space and time of cooperation that regenerates the centrality and value of interdisciplinary analysis (Margiotta 2015). In this reciprocation, scientific**,** ethical, political, and environmental tasks converge in one direction: to bring them into dialogue (Giunta 2020; Margiotta 2015).

Deploy: What measures can be taken to ensure that the strategies and plans developed in the Design phase are implemented and sustained? What else would be needed, in addition to traditional water management?

Both this question and the previous one are interconnected. Pantelleria's traditional landscape is typified by processes and logic that move between the search for autonomy, self-determination and the need for interdisciplinarity to ensure its protection and preservation. There is no need for a formalized systematization of traditional knowledge. It is already a system defined as knowledge connected to other knowledge, cross-connected, and intertwined with it. What I mean here, and as I already mentioned in *Literature Review 2.4.1*, is that Pantelleria's traditional knowledge should be systematically and seamlessly integrated into the structure and practices of the island's resource management institutions in the interest of conservation and climate change adaptation as a key purpose. Given the cross-cutting and systemic nature of the problem, it calls for systemic solutions that transcend artificial disciplinary and administrative boundaries (Tengö et al.

2017). This question has already been raised in many contexts, typically in the developing world and global assessments, primarily IPBES (Paracchini et al. 2018; Löfmarck and Lidskog 2017; Tengö et al. 2017).

Achieving such collaboration, as Tengö et al. (2017) point out, requires moving from studies "into" or "about" indigenous and local knowledge systems to equitable engagement with and among these knowledge systems to support mutual investigations into our western, shared environmental challenges. Bridging knowledge systems can be constructive and innovative in place-based problem-solving contexts. This work on Pantelleria also shows that attention needs to be directed towards the engagement of knowledge holders and institutions and that such engagement requires substantial investments of both time and funds for logistics, interpreters, preparation and participation (Tengö et al. 2017). This engagement implies an approach that implies "the preservation of cultural aspects and agricultural restoration of abandoned parts" (Int. 7), and "this is a general problem of those who manage the protected areas" (Int. 7). In the presented case study of Pantelleria, the environmental governance should be more guided by the Park, "the park has a big responsibility to safeguard the landscape, it should have more influence on the social and agricultural dynamics [...] and more synergy with the municipality, which is hardly happening" (Int. 7). A possible approach for the Park could be to follow more the UNESCO's Man and the Biosphere Programme (MAB) principles regarding the biosphere reserve system, which includes not only protected areas, but also active land management, in line with cultural and biodiversity conservation priorities (Karez et al. 2015).

Hybridization of traditional and modern technologies is another aspect of integrating different approaches. There may be opportunities for combining aspects of water-related precision farming, including digital technologies, with traditional knowledge of Pantelleria. There is a particular argument here regarding integration since precision farming today uses computerized methods that perform the same task already occurring on Pantelleria. Farmers on Pantelleria know how to maximize the little water available through pruning, species selection, land preparation before planting, when, how, and if to water, and the use of dry-stone walls. A combination is required here, not so much in terms of adopting new technologies by Pantelleria farmers, but rather integrating traditional farming practices into these new technologies. With this understanding, this combination may be a viable alternative.

I am aware that there is a lack of budgets in Italy and other places for this type of regulatory and governmental intervention. However, what I am concerned with is that what is needed is a paradigm

shift, in addition to the concrete implementation of enabling strategies between knowledge, which is desirable. Like the aim of IPBES, I wish that the Pantelleria legal framework, but not just there, develop a third dimension of knowledge, which combines economic and scientific priorities with local priorities by presenting interdisciplinary collective projects that preserve and support the living heritage of the island, tangible and intangible, from people to ecosystem and other services.

This integrated regenerative approach between different knowledge should also be learned by us researchers, but more importantly, it should be incorporated into our political-environmental reflections (and subsequent actions!). The concept of the boundary between sectors should be interpreted and used not as a rigid barrier that delimits and separates but rather as an area of opportunities and collaboration, which can be used to build and share knowledge between different knowledge that, from different points of view, observe, reflect, and design around common inquiries (Tengö et al. 2017; Capra and Luisi 2014). My case study involves the adaptation to climate change from the perspective of environmental protection rather than exploitation. Pantelleria's traditional water management system teaches that spatial planning at the local level should incorporate this principle of traditional knowledge in balance with the environmental context, supporting communities and ecosystem services.

I raise the prospect of developing in Pantelleria an interwind solution utilizing Payments for Ecosystem Services (PES) and Ecosystem-Based Adaptation (EBA) principles (see *Literature Review 2.4.2*), which recognizes the island's unique living heritage and the vitality of its traditional practices in maintaining ecosystem services that are essential for effective adaptation strategies. All the interviewees raised the issue of the constraints linked to the protection and management of Pantelleria's land as a cost borne by the bearers and guardians of these traditions, "I find myself having to change methods" (Int. 24), "with these new constraints, I think I will retire [...] I am going to live with my daughter" (Int. 56). It is already an aspect of European environmental policy to pay farmers for the ecosystem services they provide. EU's Payments for Ecosystem Services (PES) scheme provides financial incentives to encourage actors, including farmers, to avoid harming the environment, but, as a critical point, PES schemes require evidence of delivering specific services, not just in general being useful (Russillo and Pintér 2009). On the contrary, I'm advocating paying for practices that may not be economically profitable in the short term but provide long-term socio-ecological benefits, known as positive externalities, specifically related to water conservation or more efficient water use.

In the context of climate change adaptation, EBA and PES utilize biodiversity and ecosystem services as part of an overall adaptation strategy to assist people in coping with the adverse effects of climate change. The approach aligns with the EU's broader environmental and agricultural policies, aiming to preserve ecological biodiversity and ensure farming communities' economic viability (European Commission 2021). I talk about regenerative practices of non-exploitation of water, aridoculture being one example: working the soil as it is to grow vines or olive trees in a way that does not require water for irrigation but preserves the island's biodiversity and the health of inhabitants and workers without pesticides. In Pantelleria practices such as water channels, the *kannalláte*, which work on hidden waters, allow people to use water without the need for plastic suits and dispersing as much as is needed for the biodiversity surrounding the systems. Above all, this organization makes the *dammuso* an example of admired and studied organic architecture. Thus, the dry-stone walls are recognized as a UNESCO heritage for their features that make the landscape unique, help the plants grow, and allow the caper market to exist without using pesticides or water or other external resources, preserving healthy soil. Moreover, regenerative practices can refer to using seawater for cottage cheese, *ricotta*, instead of other chemicals, "we go to the sea with a barrel, come back and make cottage cheese" (Int. 59).

Developing adaptation strategies to protect traditional water management also involves saving money, and who better than the people of Pantelleria to save water and reuse it! "Before, when the washing machines were different, I used to empty it and reuse the water for the house" (Int. 67), "now there are taps and closed pipes, all [the water is] lost" (Int. 71), "before, we used to put our dirty work-shoes under the sink so they would wash a little" (Int. 57). Everyone has their method of saving and recycling water. These are all free services that the farmer, the artisan, the cheese maker, or the simple inhabitant of a house provides to the community. They are ecosystems, in fact, services that society is enriched by. Supporting those who live on these traditional methods is difficult because they are challenging to identify. But, to overcome this lack of economic embedded in the value of Pantelleria's traditional knowledge service, we should leverage participatory planning. It implies the association and union of as many points of view as possible, bridging towards the third knowledge promoted by IPBES to identify the best possible solution in terms of plans, projects or strategies. It is, therefore, essential to bring together actors representing different skills, knowledge bases, experiences and backgrounds. This inclusion and responsibility from institutions and actors is the addition to traditional water management needed in Pantelleria to preserve its traditional living heritage.

The fact that funds are unavailable to support such an initiative is unsatisfactory (European Commission 2021). These policies must be considered investments, not economic strategies like the

EU Emissions Trading system. Investing in the land and those who carry knowledge and techniques for protecting the land is not trading pollution allowances more or less; it is about investing in the environment, the people who hold it, and our future. However, it is not enough to make PES systems work for traditional knowledge; we need the people from Pantelleria to develop the tools tailored for them. In short, who pays, how much, and for what are important considerations. Investing directly in the environment and in the people with traditional knowledge and skills to protect it is necessary. This initiative's success depends on tailoring tools and approaches to local contexts, such as in Pantelleria. It is possible to obtain funding from various sources, each with its implications and benefits. Such initiatives may be funded by public money, which is taxpayer-funded, market-based mechanisms, or a combination of both. It is also possible that the insurance sector could contribute, particularly in scenarios where risk reduction can be quantified and demonstrated (Marshall 2020). However, these financial mechanisms cannot be implemented without political intention.

“I am not interested in politics” (Int. 26), “in these groups there is always someone who speaks for others” (Int. 49), “there is no participation” (Int. 63), are the most common problems, which confirm the demand for participatory processes. For example, the *Visual toolbox for system innovation* discussed in *Literarure Review 2.6* provides a framework for mapping, analyzing, and facilitating systemic change, particularly in the context of sustainability innovations (De Vicente Lopez and Matti 2016). This toolbox, integrated with Walker et al.’s perspective (2004) on resilience, adaptability, and transformability, could help the communities of Pantelleria navigate the complexities of socio-ecological transitions, drawing on a rich heritage of ecological understanding and sustainable practices.

Recognizing the need to create participatory spaces with adequate political legitimacy can only begin with the collaboration of the different levels, sectors, and actors of governance. This requires a process of horizontal participation, which can be challenging to organize and sustain over long periods of time. But in the unique context of a living heritage like Pantelleria, there is only the need to start: “We are children of our time [...] there is a cultural knowledge of dealing with a scarce resource but still you have the tanker that brings [the water] it [directly to your home]” (Int. 44). Or as the responded n. 4 said to me “they are *losing* it [traditional knowledge], but it is not lost yet”. In this context, the political and non-political actors are favored because they can experiment with privileged witnesses who are still aware of their traditional knowledge.

5.4 Traditional water management, processes, ecosystem functionality and ecosystem services

How can traditional water management systems contribute to the adaptation of territories to climate change from a socio-ecological perspective?

Based on my research and supported by literature (see e.g., Deguillame 2022; De Pasquale 2020; Laureano 2001), traditional water management systems have evolved into an integration of ecosystems-oriented approaches, and as a result, contributed to the adaptation of territories to climate change through a socio-ecological perspective. "You must understand natural systems [...], that is why I organize collective walks […] to understand nature, you have to be outdoors; as Van Matre says, have you read it? [reference to the book *Earth Education*, 1990]" (Int. 25). "I am a farmer, but first there is the Earth, Mother Nature, if I respect her, she gives me her fruits, otherwise not [...] but it is up to me to understand her, like with women [...] it is a long and careful courtship" (Int. 57).

The community that carried this forward has adapted, diversified, and changed its practices in response to changing circumstances, variability, and current problems. However, as discussed in *Literature Review 2.7*, despite the evolutions of land and water-use-related knowledge over time and the evolution of the landscape that can be observed, the people of Pantelleria have remained and continue to strive to remain in balance with the environment. This is the teaching of traditional knowledge, and the approach one learns from Pantelleria when considering the logic behind traditional knowledge: how to develop strategies for climate coping and adaptation, which I summarize as adaptation done with ecosystem services. Precisely because they adapted some of their knowledge and practices that were relevant to changing circumstances. I argue for ecosystem-based adaptation (EBA), as in the *Literature Review 2.4.2*. Pantelleria can be seen as an example of integrating biodiversity and ecosystem services into an overall strategy to help people adapt to the adverse impacts of climate change (Colls et al. 2009). In order to develop effective strategies, we have to understand the processes behind ecosystem services, which requires knowledge of the functions of ecosystems and maintaining ecosystem functionality provides a tool for coping with climate change.

This EBA process would include the sustainable management, conservation and restoration of ecosystems to provide services that help people adapt to current climate variability and climate change (Colls et al. 2009). This approach opens an opportunity for interfacing with traditional and local knowledge as it implies scientific knowledge and evidence, such as monitoring, modelling, and interpretation. Managing this interface is not easy and requires commitment, resources, genuine

engagement, and long-term commitment, especially when policy implications are also at stake (Hernández-Morcillo et al. 2014). Therefore, the Park, as an independent body that is not elected by the citizens, could take this responsibility. As the Park is a national entity, the director can change along with the changing of government, but the other employees are appointed by public call, so taking on this commitment as a continuous entity would be easier than taking on this obligation with a municipality that is more subject to the current political context, "the Park has a big responsibility to safeguard the landscape, it should have more influence on the social and agricultural dynamics [...] more synergy with the municipality, which is hardly happening" (Int. 7).

When we do not support the ecosystems, both due to climate change and human intervention and overexploitation, a loss of biodiversity occurs, resulting in a reduction in ecosystem functionality. In this way, we are losing the ecosystem services we are used to, thereby losing a series of cycles we rely upon to survive (Richardson et al. 2023). As mentioned at the beginning (see *Introduction 1.2* and *Literarure Review 2.3*), desertification, for instance, is characterized by a spiral of decreasing vegetation, soil degradation, and biological depletion, which is continuously amplified by their interplay, resulting in an ever-increasing spiral of desertification and degradation of soil, water, and vegetation (UNCCD 2022; Corona et al. 2005; Millennium Ecosystem Assessment, 2005a; Laureano 2001)

When water and land resources are exploited and the equilibrium of ecosystems becomes unbalanced, the interplay with human resource use can be harmful, but when supported, as in the case of Pantelleria, it can be generative. For example, the dry-stone wall is not only useful for demarking property or accumulating dew but also a result of removing rocks from farmland in order to create terracing, reducing erosion of the soil and protecting plants from the wind. This integrated system protects serves as a means of storing water for the vines and plants that are kept with a very low-level profile, increasing their quality. Water again and again, "everything revolves around water in Pantelleria" (Int. 4), so they utilized the rocks for the territory to develop land to cultivate, as well as developing houses with vault roofs, different terraces, and big cisterns with appropriate channels of water that take advantage of the dry-stone walls' capacity of collecting more water to ensure they had ample water for the year. So again, there is little water resource, and by using resources with the site's physical characteristics in mind, they are able to address scarcity in a regenerative way.

In summary, traditional knowledge, which has been implemented and preserved throughout history, has become a vital part of the ability to survive on a landscape characterized by general water scarcity and periodic extreme drought. Given projected climate change trends, the characteristics and

events are likely to increase in frequency and severity. This indicates the continuing and perhaps even increasing importance of the traditional knowledge and practices discussed in this thesis, possibly in combination with other ecosystem-based and technical adaptation measures. As long as the community interventions remain balanced with the environmental context, this system will succeed. As a result of adaptations made with ecosystem services (EBA), a land use policy that preserves this functionality is also accomplished. In Pantelleria and many other places (see e.g., La Mantia 2023; Pintér 2023; Herath 2020; McElwee et al. 2020; Bourne 2016; Berkes 2008; Wall Kimmerer 2002; Laureano 2001), ecosystem functionality is a concern for communities, which is why it has been implemented and preserved over the centuries. Throughout history, several layers of knowledge have been transformed into scientific knowledge (Tusa 2017; Magnaghi 2001; Gramsci 1975) or have been recognized as such and are still used and studied. The conclusion is that traditional knowledge is innovative, and if given due recognition, it would be an invaluable tool in developing climate change adaptation strategies. "This is our system [*looking at the farmland*] there is limited water, yes, but this land gives it to you, even if it is little [water], but it gives you greater quality and fruit [...] water has never been lacking on Pantelleria, you just have to stop, look at your surroundings, and embrace this [water] resource" (Int. 57).

5.5 Pathways for adaptation

Using the appreciative inquiry method, it is possible to discern Pantelleria's socio-ecosystems' interconnectedness and holistic nature. As a result of the interviewees' responses, it is evident that continuous engagement, investment, and adaptation are required in order to manage communities, biodiversity, and the environment sustainably. In the previous sections, the findings emphasize the importance of viewing socio-ecosystems as complex, dynamic entities within which each layer and actor contributes to the system's overall resilience. It is crucial to maintain a balance between human needs and ecological integrity when it comes to socio-ecological management (Bourne 2016). These findings should be further implemented within additional field studies to confirm their practical validity within the methodological framework established in this study.

Pantelleria's inhabitants demonstrate a profound understanding of ecosystem functions and develop strategies that respect the environmental and cultural context. The *kannalláte* systems, for example, the downspouts that transport water to the cisterns, demonstrate effective integration with ecosystem services (see *Results 4.2*). This traditional approach from the community emphasizes the conservation of scarce resources, such as water, which results in sustainable infrastructures, like the dry-stone walls system.

In conclusion, integrating traditional knowledge and modern scientific insights leads to ecologically sound and culturally appropriate practices. Diverse ecosystems and communities provide multiple adaptation pathways, which enhance ecosystem and community resilience. Financial and institutional support enables communities to manage resources according to their values, thereby fostering ownership and long-term stewardship of the resources.

6. Conclusions and Recommendations

Taking traditional knowledge into account implies adopting a systemic perspective, which entails, in essence, examining each phenomenon in terms of relationships, configurations, and contexts (Giunta 2020). In contemporary sustainability science (Kates 2001), the universe is no longer viewed as a machine made up of many basic components. As a whole, the material world is comprised of a network of intricate connections and the planet is a self-regulating system (Lovelock 1979). The understanding of evolution has moved from a competitive struggle for existence to one of a common dance in which creativity and the continuous emergence of novelty are the driving forces (Mancuso 2024 and 2019; Capra and Luisi 2014; Laureano 2001 and 1995; Margulis 1995). Moreover, with the new emphasis on complexity, networks, and organizational patterns, the importance of quality over quantity is slowly becoming evident (Capra and Handerson 2009), confirming the value of traditional knowledge in assessing processes. This thesis seeks to understand what Alexander the Great (Principe 2013) read in Emerald Table about water: *It slowly ascends from the earth to the heavens and descends back to the earth, gathering in itself the power of higher and lower things*. The quote refers to the cycle of water. It is clear from the interview and makes it easy to see the Pantelleria landscape. Processes, cycles, and balance are taught, not in the sense of material appropriation but rather in the sense of respect for context and ecosystem functions.

6.1 Traditional knowledge and ecosystem-based adaptation for sustainable water management

The focal point of this conclusion chapter is not only the water cycle, a cornerstone in mainstream hydrology (see e.g., Oki et al. 2004; Falkenmark 1997), but also the interpretation of this cycle through the logic and tools of traditional knowledge. Like EBA, traditional practices use ecosystems in a way that surpasses the effectiveness of physical engineering structures, such as dikes or concrete walls. For instance, in Pantelleria, the use of modern engineering solutions like concrete walls would lead to the degradation of the ecosystem and cultural heritage and identity. Traditional practices optimize water conservation and water use efficiency throughout the entire water cycle, employing time-tested, simple, locally developed and controlled methods and a comprehensive understanding of how water functions in an ecosystem, or more specifically, in the agroecosystem.

The key findings of this study, reflected in the interview responses, point to the value of viewing socio-ecosystems as interconnected wholes with multiple layers of function and meaning, emphasizing sustainability, biodiversity, and community-based management (see *Discussion*

5.5). Believing in the inseparable relationship between humans and nature in the world is the key to going beyond technical solutions. It means overcoming misguided earlier attempts to manage and appropriate nature for the sole purpose of meeting unsustainable human needs, such as climate change.

Involving local communities in the design and implementation of PES schemes would be crucial to ensure that the schemes are culturally appropriate and effectively address local environmental challenges. Recognizing and integrating traditional natural resources into EBA strategies, documenting traditional ecosystem management practices and knowledge, and using this information to inform conservation efforts would require integrated institutional and non-institutional collective work, valuing all the realities and cultural gatherings in Pantelleria, where this awareness-raising work already exists but has not been given political and implementation space.

Integrating traditional and local knowledge into ecosystem-based adaptation strategies offers a holistic approach to addressing climate change. By taking into account the context, processes, and functionality of ecosystems and fostering inclusive, dialogic, and adaptive management practices, we can develop robust, culturally appropriate, and ecologically sustainable solutions. This approach not only supports ecosystem services but also enhances community resilience and well-being, demonstrating the profound interconnectedness of social and ecological systems.

6.2 Recommendations for practice and policy

This thesis is intended to look to the future, in the words of Berkes (2008), "for the benefit of Western thinkers" (270) who are trying to understand traditional knowledge using Western sciences such as complexity theory and fuzzy logic (Berkes 2008). Traditional knowledge holders do not require the theory; they already practice it (Berkes 2008), but that does not necessarily mean they know how their practice could be of value in non-traditional contexts. We are responsible for this process of change. Our responsibility as political scientists, civil society members, employees, and citizens is to support these practices and their understanding and integration into science and policy.

According to Magnaghi (2020), the process of ecological transformation can only be achieved in a society with local awareness and conscious residents. This task cannot be delegated to large techno-economic systems; instead, it involves reorganizing regional communities aware of their collective projects (Magnaghi 2020). Taking care of the environment, therefore, necessitates the development of forms of community awareness and participatory democracy, the reconstruction of collective and traditional knowledge, as well as the appropriate application of technology in accordance with local

communities' self-determination, self-government and resources (Reyes-García 2023; Magnaghi 2020).

In order to ensure the future of tradition, as a fundamental asset in the interest of sustainability and resilience, it is necessary to preserve and maintain the innovative, creative capacity of the present, nor is it necessary to inventory traditional knowledge for the purpose of storing it in a museum of lost knowledge, but rather to spring from it a new life and a renewed drive for progress (La Mantia 2023; Laureano 2001). Understand its logic. Observe that water is a dynamic and holistic cycle that should not be exploited, that traditional knowledge is a process, and that this knowledge is applied in a dynamic manner, resulting in the landscape. Understand that land is a process and that we are surrounded by creative processes that create our world all the time.

This creative process that has come so far should be protected, along with all the earth's natural resources. In the cycle of life, resources are connected, as they are part of the continuous flow of nature (Magnaghi 2020; Berkes 2008; Laureano 2001; Odum 1997; Bateson 1976 and 1984). Water cycles are responsible for the physical and morphological transformations of the earth, the evolution of its life forms and the system of self-regulation that maintains the conditions that allow human presence on earth. Modern technology should learn the mechanism of the life cycle so that a paradigm of coexistence can be established.

As librarians, we are not entirely lost in the library of Babel in which we are immersed. Essentially, it is a question of how we approach different types of knowledge. The concept of a book is not merely a physical object but also a portal to infinity that lies in the contact between the writer's imagination and the reader's interpretation of the book (Borges 1967). Likewise, incorporating traditional knowledge in policy-making advocates for a dialogue between different ways of understanding the world, similar to Borges' description (1967). It is about creating policies that are not only informed by science but are also enriched by the deep-rooted wisdom of traditional practices.

We need to give space, voice, recognition, understanding, sharing, and integration to the traditional knowledge that still lives in populations in seemingly backward areas or in the interstices of advanced society, as well as in places which have been preserved for their cultural value, such as Pantelleria. We can find solutions to climate change through historic settlements, traditional landscapes, and local knowledge. Moreover, those realities represent valuable assets for the implementation of our sustainability models due to their local knowledge and intact ancient structures that have survived even the harshest environmental conditions. In order to develop a quality science based on knowledge

learned from ecosystem functions, we need to become aware of our surroundings, learn from them, and repurpose them as needed. Traditional knowledge holders do not oppose modernity; there is no black and white, but there is a third way: "combining the old and the new in ways that maintain and enhance their identity while allowing their society and economy to evolve" (Berkes 2008, 258). This process includes, for example, developing the capacity to increase domestic resources and manage them locally; recognizing and supporting the interplay between technical, aesthetic and ethical values, and, for some, sacred values; changing and ceasing to incentivize and finance production that is not for its own sake, but oriented toward the welfare of the community and to the preservation of the common heritage; the principle of ensuring that each activity feeds the next; and the utilization of energy that is based on regenerative cycles (Laureano 2001 and 1995).

According to Berkes (2008), an alternative solution incorporating this view is adaptive management and adaptive co-management (Olsson and Folke 2004): complexity, systems thinking, and evolutionary approaches represent the alternative post-positivist approaches to environmental management. Adaptive management is an application of this stream in which uncertainty and surprises are integral parts of the anticipated responses (Holling 1978). It is fundamentally an interdisciplinary approach that combines historical, comparative, and experimental approaches. Usually, problems are treated as systems problems in which the behavior of the system is unpredictable and complex, and the causes are often multiple (Reyes-García 2023; De Vicente Lopez and Matti 2016; Berkes 2008; Walker et al. 2004; Folke 2004). By focusing on ecosystem processes rather than ecosystem products, adaptive management involves multi-equilibrium thinking and system integrity considerations.

In Pantelleria it is evident that considering agriculture a simple production system does not work. Increasingly, there are fewer and fewer young people and society as a whole is disintegrating. Pantelleria, as the majority of rural communities (see e.g., La Mantia 2023; Shiva and Cummins 2020; Kravčík 2007), depend on farming and other services to maintain their cultural heritage and livelihood. A new direction must be given to financial investments, moving away from destroying local knowledge and overexploiting rural landscape, towards projects, institutions, technologies, and practices that promote processes and resources in support of climate change adaptation and mitigation.

The first step is to give space to those who utilize resources differently, such as foresters who are aware of how to manage the forest as a whole ecosystem, as a living entity, rather than focusing on wood production, or other experts who take into account the relational context with other subjects

rather than focusing solely on their academic areas. Rather than investing in and promoting land degradation and destructive changes to the landscape, we should promote traditional systems of production, water collection and distribution, and other ecosystem services that help meet real human needs versus unrealistic wants. Organize territorial networks or create space, squares, parks, meeting places and tools to facilitate the population's participation, for example, by re-evaluating the role of the elderly, women, children, and marginalized groups. The purpose of these meetings is to leverage processes in order to facilitate the creative emergence of those who live on the land and to listen to their suggestions. It requires a significant amount of time, effort, and money. It is only necessary to begin experimenting in this direction if we wish to change the situation and not be swept away by climate change as if we did not have the tools and skills to respond. Today's decisions will be tomorrow's traditions.

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Appendices

Detailed information about the interviews conducted between February and April 2024 in Palermo, Pantelleria, and Aprilia.

TOTAL: 79

Number	Profession	Interview day	Extra information

Palermo (10)

1.	Professor Silviculture	Thursday 29/02	
2.	Professor Anthropology	Monday, 26/02	He gave me a book
3.	Professor Petrology	Tuesday, 27/02	He drew a map and gave me some *pantellerite*
4.	Professor Arboriculture	Tuesday, 27/02	
5.	Professor Geobotany and Plant Physiology	Wednesday 28/02	He gave me a book
6.	Professor Geology and Geochemistry	Monday, 26/02 and Wednesday, 28/02	He drew a map
7.	Professor of Forest Ecology	Thursday 26/02 and 5/03 on Pantelleria	
8.	PhD candidate in anthropology	Thursday 29/02	
9.	National Institute of Geophysics and Volcanology (INGV)	Monday 26/02	
10.	PhD candidate in Ethnology	Thursday 29/02	

Pantelleria (64)

Number	Profession	Interview day	Extra information	Origins
11.	Activist, expert in participatory practices, project coordinator in schools in Pantelleria of relationality and local ecological knowledge	Thursday 22/02, Wednesday 6/03 and Thursday 4/04		Pantesca, does not live on the island but would like to return
12.	Lectures on *Panteschità* at the St. Vito Circle	Saturday 2/03	Group meeting, handouts and group questions, group of ~20 people	
13.	Gardener	Saturday 2/03		Not a Pantelleria native but has lived in Pantelleria for more than 30 years
14.	Technique	Saturday 2/03 h21 and Saturday 17/03 h17		Pantesca, period out and then back
15.		Sunday 3/03	Mycological excursion: a group of people with the opportunity to ask individual questions during the walk	
16.	Mushroom expert	Sunday 3/03		Non-pantesco but has lived on Pantelleria for more than 30 years
17.	Videomaker	Sunday 3/03		Pantesca, period done out to study then returned

18.	Seasonal tourist on the island	Sunday 3/03		Not pantesco
19.	Seasonal tourist from northern Italy on the island	Sunday 3/03 d		Not pantesco
20.	Seasonal tourist from northern Italy on the island	Sunday 3/03		Not pantesco
21.	Retired elementary school principal	Sunday 3/03 d		Not from Pantelleria, but on the island for more than 30 years
22.	Middle school teacher	Sunday 3/03		Not pantesco
23.	Husband of the middle school teacher, on sabbatical year	Sunday 3/03		Not pantesco
24.	Farmer	Sunday 3/03		Pantesco
25.	Farmer	Sunday 3/03 and 6/03	Field tour and exploration of techniques, with physical testing	Pantesco
26.	Bartender and worker in island restaurants	Sunday 3/03 and Tuesday 5/03		Not pantesco, but for more than two years in Pantelleria
27.	Law student	Sunday 3/03 and Friday 8/03		Born in Pantelleria but raised in Florence
28.	Winemaker who would like to take over family legacy on the island	Sunday 3/03 and Friday 8/03		Pantesco
29.	Food service worker	Sunday 3/03		Pantesco
30.	Artist	Sunday 3/03		Not pantesco, but moved in with her boyfriend for a couple of years
31.	Artist	Sunday 3/03		Pantesco, period abroad

32.	Food service worker	Sunday 3/03		Pantesco
33.	Cook and handyman	Sunday 3/03		Pantesco
34.	Food service worker	Sunday 3/03		Pantesco
35.	Food service worker	Sunday 3/03		Pantesco
36.	Manages homes	Monday 4/03 and Thursday 7/03		Not from Pantelleria but in Pantelleria for more than 20 years
37.	Farmer	Monday 4/03		Pantesco
38.	Groceries	Monday 4/03		Pantesco
39.	Desalter technician	Monday 4/03		Pantesco
40.	Farmer and rancher	Monday 4/03		Pantesco
41.	Cultural association, activists	Monday 4/03		Not from Pantelleria, but for 10 years on the island
42.	National Park Guide	Tuesday 5/03		Pantelleria, lived on the mainland (Italy) and then returned to Pantelleria a few years ago
43.	VicePresident National Park	Tuesday 5/03		Pantesco
44.	National Park Geologist	Tuesday 5/03		Pantesco
45.	Island historian	Tuesday 5/03		Pantesco
46.		Tuesday 5/03	Meeting between island producer and park agronomist to define strategies for attracting tourists	
47.	Social media manager	Tuesday 5/03		Not a Pantelleria native, works in Pantelleria for the

				park and salutarily returns to Sicily
48.	Beekeeper and farmer	Tuesday 5/03 and 12/03		Pantesco
49.	Farmer	Tuesday 5/03		Pantesco
50.	Seasonal worker	Wednesday 6/03		Pantesco
51.	Intelligence - military base	Thursday 7/03		Not pantesco, in Pantelleria for more than 10 years
52.	Starting a new life	Thursday 7/03		Not pantesco, in Pantelleria looking for a home for 2 years
53.	Landscapers	Thursday 7/03		Not from Pantelleria, but in Pantelleria for more than 30 years
54.	Agronomist and farmer	Thursday 7/03 and Wednesday 13/03		Pantesco
55.	Former expert mason of dammusi	Thursday 7/03		Pantesco
56.	Farmer	Thursday 7/03		Pantesco
57.	Farmer	Friday 8/03		Pantesco
58.	Entrepreneur	Friday 8/03		Pantesco
59.	Cheese maker and farmer, also farmer	Fridays 8/03 and 13/03		Pantesco
60.	Island hiker and guide	Saturday 9/03		Pantesco
61.	Farmer	Saturday 9/03, 12/03 and 13/03		Pantesco
62.	Skilled mason and handyman	Saturday 9/03		Pantesco
63.	Curator of an art gallery	Saturday 9/03		Pantesco
64.	Retired water expert	Saturday 9/03		Pantesco, lived outside then returned
65.	Catering	Saturday 9/03		Pantesca

66.	Nurseryman	Monday 11/03		Not from Pantelleria, but on the island for more than 30 years
67.	Retired lady	Tuesday 12/03		Pantesca
68.	Winemaker and farmer	Tuesday 12/03		Pantesco
69.	Businesswoman	Wednesday 13/03		Not from Pantelleria, but on the island for more than 20 years
70.	Historical of the area	Thursday 14/03		Not from Pantelleria, casual tourist
71.	Anthropologist	Thursday 14/03		Born in Pantelleria, emigrated to Italy and then returned for 10 years to Pantelleria
72.	Large wine distribution house	Friday 15/03		Not from Pantelleria, but more than 20 years in Pantelleria for work
73.	National Institute of Geophysics and Volcanology (INGV)	Saturday 16/03		Non-pantesco
74.	Island artist and activist	Saturday, 16/03		Not from Pantelleria, but from growing up on the island from a young age
75.	Contributing artist and park guide	Saturday, 16/03		Not from Pantelleria, for a couple of years in Pantelleria

Aprilia - community of Pantelleria people in Lazio (4)

Number	Profession	Interview day	Extra information	Origins
76.	Poet and historian	Thursday 4/04	She gave me a book	She was born in Pantelleria, and when she was 13, the family went to Lazio, between Nettuno and Anzio
77.	Farmer	Thursday 4/04		Born in Pantelleria and also emigrated to Lazio
78.	Farmer	Thursday 4/04		Born in the Pantelleria community in Lazio
79.	Farmer	Thursday 4/04		Born in the community in the Lazio

U ZULU'

by Spampinato/Vecchione

A song by the Slipbreackers, a band of Pantelleria from the 1980s, describes youths' feelings at that time. Through the metaphor of the stone cliffs in their room, the song speaks of that sense of visual (and real) horizon that "has limited our existence since childhood" (Int. 58).

TUTTU U JORNO A FIRRIARI N'TUNNU	All day long running around
SENZA SAPIRE MA SOCCU FARE	Without knowing what to do
SUPA I SCOGGHIA O NTA ME STANZA	Above the cliff in my room
JE A SENTO A LUNTANANZA	I already feel the distance
AVIA IRI A AMERICA MA PI ORA JE SUGNU CA	I was supposed to go to America but for now I'm still here
AVIA IRI A AMERICA MA PI ORA JE SUGNU CA	I was supposed to go to America but for now I'm still here
CHI AVA FARE CHIDRRU CA NOIA SAVA SUPPARE	What should one do who has to endure boredom
CHI AVA FARE CHIDDRU CHI VULISSI CANCIARE	What must do the one who wants to change
A TRAVAGGHIARE A QUATTORDICIANNI	Working at age 14
E U TO MUNNU FINISCI DRA	And the whole world ends there
U SAPEMU E NI NI FUTTEMU	And we know, and we don't care
MA U GUAIO E PROPRIU CHISTU CA	But the trouble is just this
MA QUALE AMERICA E AMERICA	But which America and America
JE PI ORA, JE SUGNU CA	Me for now, I'm here
MA QUALE AMERICA E AMERICA	But which America and America
PANTIDDRARIA UN TAVA STARE STRITTA	Pantelleria doesn't have to be tight on you
CHI AVA FARE CHIDRRU CA NOIA SAVA SUPPARE	What should one do who has to endure boredom
CHI AVA FARE CHIDDRU CHI VULISSI CANCIARE	What must do the one who wants to change