Social memory and the resilience of communities affected by land degradation

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This article has been accepted for publication and undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process which may lead to differences between this version and the Version of Record. Please cite this article as doi: 10.1002/ldr.2669

Abstract

Based on evidence collected in 22 village communities from nine study sites situated in Spain, Italy, Greece, Morocco and China, this study analyses the complex interlinkages between social memory, community resilience and land degradation. Social memory is seen as an important explanation regarding the ability of a local community to manage and cope with land degradation. Emphasis is placed on the importance of three components of social memory – rites, traditions and social learning processes – for shaping community resilience in coping with land degradation processes. The study argues that, although there are subtle differences between the 22 village communities, the loss of social memory and learning pathways associated with managing land degradation is emerging as a critical factor constraining stakeholders from effectively responding to land degradation issues.

Keywords: social memory; land degradation; resilience; LEDDRA Project

Introduction

The notion of 'resilience' is rapidly gaining ground as a key issue and process influencing societal development. Indeed, questions of resilience have become a prominent research topic and policy concern, with some even arguing that resilience may be replacing 'sustainability' as the keyword of political and policy-making rhetoric (Wilson, 2012). As a result, the notion of resilience has begun to provide an important conceptual framework to understand how socio-ecological systems adapt to, or cope with, environmental and societal changes and has become a powerful idea increasingly used as a basis for policy-making that transcends both the natural and social sciences (Folke, 2006; Walker & Salt, 2006). The generally accepted definition of resilience is "the capacity of a system to absorb disturbance and reorganize while undergoing change to still retain essentially the same function, structure, identity, and feedbacks. Resilience is measured by the size of the displacement the system can tolerate and yet return to a state where a given function can be maintained" (Forbes et al., 2009: 22041). The complexity of disturbances affecting socio-ecological systems suggests that human communities are never 'stable', but that they are continuously and simultaneously affected by several disturbances at any point in time. Communities can, therefore, never reach

'maximum' resilience levels but can only strive towards maximising resilience (or optimising resilience under uncertainty).

Several studies have highlighted that 'resilience' is a plural discourse and not a discrete concept, and that it is increasingly subject to critical interrogation, especially with regard to the socio-political effects of applying 'resilience-based' approaches (see in particular Adger, 2000, Chaskin, 2008, Davidson, 2010, and Wilson, 2012, for explicitly critical studies of the notion of resilience). Cognisant of these challenges to, and critiques of, resilience theories, the notion of resilience has been identified by many as a compelling and powerful approach for understanding processes of socio-environmental change.

In this study, resilience will be approached from a perspective that places emphasis on understanding the complex interlinkages between resilience and the (usually) slow-onset disturbance of *land degradation*, in which resilience is operationalised as a means for understanding and changing community responses. Land degradation poses enormous challenges about how to tackle environmental and social changes, who should be in charge of key decisions about possibly altering current pathways, and what institutional and policy-related mechanisms should be used to influence decision-making for strengthening resilience processes. Authors such as Reynolds & Stafford-Smith (2002), Briassoulis (2005) and Imeson (2012) have argued that land degradation can be understood as a complex socio-environmental phenomenon that results from the intricate interplay of biophysical and societal forces across various spatial levels. Under adverse biophysical conditions, resource-exploiting human activities that are driven by place- and time-specific combinations of societal forces set in motion processes of degradation of land resources. Land degradation may be reversible but if its drivers are left uncontrolled, land resources further deteriorate leading to the irreversible state of desertification and to further reduction of ecosystem services. Land degradation is, thus, a complex socio-environmental phenomenon resulting from the interactions between biophysical and socio-economic factors operating at different spatial and temporal scales (Detsis, 2010; Imeson, 2012). These coupled socio-ecological systems are characterised by nonlinear relationships exhibited through positive feedback mechanisms that may give rise to drastic transitions to irreversible states of degradation.

Community resilience can be defined as "the existence, development, and engagement of community resources by community members to thrive in an environment characterized by change, uncertainty, unpredictability, and surprise. Members of resilient communities intentionally develop personal and collective capacity that they engage to respond to and influence change, to sustain and renew the community, and to develop new trajectories for the community's future" (Magis, 2010, 402). Folke (2006, 255) argued that resilience research shows the importance of acknowledging how socio-ecological systems *learn to manage by change*, implying that "uncertainty and surprise is part of the game". In this view, social resilience can both be preventative, through adaptive capacity, and can facilitate recovery of a system after a disturbance. Social resilience research, thus, focuses more on 'bottom-up' approaches predicated on understanding human and social drivers of resilience at community level, of which human-environment interactions are only *one of many* components.

Scale is important in social resilience research and the focus of this study will be on how local communities (i.e. villages, small towns) cope with, and respond to, land degradation. Understanding the impact of scale is also particularly important in terms of land degradation, which is driven by multi-scalar and temporally dynamic processes. Since the 1990s, there has been a re-focussing of attention on local community as a critical arena for addressing a range of issues including environmental and societal pathways of change (Chaskin, 2008). It is, therefore, important to understand the local level first, before scaling-up to regional, national and global environmental decision-making levels. In this study, community will be understood as "a social network of interacting individuals, usually concentrated into a defined territory" (Johnston et al., 2000, 101) – i.e. a small local community as the totality of social system interactions, as an affective unit of belonging and identity, a space of human connectedness to a local place of physiological condition, and as a network of relations within a defined geographical space.

Due to the relative novelty of the research field, conceptual discussions about processes and drivers of social resilience at community level are not yet fully developed, especially with regard to how the inbuilt 'memory' of a local community helps shape resilience pathways (Wilson, 2015). Several studies from different disciplinary vantage points have highlighted the importance of *social memory* in understanding community resilience and vulnerability. These include, in particular, Folke et al.'s (2003) seminal study on the importance of social memory in building community resilience and adaptive capacity, Barthel

et al.'s (2010a, 2010b) and Tidball et al.'s (2010) analysis of social memory and learning in disaster resilience, research on complex interlinkages between social memory and post-earthquake recovery (e.g. Wilson, 2013), or Olick & Robbins' (1998) study of local communities as social systems exposed through time and space to manifold endogenous and exogenous drivers affecting resilience. These studies suggest that a community will have specific inherent qualities that will be shaped by the 'memory' contained within the system – a memory linked to individuals (individual life histories) and stakeholder groups (acquired memory; communal memory) that will affect communities' adaptive capacity to disturbances.

Building on studies such as Folke et al. (2003), the novelty of this study, thus, lies in its exploration of the possible interlinkages between social memory, community resilience and land degradation. As a result, specific emphasis will be placed on *social resilience* which focuses on responses of socio-ecological systems to land degradation, and on debates attempting to understand resilience at the local community level where resilience-building pathways are implemented 'on the ground'. Analysis will focus in particular on the importance of three components of social memory – rites, traditions and social learning processes – for shaping community resilience in coping with land degradation processes. In other words, social memory will be seen here as an important explanation regarding the ability of a local community to manage and cope with land degradation, especially as it partly explains the degree of community resilience observed (Wilson, 2015). Community resilience, in turn, can modify social memory regarding the management of land degradation as people may eschew poor land management practices in favour of more beneficial ones.

Social memory and land degradation: conceptual issues

This study places specific emphasis on the context within which decision-making affecting land degradation takes place. By taking the temporal dimension into account, the study particularly acknowledges the role of history and path dependencies within which decision-making is embedded. In this context, the notion of 'social memory', and how it affects land degradation processes and responses, is particularly important. The notion of 'social memory' was popularised by Von Bertalanffy (1968) who highlighted that any system – human or natural – is imbued with a 'memory' that relates the system to past events, i.e. that transitional pathways do not occur in a vacuum but are embedded in often complex antecedent histories. It implies that knowledge, experience and accumulated wisdom are

passed on within a community, and any community system will be at its specific starting point because of the history of decision-making trajectories *preceding* that starting point (Folke et al., 2003; Stump, 2010). In other words a land management system carries with it the memory or 'baggage' of previous decision-making trajectories.

Several studies have highlighted the importance of social memory for human development pathways (see, in particular, Healy, 1997, from a colonial history perspective, or Olick & Robbins, 1998, from a historical sociology approach). Researchers such as Folke et al. (2003), Adger et al. (2005) and Folke (2006) emphasised the importance of social memory for understanding resilience processes by arguing that social memory comes from the diversity of individuals and institutions that draw on reservoirs of practices, knowledge, values and worldviews, and that social memory is, therefore, crucial for preparing a system for building resilience and for coping with surprises. While natural systems are imbued with system memory, they are usually *non-anticipatory* as the system cannot forecast and adjust for a change in output. Human systems, on the other hand, are *anticipatory* and *non-deterministic*, and social memory is a crucial element which may lead to a *learning* and *adjustment* phase based on past experience (Wilson, 2015).

There is a close link between social memory and path dependency that shapes the nature and pace of land degradation processes and responses (Wilson, 2012). Key is how social memory of human systems is shaped by, and in turn shapes, institutionalized forms of learning, communication, knowledge transfer and institutional processes and effectiveness, and the fact that personal choices can be self-reinforcing and, therefore, often self-fulfilling (Davidson 2010). In other words, means may become ends and alternative pathways may not even be considered. This shows that social memory can be both a good and bad thing, as it may 'lock-in' areas on pathways but may also propel communities onto pathways that may, ultimately, lead to their disappearance (Walker & Salt, 2006). Social memory, thus, implies that once a transitional pathway has been chosen it may be difficult to leave due to various cultural, socio-economic, political and institutional factors. Yet, Rotmans et al. (2002, 3) argued that "a transition process is not set in advance, because during a process of change, humans are able to adapt to, learn from and anticipate new situations". For human systems, this means that forecasting the effect of transitions is complex, as the direction of change is influenced often by unpredictable human adjustment strategies.

The critical literature on social memory suggests that there are three human processes most closely associated with social memory: community learning, tradition and stakeholder networks. First, a community's adaptive capacity will largely depend on past and present social learning described as "the diversity of adaptations, and the promotion of strong local social cohesion and mechanisms for collective action" (Adger et al. 2005, 1038). Learning is a complex process that involves interpretations of information, reflections on previous experience (social memory), group discussions, and established practices (rites). It is, therefore, intricately intertwined with communication processes and how knowledge about land degradation is passed on at inter- and intra-generational levels. Learning is often non-linear, uncertain and unpredictable and depends on specific spatio-temporal processes and histories (Gale, 1996). New knowledge gained through the experience of land degradation can, therefore, both influence antecedent conditions and enhance the potential for land degradation alleviation in the future through the implementation of new strategies (Wilson 2012).

The notion of anticipation highlights that social learning implies human adjustment processes that propel the post-disturbance system to a different (sometimes 'better') state (Gale, 1996; Wilson, 2012). One key advantage of human systems over natural systems is that the quality of learning can be enhanced as human communities can *benefit from hindsight* about pathways that have 'gone wrong' (Stump, 2010). Positive learning quality, therefore, also has to be associated with learning processes that occur *before* a disturbance takes place and is closely associated with levels of education (formal and informal) and how information about possible effects of disturbances is communicated to, and within, the community. Yet, socio-ecological systems rarely (if ever) follow linear pathways of change and are usually characterised by multiple complex pathways that occur in unpredictable ways. This means that learning processes need constantly to adjust to new challenges, such as finding the best possible ways to pass on information to the next generation, which may challenge how things were done in the past (Olick & Robbins, 1998). The most successful social learning takes place when the entire community is given opportunity to take part in joint learning efforts to tackle land degradation (Gale, 1996). This is best exemplified in cases where most stakeholder groups in a community have been affected by a major disturbance, such as land degradation, encouraging community residents to 'pull together' and learn how to survive and/or address the issue.

How learning processes function, and how knowledge about how to tackle disturbances is passed on to individuals, is, therefore, another crucial step for understanding communication and knowledge transfer at local level. Some argue that social learning is most successful when beneficial actions linked to environmental management are put into formal policy or informal customary laws/rights (e.g. oral tradition) for handling future events (Gale, 1996). It is this 'encoding' of learning that is seen to be particularly important by sociologists, as individual memory can be subject to decay over time (Stump 2010). The most successful learning processes are, therefore, those that encode knowledge in a way that is available to stakeholders over several generations (referred to by Ostrom, 2008, as 'rules-in-use'). Individual 'encoding' of knowledge can, however, be selective and may lead to ruptures in social memory, for example through the outmigration or death of knowledgeable community members. Social learning is also shaped by power structures. Who is learning to cope with land degradation and who benefits most? Who decides what is passed on to others and why are some pieces of knowledge discarded altogether? Indeed, in every society power is unevenly distributed, with some actors or stakeholder groups having disproportionate access to information or influence (Olick & Robbins, 1998; Wilson, 2012), and those in power may not be those with the strongest motivation to seek positive solutions.

Attachment to place and the desire to preserve pre-disturbance cultural and environmental norms are similarly important aspects of social memory. Attachment to place is often dependent on the embeddedness of actors to 'their' community. Sociological literature suggests that the longer an individual has been living in the same community, the stronger the attachment to place is developed and the more social learning processes will be shaped by long-term interaction (Olick & Robbins, 1998). Attachment to place may be most closely associated with social memory at community level, as strong development of both is predicated on long-term residence in, and embeddedness of, a community (Ward & Styles, 2006).

The notion of 'tradition' is also closely interlinked with social memory as it is associated with environmental beliefs and customs usually handed down orally from generation to generation. Tradition is often linked to strong embeddedness and attachment to place, and can frequently be found in communities where a core group of stakeholders have lived in one place over several generations. Tradition is associated with specific conscious or sub-conscious environmental management practices that can be either benign or malign for the environment (Stump, 2010). As a result, environmental customs, rites or 'taboos' are often

linked to traditional beliefs and can be seen as orally encoded sets of practices about 'how things have been done for generations' (environmental customs), or as restrictions on certain environmental decision-making behaviours (taboos). Most communities or individual stakeholders attempt to encode (consciously or sub-consciously) successful past disturbance avoidance strategies into tradition (Ostrom, 2008).

Social memory is at its most effective when it is implemented by the majority of a community, rather than by individuals alone. Lebel et al. (2006), therefore, argued that understanding community networks, and associated power relations, is crucial for understanding how social memory may affect communities. Stakeholder networks in a community can take several forms, most important of which will be embedded and disembedded actors. Although marginalised actors can shape community pathways if they wield a lot of power, power within a community usually stems from the fact that individuals or stakeholder groups are well connected and command the respect of other members. Often, it is the social memory of these powerful actors – and links of these local powerholders with supra-local power structures – that tends to shape environmental pathways for the community as a whole through the implementation of traditions, customs, and rites (Wilson, 2015).

There are several ways in which such historical stakeholder networks can be disrupted. First, they can be changed over time through shifting power structures within a community. Such power can be affected by various endogenous and exogenous processes, including exogenous political change or market upheaval, or endogenous changes such as the death of a community leader. Although this may not necessarily affect social memory of the community as a whole, changes in power balances often go hand-in-hand with adjustments to existing environmental management practices. 'Preferences' of the new stakeholder group in power may change (e.g. water management), emphases may shift (e.g. more focus on forest exploitation), or traditions and customs may be 'interpreted' in slightly different ways (e.g. relaxation of taboos) (Stump, 2010). Second, historical stakeholder networks can be severely disrupted through outmigration of community members (Wilson, 2013). Outmigration of individuals or entire stakeholder groups affects social memory, as these outmigrants 'take with them' long acquired local knowledge, disrupt existing power structures (often young people leave the community) and may also reduce economic capital (Forbes et al., 2009).

These debates highlight several key themes hypothesised to be of crucial importance for shaping and affecting social memory. Figure 1 highlights that these individual factors affecting social memory are interlinked in complex ways[1]. Thus, the impacts of *outmigration* will be investigated in detail, especially with regard to potential *loss of local knowledge*, *interrupted learning pathways*, *loss of attachment to place*, and associated *disruptions in local stakeholder networks*. The repercussions of *land abandonment* for social memory will also be analysed, in particular with regard to potentially *severing the link to the land* and *reduced natural capital*. Finally, *loss of cultural values* and *abandonment of traditional management practices and rites* will be investigated, especially how they may impact on social memory and land degradation alleviation.

Methodology

This study was part of the €3.1 million EU-funded LEDDRA Project[2] (2010-2014) which focused specifically on human responses to land degradation in selected communities[3] in Spain, Italy, Morocco, Greece and China. Nine study sites were selected for in-depth analysis, comprising different land use types affected by land degradation including cropland, forest and grazing areas. Case study communities within these areas were selected on the basis that they suffered to varying degrees from land degradation.

The methodology for the analysis of the link between social memory and land degradation was based on selection of 22 communities from the nine study sites (Figure 2). The approach ensured that a wide range of different community types were included to assess the importance of social memory for resilience in different contexts affected by land degradation. The selected communities had a variety of socio-cultural, political, environmental and economic characteristics, various degrees of land degradation and space- and time-specific responses to land degradation. Four study sites (with 12 communities investigated in detail) were in cropland areas, three of which were located in Mediterranean Europe and one in China. They included the Messara Valley (Greece) (hereafter referred to as

[1] Note that many more links among individual factors exist than shown in the figure. The figure is a simplification of the 'real world' situation for illustration purposes and only selected links are shown.

[2] LEDDRA received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no. 243857 (http://leddra.aegean.gr).

[3] Although definitions of 'community' vary considerably (Wilson, 2012), in our study communities were villages with a clearly defined community boundary (administrative), clearly attributable land ownership patterns (i.e. most farmers belonging to one specific community), and with evident cultural attachment of residents to 'their' specific community.

MV), the Alento River Basin (Italy) (ARB), Western Andelavo (Spain) (WA) and Zigui County (China) (ZC). Grazing study sites (7 communities) were located in the Asteroussia Mountains in Crete (Greece) (AM), the Ait Arfa du Guigou area (Morocco) (AADG) and the Central Pyrenees (Spain) (CP), while the two forest study sites (3 communities) were in Baixo Guadiana (Spain) (BG) and Matera Prefecture (Italy) (MP).

The nine study sites were also selected because they constitute a variety of socio-ecological systems comprised of cultivated land (mainly olives, vineyards, annuals, oranges, vegetables and tea production [ZJ]), drylands and semi-arid areas, forests, mountain ecosystems and grazing lands (Table 1). Some sites were part of protected areas, such as ARB (Italy) which is part of the National Park of Cilento and Vallo di Diano (a UNESCO World Heritage site), and AM (Greece), WA (Spain) and BG (Spain) which are Natura 2000 areas. The study sites face various problems of land degradation including, in particular, loss of soil fertility and organic matter, soil compaction and sealing, landslides, loss of water storage capacity and aquifer depletion, biodiversity loss, loss of land to urbanisation and development (see Barbayiannis et al., 2011, Karamesouti et al., 2015, Kosmas et al., 2015, for Greece; Kelly et al., 2015, Wilson et al., 2016, for Italy). As a result, soil erosion constitutes a major issue in all study sites causing loss in crop production and farm income, damage to road infrastructure and resultant outmigration. Main drivers of land degradation include reduction of agricultural area due to low land productivity or urban expansion, intensification of crop production, over-concentration of production on productive soils, land abandonment, expansion of tourism especially in coastal areas, EU and national subsidies (as negative drivers; see Kelly et al., 2015), fires for clearing agricultural land, and climate variability. One of the most important drivers of agricultural reform in ZC (China) was the increase in water availability leading to agricultural intensification.

Interviews using both structured and unstructured questions were conducted by local research teams who knew the areas well and spoke the language in each of the 22 communities. Interviewees included members of all relevant stakeholder groups in a community and usually included farmers, tourist businesses, local and regional policy-makers, persons with knowledge or influence such as school teachers, village priests and mayors, as well as local scientists with knowledge of land degradation issues (see also Kizos et al., 2014, for a detailed account of interview approaches used in AM). The number of

respondents varied depending on the size of communities under investigation and the complexity of stakeholder networks, ranging from ca 30-60 interviews in each study site with a total of 350 interviews conducted overall. The unit of analysis was the individual, although in the case of farmers some interviews were also held at household level with the key aim of understanding land use decision-making processes at the farm level. Individuals were selected either on the basis of their position within stakeholder networks in the case study communities (e.g. teachers, mayors, influential individuals) or as key representatives of their stakeholder group (e.g. individuals representing large or small farmers, farmers' union representatives, leaders of citizen groups, etc.). Interviews were mostly held in respondents' homes and were either taped and transcribed or recorded through note-taking and then translated into English by the local teams. Building on Magis (2010), Kizos et al. (2014) and Kelly et al. (2015), the data was analysed using content and context analysis. The UK team coordinated the interview process and was in charge of comparing and contrasting responses which enabled triangulation and cross-checking of data and provided consistency in interpretation and analysis of interview material. Direct quotes from interviews in the analysis below will anonymise respondents by area (e.g. ARB6 = Alento River Basin respondent number six), although the role or profession of an interviewee may be indicated where appropriate (e.g. farmer, teacher).

Resilience and social memory in the 22 LEDDRA communities

Building on Figure 1 (above), the results of this study will be presented through a focus on the key interlinkages between social memory, community and land degradation: outmigration, disruption of local stakeholder networks, loss of local knowledge, interrupted learning pathways and associated problems passing knowledge to the next generation, abandonment of traditional management practices and disruptions in traditions and rites, land abandonment and changes in natural capital and, finally, severed links to the land and associated loss of attachment to place.

Outmigration

Outmigration was an issue in all 22 communities and is one of the key drivers affecting social memory. Outmigration involves the moving away of entire segments of a community, e.g. several households or stakeholder groups, or certain cohorts within communities, in particular young people seeking better socio-economic opportunities elsewhere. ARB (Italy) saw a reduction in population by about 3% since 1971, AM (Greece) lost 30% of population 1961-2011 (current population density <17 people/km^2) (Kizos et al., 2014), while ZC (China) saw a population decrease of ca 5% since 1979 (part of large-scale rural-urban migration in China). Certain communities have been, and still are, losing population more rapidly than the average, e.g. in MV (Greece) Gkagkales currently has only 460 inhabitants (down from 728 in 1991) and Protoria only 190 (down from 275 in 1991). Similar trends have been apparent in the two Spanish study sites BG and WA. The study site of MP (Italy), meanwhile, "experienced a sharp decline in population since the 1900s. [The] rural exodus began in the 1950s with internal migration … and emigration, driven by mass unemployment. …Population movements again gathered pace during the 1990s with young adults moving away to find work, leaving an ageing rural population" (Kelly et al., 2015, 15). One respondent, for example, argued that "the consequences are inevitable … the members of the community prefer to leave the community because it does not guarantee a sufficient income" (MP12).

All areas have suffered particularly from outmigration of *young people* due to reduced viability of farm holdings, loss of local services such as shops, post offices or local schools (e.g. AM, Greece), and high youth unemployment rates at times reaching 50%. The share of people working in agriculture has also plummeted in all 22 study sites (e.g. CP [Spain] saw a decline in agricultural employment from ca 60% in 1990 to less than 15% in 2014), while the average age of farmers has increased substantially over the past decades in all study sites (e.g. >50 years in CP; >45 years in ZC). In mountainous areas (e.g. ARB, CP) this has often gone hand-in-hand with a shift from extensive and environmentally benign sheep grazing on upland pastures to more intensive environmentally more damaging dairy and beef farming in lowland areas.

Yet, the nature and characteristics of outmigration vary substantially across communities. Thus, while in ZC (China) outmigration was linked predominantly to young people under the age of 40 moving to large metropolitan areas in Eastern China, in CP (Spain) outmigration was more pervasive (loss of >50% of population during 20th century), with segments of the population moving away to larger population centers to the south (Alados et al., 2014). In extreme cases this has led to complete depopulation of former villages, especially in relatively inaccessible areas. As a result, a mood of pessimism was evident in most communities. Respondents in communities in ARB, for example argued that "emigration has always been a problem in the area, young people nearly all migrate away" (ARB10). However, in a parallel process some young people have moved back to their communities due to lack/loss of jobs linked to the post-2008 economic recession (see also Kizos et al., 2014; Alados et al., 2014).

In some areas, outmigration by young people has been counter-balanced by inmigration of second home owners. In CP, for example, between 30-50% of houses are now owned by second home owners (largely urbanites or tourists enjoying the national park). As Wilson (2015) argued, this can have severe repercussions for social memory as it leads to further disruption of formerly more tight-knit stakeholder networks, especially as newcomers bring with them new and different ideas about 'ideal' landscape management (this was the case, for example, in AADG, and ARB). One CP respondent, for example, argued that "second home owners often don't know much about this landscape. They prefer to see forest rather than open pasture areas, even if they are grazed by native breeds" (CP2).

Disruption of local stakeholder networks

Outmigration has severe implications for land degradation processes in the 22 communities (see Fig 1). First, it often leads to reduced social capital through disruption of local stakeholder networks**.** All communities relied on strong and well established local stakeholder networks for the emergence and maintenance of strong resilience pathways. The resilience literature has particularly highlighted how reciprocal help in land degradation alleviation practices (e.g. maintaining terraces or irrigation networks) relies on strong local stakeholder networks based on trust, neighborly help, and reliability of community support (Kizos et al., 2014). Both outmigration and land abandonment cause 'ruptures' in these networks by disrupting communication and trust between and across community stakeholder

networks, by interrupting learning pathways vital for passing on knowledge about land degradation alleviation (see below), by eroding social capital and disrupting the cohesion of the community and their ability to prevent outmigration, and by leading to abandonment of traditional and often sustainable land management practices, skills and knowledge.

In our study sites, impacts of outmigration on local stakeholder networks showed a mixed picture, with evidence of surviving strong local embeddedness (e.g. ARB, WA, MV), self-regulating moral codes (e.g. ZC, BG), and relatively strong social ties, interactions, trust and norms of reciprocity (e.g. ZC, ARB, AADG). In the community of Kapetaniana (AM, Greece), for example, a planned hybrid wind and hydro energy farm brought people together to voice their strong opposition, which may have temporarily strengthened social capital as it has engendered a sense of cohesion and increased collaboration and networking among some stakeholder groups in order to oppose the plans (including young people). But not all communities were characterised by close interaction between people through tight-knit communities, the ability to rely on neighbours in times of crisis, or relatively good communication between stakeholder groups. In particular, the 'greying' of communities through outmigration of young people, as well as the gradual development and persistence of clientelist social and political networks at community level, are signs of weakening social capital. Thus, in the AM and AADG study sites in particular, the establishment, persistence and functioning over long time periods of informal, hierarchical, patron-client socio-political networks, associated dependence of social agents and primary producers on these networks, and the common usage of these networks for achieving multiple and often contradictory purposes, has led to gradual erosion of wider social trust among many stakeholders and especially to non-compliance and conformity with social norms promoting land degradation alleviation and socio-economic justice. Moreover, even agricultural stakeholders' trust of their own associations and cooperatives was limited due to the dominance of informal clientelist networks. In one of the Spanish study areas respondent BG7 thus lamented that "most of us have lost faith in the ability of the local cooperatives to help small farmers as they seem to be increasingly taken over by big business and international interests over which we have little control". In AM (Greece), Kizos et al. (2014, 8), therefore, argued that before the 1980s strong stakeholder networks "co-shaped relations and practices of farmers" but that such forms of social capital "slowly but steadily eroded during the 1980s … [which] … contributed to the growing land degradation problems in the area".

Respondents in other communities also mentioned the relative loss of trust, partly due to the disintegration of traditional community structures through the outmigration of young people, and partly due to deeper socio-economic changes linked to globalisation affecting many remote rural locations. One farming respondent in CP, for example, talked about "old resentments [that] sometimes hamper relations between individuals in the community", suggesting strongly entrenched views and animosities that can, at times, negatively influence land degradation alleviation. One farmer in ARB, meanwhile, referred to the frequent "absence of common interests" among stakeholder groups (ARB20), another argued that "neighbours don't really trust each other, there is a culture of individualism, everyone looks after their own interests first (ARB7), while in AM, Kizos et al. (2014, 1) referred to "very low levels of wider social trust among [stakeholders]" and that "conflict among stakeholder groups sometimes takes on extreme forms of violent conflict, criminality, and avoidance of any social relation with other opposing families and kinship groups" (ibid, 6). Similar problems were expressed in AADG and BG. This has severe repercussions for the ability of communities to *collectively* address land degradation issues. Indeed, many respondents suggested that trust has been gradually lost over time, that there are few strongly linked stakeholder networks or community groups, and that a lack of community engagement and connectedness between individuals are one of the biggest problems. The evidence from the 22 case study communities, thus, supports Kizos et al.'s (2014) assertion that disruptions in local stakeholder networks have affected social memory, the loss of which in turn has resulted in the erosion of the collective ability of social actors to cope with land degradation problems.

In addition, many communities have suffered from loss or lack of leadership, resulting in limited availability of information about land degradation alleviation (e.g. ARB, ZC). Associated with this is also often the loss of religious leaders (e.g. local priests) who performed crucial roles in the past encouraging communication with and between different stakeholder groups. As a result, there is also a lack of trust between community residents and powerful individuals/community leaders (ARB, CP, MV, AADG), and many stakeholders reported that the community worked better together in the past, or that community members trusted each other more than at present – key factors that reduce the ability to tackle complex land degradation issues that often require inputs from a large array of stakeholders working in unison and with a common shared goal (e.g. jointly repairing terraces or irrigation systems). In CP, for example, respondents argued that open discussion was easier in the past but that

changing stakeholder networks mean that "today open discussion is no longer possible; before we could all voice our concerns, but not anymore" (CP7). In another CP community powerful individuals have at times benefited from outmigration and changing power structures within close-knit communities. One mayor was highly influenced by politically powerful hunters from the lowlands (who pay for hunting rights), thereby controlling and often preventing new development in the community, especially by discouraging new people moving into the area who may not agree with development pathways selected by that individual. Disruptions to traditional stakeholder networks have, therefore, inevitably influenced community-level decision-making with regard to land degradation alleviation, for example by preventing young people or conservation-oriented stakeholders from influencing land use decisions (CP2, MP3).

Loss of local knowledge

Loss of local knowledge and weak encoding of positive knowledge about land degradation alleviation is directly linked to outmigration, as local people moving away from their area inevitably take important knowledge about land use decision-making with them (see Fig. 1). This is particularly true if members of the older generation migrate away from their communities, as they often take with them key knowledge linked to land degradation alleviation measures such as the maintenance of protective terraces, the use of environmentally benign traditional animal breeds, the planting of appropriate crops able to cope with climate variability, the selection of the best types of plants or trees for soil protection, or knowledge about the least environmentally damaging irrigation practices. This loss of knowledge is further fueled by an altered technological and economic environment that makes the 'old ways' uncompetitive, which means that even those young people staying on site are unwilling to use, and sometimes take up, the accumulated wisdom of their community.

CP (Spain) and AADG (Morocco) provided particularly interesting information related to the complex interconnections between outmigration, loss of local knowledge and community resilience. In both areas shepherding emerges as a key issue as it has been difficult to find local people willing (and able) to shepherd animals due to outmigration of skilled people. As shepherds need to stay for prolonged periods with their herds without the commodities of towns, this job has become increasingly unattractive to new entrants and young workers. In

both areas, knowledge about sustainable shepherding practices that protect fragile ecosystems from land degradation has not been passed on by older people with good knowledge, as young people no longer stay in the areas. This has meant that outsiders often need to be employed (e.g. shepherds from Africa and Romania in CP) which disrupts social memory associated with knowledge about complex transhumance systems, often exacerbating land degradation issues (see also Kizos et al., 2014, for AM). A negative outcome has been the closure of a former shepherds' school in CP specifically geared towards training local shepherds in environmentally sustainable grazing management (CP2). In CP, therefore, loss of social memory is closely linked to declining shepherd cooperation networks which are gradually reducing the resilience of grazing systems based on transhumance. One respondent, thus, argued that "the outmigration of young people has been a disaster as shepherding skills can no longer be passed on from generation to generation. New shepherds from outside the area lack the skill and local knowledge to manage the fragile upland pastures in a way to prevent erosion and biodiversity depletion" (CP2). The associated outcome of a lack of shepherds is the switch from sheep to cattle production, as cattle can be maintained without the need for the permanent presence of a shepherd, and the almost complete abandonment of transhumance systems that have linked upland and lowland the landscapes for centuries. Many respondents in CP mentioned that this has particularly led to a traditional and environmentally more benign 'mountain mentality' being superseded by an environmentally more malign 'plains mentality'. Although policies have been implemented to help keep farmers on the land, these have been unsuccessful in preventing outmigration.

Sendzimir et al. (2011) similarly highlighted the importance of maintaining local knowledge systems and the transfer and sharing of knowledge between stakeholders and intergenerational groups as critical components for community resilience. Kelly et al. (2015, 17) further argued for MP that "as young people leave the community and opportunities for inter-generational learning and knowledge exchange are reduced, so too are opportunities for innovation and diversification based on deep knowledge of local soil, vegetation, hydrographic and climatic conditions". This was echoed by one MP respondent who argued that "the abandonment by farmers of their activities is also a loss in local knowledge. So when something is going to re-start in twenty years we will have lost this local knowledge" (MP13). In a similar vein, several respondents in other study site communities mentioned the decline in the use of local animal breeds as a particular problem, especially as local breeds

are often better adapted to poor pasture conditions in erosion-prone areas. Linked to the relative loss of local breeds is the loss of social memory associated with managing these animals, which are usually used in more extensive systems and are, therefore, not as damaging to soils as their modern counterparts (Ghorbani et al., 2013). In addition, some respondents argued that "maintaining local knowledge is difficult at the moment, because information is only available if you have a strong relationship with the community" (CP6), suggesting that these formerly stronger links have partly broken down.

Nonetheless, policies can help improve the retention of local knowledge. In the community of Gorgoglione (MP, Italy), for example, since the 1970s substantial administrative reforms led to devolution of competences for land use planning from national to regional levels. As a result, regional-level administrations became directly involved in the development of forest policies. This meant granting legislative powers to the regions as well as ownership and responsibility for state-owned public forests. Kelly et al. (2015) have highlighted that this has had a positive impact on the quality of forests, and that forest management for land degradation alleviation has benefitted from regionally formulated forest, environmental and soil protection policies which are better targeted at local needs than previous policies. Most crucially for a rekindling of social memory, the devolution of power led to a new and more participatory approach to forest management that valued the use of local knowledge much more than in the past. Indeed, traditional local forest management practices that had proven effective for soil degradation alleviation – such as sustainable agro-pastoral management, coppicing rather than clear-felling, renewed browsing by livestock to clear undergrowth from vegetation prone to fires (fire protection management), and the planting of more deeply-rooted tree species – were re-incorporated into regional policies (Kelly et al., 2015).

Interrupted learning pathways/problems passing knowledge to next generation

As Figure 1 highlighted, outmigration also disrupts social memory by interrupting learning pathways, especially creating problems passing on local knowledge to the next generation (Fairhead & Scoones, 2005). As the majority of migrants are young people, older people with intricate knowledge about land degradation alleviation can no longer pass on this knowledge to the next generation. Several respondents commented on how local knowledge, that accumulated over centuries of close human-environment interaction may, for the first time,

be lost forever as few young people stay behind to take over their parents' farms (ARB2, BG1, MP2). As a result, in most LEDDRA study sites local knowledge and skills regarding key land management issues appear to be only moderately passed on from the older to the younger generation, with many interviewees suggesting that there was more intergenerational dialogue in the past (e.g. ARB12; CP2; ZC3; see also Kizos et al., 2014, for AM). This was echoed by a young ARB respondent who suggested that "local knowledge is still useful in addressing land degradation problems, but unfortunately we are losing that knowledge. My grandfather knew a lot more about environmental resources than I do" (ARB21). Another farmer in the same area argued that "there is a generational gap, and young people and older generations rarely have the opportunity to spend time together" (ARB11), a neighbour suggested that "the same old people always make the decisions for the area" (ARB12), while another argued that "there are few young people left, and those who have remained are reluctant to participate in community initiatives or decision-making processes" (ARB20).

Young people in many of the study communities seemed to have little direct engagement with community matters and projects and do not partake in decision-making affecting the community. As a result, several interviewees highlighted a fracture between older and younger generations and a concurrent lack of knowledge transfer, with one respondent lamenting that "there is no knowledge transfer, which means people need to bring in experts from outside the community" (ARB25). Wilson et al. (2016) also argued that in ARB the older generation is often only moderately interested in passing their knowledge about land degradation to young people (e.g. expertise in building dry stone walls), and similarly many interviewees in other study sites felt that young people's aspirations were no longer rooted in skilled local work (BG2, CP3, ZC1). In addition, several respondents argued that community leaders do not facilitate the passing on of knowledge, and that "decisions are always made by the same group of individuals, everyone else is excluded" (ARB21). Indeed, many lamented that key decisions are taken by only a few key stakeholders (e.g. CP2; ARB6) and that those in power often failed to pass on knowledge about land management practices that may alleviate land degradation.

This suggests that outmigration and other processes affecting social memory have severe repercussions for changing *power structures* in communities, as older and more established stakeholders staying behind tend to adopt less inclusive and more conservative views about land degradation. Many respondents, therefore, referred to their communities as very 'conservative' (e.g. AADG, MP, MV, AM), with one respondent arguing that "sadly there is

a strong sense of apathy and resignation in the local community" (ARB12). For the ARB Wilson et al. (2016, 533), therefore, argued that "psychological conservatism, cultural resistance and inertia have, thus, led to social passivity, even if it leads to worsening soil erosion and landslides".

While community stakeholders may communicate at times of extreme crises (e.g. during flood events), on the whole most of the 22 communities suffered from lack of communication on day-to-day land degradation issues. This means that although local knowledge continues to be useful in addressing land degradation, much of this knowledge is at increasing risk of being lost. This often happens because stakeholders now have different value systems from those in the past, different priorities, and because livelihoods are often separated from notions of 'good' environmental management. As both Fairhead & Scoones (2005) and Stump (2010) suggested, these disrupted learning pathways inevitably lower resilience, as they reduce the ability of communities to effectively address land degradation. In particular, weak self-reliance in dealing with problems, coupled with breakdown in traditional stakeholder networks and weak intra- and inter-stakeholder communication, highlight future problems associated with community-based implementation of successful responses towards land degradation.

There are nonetheless some community-based initiatives set up by local people that aim at addressing weakening learning pathways. One of the most successful inter- and intra-community examples relates to the cooperative in San Mauro Cilento 'Nuovo Cilento Cooperative' (ARB) where young farmers are actively helped with olive grove management, and where knowledge about sustainable soil management is passed on within and across stakeholder groups. Almost all farmers in the community of San Mauro Cilento are members of the cooperative, which uses traditional local olive cultivars, does not use fertilisers or pesticides, and handpicks fruits which are then cold-pressed to retain more nutrients (Wilson et al., 2016). Interview respondents suggested that this has reduced the threat of land degradation, especially as remnant agricultural waste is spread to protect soils from desiccation and erosion. Most importantly for the maintenance of positive social memory, the cooperative is also involved in campaigns for greater environmental and consumer awareness in the area, disseminates information about repair and maintenance of terraces, and encourages farmers to use and revalue ancient types of olive trees better suited to local soil protection needs. The cooperative also helps with information and communication about

subsidies, grants, and erosion management practices. A local farmer, therefore, suggested that "the cooperative is a sort of saving grace for farmers who otherwise would have no means of learning new skills or selling many of their products" (ARB5). As Wilson et al. (2016) highlighted, due to its success the cooperative has helped prevent further land abandonment and many respondents suggested that it has acted as an example of 'best practice' for the whole region. Similar positive developments were mentioned by respondents in AM where the community of Kapetaniana has a successful community-based cultural association, or in Broto Valley (CP) which has both a buoyant livestock association (Asociación de Montaňa Ganaderos Valle de Broto) and a Citizen Participation Forum. The latter was established to provide a forum for talking about local issues (including land degradation) and to give stakeholders (e.g. farmers, National Park representatives) a chance to meet and discuss specific issues (AM1, CP1).

Abandonment of traditional management practices/disruptions in traditions and rites

The frequent disintegration of local stakeholder networks has meant that social memory has been negatively affected by gradual abandonment of traditional management practices and knowledge, and by disruptions in traditions and rites associated with specific skills (see Fig. 1). Grazing systems in CP, AM and AADG were particularly affected by these processes, although arable and forest-dominated areas also severely suffered. All these systems are associated with strong cultural and symbolic attachments of communities to their specific 'ways of life' (e.g. shepherds in CP; traditional olive grove management in ARB; forests as important part of cultural life in MP), and that for many stakeholders no other options for income generation are even conceivable (i.e. limited options for pluriactivity). One of the key strands of our investigation was, therefore, to understand not only the physical repercussions to changes in agricultural practices such as erosion processes, but also deeply ingrained cultural and symbolic meanings attached to specific land management approaches.

In many of the 22 case study communities traditions and social memory often revolve around specific crops and plants such as olive grove planting and management as an important aspect of long-term soil management processes (e.g. BG, ARB, MV, AM). In the community of San Mauro Cilento (ARB), for example, traditional olive grove management can be traced back through official documents to AD1092 when Italo-Greek monks began cultivating the steep slopes in the area. Similarly, in ZC soil protection measures such as

terracing and planting deep-rooting crops date back to the first millennium AD (ZC1). For communities in the ARB, Wilson et al. (2016, 532) argued that

> "although modernisation of olive oil production is evident in all communities through increased mechanisation and planting of new olive tree varieties … current production remains much the same as in the past, in particular with regard to the use of olive trees that are often centuries old, traditional pruning techniques, and wide irregular spacing of trees seen as optimal for quality oil production. Many of the olive plantations in the area are remnants of older groves (using varieties dating back to Roman periods) whose produce was destined solely for local markets. The slow growth of the trees, their age and the modes of production employed largely inhibit implementation of modern farming techniques. … The olive quality and yield of these ancient trees is the same as newer high yielding varieties, but the smaller size of traditional trees, their denser shape, and their root systems are better for soil protection than newly established plantations."

Rites and traditions associated with the social memory of traditional olive cultivation, thus, are positive for raising resilience in olive-based communities. However, loss of local skills and knowledge – often linked to outmigration, land abandonment and the associated need for pluriactivity – has meant that farmers have needed to minimise time spent on the land, maximise crop yield, and use crops and tree species better suited to more 'efficient' farming (ARB1, BG1). This has meant that old olive trees are often replaced by new varieties that can be planted more densely and clustered more closely on land not affected by crumbling terraces – in turn leading to a vicious circle in which local skills linked to old olive grove and terrace management are increasingly lost. A farmer, thus, lamented that "olive plantation management was influenced in the past by the rites and traditions of previous generations, but that is no longer the case" (ARB14). Most respondents, therefore, felt that there was a gradual loss of knowledge, skills and rites associated with sustainable management of olive groves, leading to increased vulnerability in the face of terrace collapse, land degradation and landslides.

Respondents also often mourned the loss of traditions around use of forest resources (MP, ARB, BG, CP), especially linked to use of medicinal plants, wild mushrooms and honey, and traditional coppicing practices – which all indirectly helped prevent soil degradation through forest conservation. In MP, in particular, respondents highlighted the strong cultural bonds to their forests and ancient forest management practices. MP stakeholders maintain their links with past forest management strategies, especially through ancient traditions and festivals associated with forest product harvest and fertility. Kelly et al. (2015) argued that these festivals show the deeply embedded relationship between forest, culture and identity of local people and the historic and on-going importance of forest resources (timber, food, fuel). In the village of Gorgoglione (MP), for example, forests are used by locals for harvesting nuts, fungi, fruits and herbs, and respondents also highlighted that forest grazing continues to be important: "Grazing is an income, so grazing is connected with the forest. … In the past we always had grazing in the forest" (MP8). However, respondents highlighted how depopulation has meant that these practices are declining, with concurrent loss of traditional knowledge. One key example is the gradual loss of knowledge of traditional seasonal transhumance practices involving forests which were largely sustainable, towards grazing all year round with negative impacts on seedling survival and species succession. Thus, as local knowledge and traditions are lost, forests lose their cultural and economic importance, and sustainable management tends to decline.

The production of local foods also plays an important role in traditional land use and land management practices in all 22 study sites. But production and sale of local products has not been helped by instrumentalist policies that often prevent local people from selling local products and speciality foods due to excessive bureaucracy and ill-conceived restrictions such as specific hygiene requirements for the sale of speciality cheese (e.g. CP, ARB). One farmer/hotelier respondent from CP, for example, argued that "we have largely given up selling local produce such as fresh milk, mushrooms or fish, as their sale is increasingly complicated by excessive bureaucracy and legislation", while an ARB farmer said that many farmers in the area "have opted out as they are too daunted by the bureaucracy surrounding the process" (ARB6). Interviews suggested that smaller farmers, in particular, often lacked confidence, experience and capacity to tackle complex forms and cope with the bureaucracy associated with farm diversification or on-farm processing. In addition, in the EU study sites meat from local livestock can no longer be slaughtered locally but often has to be transported

50-100 km away for slaughter by 'experts', which often makes the sale price prohibitive and uneconomic (e.g. MP, ARB).

Nonetheless, several communities organised a variety of events that focused on the maintenance of traditional management practices through local feasts (MP), animal shows (CP, AM), an apple juice festival using local apple varieties (CP), and cultural weeks (ZC). In both CP and AADG, local communities were producing liquor ('Pacharan') or fragrant oils from sustainably managed *Prunus spinosa* or scented oils from sustainably harvested *Rosmarinus officianalis*. Respondents suggested that this has led to a re-valuation of traditional herbs/shrubs that also act as important vegetation buffers preventing desertification. Many respondents argued that these practices helped re-value traditional crops and breeds, and that it fostered the maintenance of traditional management practices that often prevent soil erosion (e.g. how best to use and manage local breeds in WA). In MP, meanwhile, the development of agricultural and forest science courses at the University of Basilicata led to a renewed interest in the local forest environment, and has played a key role in rekindling social memory associated with traditional management practices which support sustainable forest management and land degradation alleviation (MP1, MP2).

Land abandonment/changes in natural capital

Resilience studies have highlighted the close link between outmigration and land abandonment (see Fig. 1). Land abandonment is closely linked to social memory as it can lead to loss of skills (e.g. how to build terraces), disrupted knowledge pathways (e.g. how to sustainably manage less accessible and steep farmland), and loss of attachment to the land (e.g. former agricultural land converts to 'unproductive' shrub or forest lands). Reasons for land abandonment are manifold, and depend on socio-cultural factors and opportunities for policy-makers to alleviate the negative effects of land abandonment (Briassoulis, 2004). In AM, for example, land abandonment has been an important response to land degradation as people leave the unproductive, degraded land. In particular, migration of people to urban areas has resulted in under-grazing or non-grazing of the land. Worst of all, however, land abandonment leads to reduced resilience through its interlinkages with erosion, reduced income, and potential loss of social and cultural factors such as skills, local knowledge and learning pathways (see also Kelly et al., 2015).

In most communities, land abandonment was closely linked to lack of options for pluriactivity as most communities are rural, with poor transport links and highly reliant on farming. This has meant that economic capital is poorly developed, especially the relative lack of funds to sustainably manage agricultural and forest land despite often generous subsidies. In some areas population decline has led to abandonment of 40-60% of previously used pastures (e.g. CP), while in the AM study site utilized agricultural area declined by 20% between 1961 and 2000 (Kizos et al., 2014).

Land abandonment can lead to substantial changes in natural capital. Centuries-old agricultural systems that often provided a balance between conservation and soil exploitation, thereby preventing land degradation, can change rapidly through land abandonment into vegetation associations very different from their original state. On the one hand, this has been detrimental for land degradation alleviation, especially when deep rooting agricultural vegetation (e.g. olive trees) are gradually overwhelmed by bushy vegetation or by perennials. Woody encroachment has particularly affected social and economic capital in CP as the traditional agro-pastoral economy of the mountain grassland ecosystem has been characterized by a dependence of the population on natural grazing systems that stems from centuries of co-evolutionary processes. On the other hand, land abandonment has led to improvement in soil retention capabilities, especially in areas that were originally more forested. In CP, for example, although forest regrowth after land abandonment has led to reduced biodiversity in the short-term (Alados et al., 2007), it has also often led to a better anchoring of soils through establishment of trees in often steep environments. In MP, some respondents felt that there were no longer major land degradation issues, because land abandonment had resulted in less soil erosion and the stabilisation of some slopes due to vegetation regrowth (MP 1, MP 3).

Severed links to the land and associated loss of attachment to place

Land abandonment also severs the cultural link to the land (CP2, AM1). Indeed, over centuries people build up strong links between the land and their communities, with often intricate knowledge related to optimum land management to alleviate land degradation for a specific parcel of land. Once this link is disrupted through land abandonment, the associated loss in social memory is difficult to remedy. Knowledge about specific land degradation alleviation techniques such as terracing, green cover during wet periods, ploughing along

contour lines, crop rotation, mulching, irrigation techniques, or planting of optimum crops is rapidly lost, often leading to accelerated soil erosion. Collapsing terraces due to lack of maintenance after land abandonment was mentioned as the most severe problem, and in several study sites (ARB, CP, AADG, AM, BG, MP) the collapse of century-old terracing systems was evident, with visible increase in erosion such as landslides, soil loss, and accumulation of debris at the bottom of fields. This severance of the human link to the land was expressed by several respondents. An ARB craftsman, for example, argued that "a big problem is that the land is no longer farmed like before" (ARB28). For ARB Wilson et al. (2016, 529), therefore, argued that "the communities are locked into economic pathways that do not provide many opportunities for the development of innovative and forward-looking initiatives that would help revalue often derelict or underused agricultural land". This is also closely associated with a loss of pride by local stakeholders towards their community and its farmed hinterland. Comments such as "there is no longer a sense of pride or belonging in the community … as such our community is very much losing its original identity" (ARB21) were, therefore, common.

An additional side-effect of land abandonment is the need for a shift to economic activities away from agriculture. Tourism income increasingly acts as a substitute for income loss from reduced agricultural activities. As a result of lack of development opportunities, many communities have focused on tourism as a possible 'positive' response to counter land abandonment. However, tourism is a complex process with regard to social memory and resilience. On the one hand, it provides much needed income for economically struggling rural areas, and may even help reduce outmigration as new job opportunities emerge for young people. In CP, for example, tourism has provided (some) jobs to community members who were contemplating moving away, and has provided additional income to farmers (e.g. through pluriactive farm tourism or increased focus on local products marketed for tourists) which has helped keep some farmers 'on the land'. The establishment of national parks in some study sites (CP, ARB) has provided some limited job opportunities for local young people, but overall has been insufficient to stem the flow of outmigration by young people (CP2).

On the other hand, tourism can further accelerate the disassociation of local people with the land, as it increasingly pushes poor agricultural stakeholders into the often more lucrative alternative of tourism. This, together with frequent pressure exerted by tourists on fragile ecosystems (e.g. ski runs in CP; urban development in MP; increased water needs in ARB), can easily tip the balance from land conservation to degradation. In addition, in many communities poor infrastructure has prevented the expansion of tourism (CP2, MP3) (see also Wilson et al., 2016). One respondent who was interested in setting up a tourist business in his remote upland community, for example, argued that "there are no prospects for tourism development. Just looking at the roads, you can see the level of neglect. In the summer months when tourists arrive the roads are practically impassable. There are often landslides and fallen vegetation" (ARB 6). In many communities, tourism is, therefore, not yet a viable economic alternative. The relative poverty of local communities and the relative loss of the hegemonic position of agriculture as a guarantor of income have, therefore, meant that there are often insufficient funds to tackle land degradation issues (e.g. AADG, BG, AM).

Many respondents also argued that outmigration is closely associated with loss of attachment to place (see Fig. 1). It was evident that when young people leave their communities, often never to return, the long-established link between community members and the land is disrupted. While in the past communities would have been close-knit, with stronger social networks and knowledge systems, the loss of attachment to place by migrants means that there are fewer incentives to maintain the land and soils in good working order. While the remaining older people do their best at preventing soil erosion and land degradation to maintain at least some agricultural productivity, the disassociation of young people who have moved away from their ancestral lands means less investment, less care, and less incentive for the remaining populations to sustainably manage the land for future generations. In the MP study site, for example, the loss of attachment to place was particularly manifested in a pronounced lack of 'entrepreneurial spirit' in the community, linked to a lack of culture of self-help (MP1). One farmer, for example, suggested that "farmers insist on continuing to cultivate the obsolete crops instead of trying new alternative crops" (MP5), while another argued that "the main threat … in our small community is the lack of people with entrepreneurial mindsets, persons willing to launch a new venture or enterprise" (MP9; similar responses were also given by respondents in MV). Many respondents in MP, thus, suggested that although the community was well aware of the problems and issues it faced, outmigration and the associated relative loss of attachment to

place meant that the community did not feel able to address land degradation (MP8, MP9, MP14). In many communities, loss of attachment to place has, therefore, created a dangerous 'lock-in' linked to loss of social memory that has, overall, reduced community resilience (Wilson et al., 2016).

Discussion and conclusions

Building on critical studies that have emphasised the importance of social memory for understanding the resilience and vulnerability of communities affected by land degradation (e.g. Folke et al., 2003; Kelly et al., 2015; Wilson et al., 2016), this study has analysed the possible interlinkages between social memory, land degradation and community resilience in a novel way. Emphasis was particularly placed on how processes such as outmigration, land abandonment and changing stakeholder networks have influenced social memory through changing rites, traditions and social learning processes in shaping community resilience in the face of land degradation. Figure 1 highlighted the complex interplay between these variables and showed that processes such as outmigration or land abandonment cannot be understood in isolation, but only through recognition of their complex interlinkages with other variables affecting social memory.

The relative loss of social memory in all 22 case study communities has led to a lowering of community resilience in recent decades which, in turn, affects these communities' capacity to address land degradation issues. This means that age-old 'traditional' ways of sustainably managing soils and key skills are increasingly forgotten, often leading to an exacerbation of land degradation problems. This can be found in grazing systems where locally-specific traditional knowledge and skills held by shepherds is increasingly lost (e.g. CP, AADG), but was also particularly evident in cropland systems where several stakeholders referred to loss of knowledge about which olive tree varieties to use and how to plant and manage old trees with often deeper roots that better protect the soil (e.g. ARB, BG, MP). In particular, vicious circles of self-reinforcing processes were evident that often trigger a chain reaction of further decline, best highlighted through interlinkages between outmigration of young people, land abandonment, and loss of skills. In addition, corruption, weak pathways for learning and knowledge about land degradation, poor governance/power structures within communities, psychological conservatism, cultural resistance, inertia among community stakeholders, and resulting low pride in their area, have all conspired to reduce resilience. As Wilson et al.

(2016, 534) suggested, "a spiral of declining resilience with regard to communities being able to address land degradation issues is, thus, often evident".

The study has, nonetheless, highlighted that different village communities have highly varying skills, communication and learning processes, emphasising that social memory is applied in different and complex ways to address land degradation issues (see also Sendzimir et al. 2011 for Niger). Thus, while some communities have been able to positively respond to changes (e.g. more emphasis on conservation measures in CP; development of well-functioning cooperatives in ARB), other communities have been unable to adjust management approaches due to specific social-historical lock-in effects that often mean that alternative pathways of change are impossible (e.g. some communities in AADG, ZG, MV, MP). Indeed, the discussion has highlighted that the capacity to adapt and to manage resilience requires robust learning pathways and the ability to make sense of land degradation threats, especially in arenas of collaborative learning, using a combination of various sources of information and knowledge.

Both social processes and actors who act as knowledge brokers are, therefore, needed to combine information and knowledge from multiple sources and a range of scales through approaches that can reinvigorate social memory. Our evidence suggests that learning is highly relevant for responses to land degradation in many ways by including discussion of knowledge utility and use, availability of skills and training, integration of knowledge types, as well as policy learning and capacity for inclusive decision-making. As highlighted above, the role of cultural traits (values, habits, etc.) in encouraging learning need to be included. Most crucially, our research has shown that cross-scale interactions are crucial, as for systems at a particular focal scale (e.g. community), trajectories depend on both bottom-up and top-down cross scale interactions (i.e. community-region interactions which are key in all study sites). Thus, adaptive cycles at one level can be 'repeated' if higher levels provide 'memory' – i.e. the connection between spatial scales provides opportunities for memory and learning from higher to lower scales and from lower to higher scales. This has rarely been the case in the case study communities due to mismatches between stakeholder needs and aspirations at regional and local level (e.g. AM, AADG), although examples such as the re-valuing of knowledge and skills in MP through the establishment of specific forestry courses at regional level stand out as positive cases. Social memory is particularly important in these processes, and experience of communities with past phases of more intensive land degradation (e.g. AADG, AM, MP, ZG) can substantially help in alleviating short-term land degradation

processes. However, the rapidity of land degradation processes is often overwhelming local knowledge systems, so that even the most astute adjustments to existing knowledge systems may be insufficient to address contemporary problems.

This study has highlighted that social memory is closely linked to social capital, which plays a deciding role in regulating the inter-linkages between natural and economic capital. Weak social capital means that land degradation is not seen as an issue that affects all members of a community, leading to a lack of will to act, which hampers collaborative efforts to tackle land degradation problems. Our findings suggest that there are still some remnants of bonding capital (i.e. vertical stakeholder interactions within communities) in most of the communities, but that this capital has also declined due to the ripple effects caused by outmigration (e.g. land abandonment, disrupted learning pathways, etc.). This suggests that improving the resilience of communities affected by land degradation has to be accompanied by knowledge and awareness raising schemes (important social capital components), training courses and school education about 'optimum' management of land degradation (i.e. building 'positive' social memory) (Davidson, 2010), possibly associated with an understanding of how well managed systems may help attract more tourists (e.g. ARB, CP, AM). The fact that some study sites are situated near national parks (CP, ARB) has shown that complex interlinkages exist between sustainable management regimes (e.g. well maintained terraces, use of traditional olive tree varieties and management) and the potential of these areas for tourism as a pluriactive opportunity. In addition, a re-valorisation of activities currently seen as 'unimportant', or indeed 'unattractive', will also be needed to revert loss of cultural values, such as shepherding in transhumant grazing systems (e.g. CP). Only if such activities are given additional or new values (possibly encouraged by policies) that may attract and retain young local people is it likely that the resilience of these systems will be improved.

Closely associated with processes exacerbating loss of social memory is the issue of knowledge transfer at different scales and how it affects responses to land degradation. The discussion above has highlighted the importance of knowledge transfer in successful land degradation alleviation, and also emphasised that in most study sites knowledge transfer has been sub-optimal. The discussion particularly highlighted how the loss of learning and knowledge about land degradation has severely disrupted social memory which is crucial for successful land degradation alleviation (e.g. loss of skills how to properly manage and repair dry stone terraces). But intra-community knowledge transfer – i.e. transfer of land degradation-related information and knowledge *between* different communities in a region –

has also been severely disrupted by socio-cultural and economic changes in all study sites. Loss of social capital has been a key driver for this, especially as rural outmigration (particularly young people) has led to weakening family ties with neighbouring communities (e.g. fewer marriages between communities). This has been further exacerbated by globalisation and 'vertical' rather than 'horizontal' integration in regions, as well as increased competition between communities and the resulting rise in self-interest, which means that advice on land degradation by community stakeholders is increasingly sought from 'higher-level' actors rather than from neighbouring villages, as was often done in the past (e.g. BG, AM, ZC). Loss of trust is closely associated with a reduced (perceived) need to obtain information about land degradation alleviation provided by neighbouring communities. The overall picture that emerges, therefore, is one of loss of need to rely on other communities for help, which means that it is becoming rarer for stakeholders affected by land degradation to see 'best practice' outside their community. In addition, intra-community rivalry is often encouraged by opaque regional governance structures, further marred by cronyism and corruption. Policies, thus, need to ensure that power structures and hierarchies between the local and regional level are clear to all stakeholders affected by land degradation, that they can trust experts in other communities or at regional level, and that evidence of 'best practice' is not only disseminated within one community but across the wider region.

Policy implications related to loss of learning and knowledge, disruptions in social memory, and problems with knowledge transfer about land degradation at various scales, are particularly linked to providing better incentives for stakeholders to find ways to retain existing knowledge, and to pass this on to the next generation. The successful cooperative in San Mauro Cilento (ARB) has particularly highlighted that social memory and traditions still play an important role in decisions affecting both land management and land degradation alleviation, especially by bringing together stakeholders to share positive skills and knowledge for addressing land degradation. Policies that enable better funding for similar initiatives in other communities would enable much better knowledge retention and implementation of sustainable environmental management practices than is currently the case. Indeed, 'demonstration cooperatives' supported by the advisory services could play an important role in facilitating changes and improving trust in the farming community.

Finally, and as both Sendzimir et al. (2011) and Wilson et al. (2016) have highlighted, a key stumbling block for improving social memory in communities affected by land degradation relates to psychological conservatism, cultural resistance and/or inertia within communities with regard to implementing new pathways of decision-making, innovative ideas, and changing long-established practices which have proven detrimental for alleviation of land degradation. Our findings suggest that many of the 22 case study communities are conservative (with a small 'c'), and that people are often 'stuck in their own ways' without much willingness or ability to envisage change. This locks in specific rites, traditions and customs in often unsustainable soil management pathways that have gradually eroded natural capital and that have also frequently led to an unwillingness to embark on innovative pathways related to land degradation alleviation. Most worryingly, however, respondents also often emphasised that communities needed help from outside in order to address land degradation – epitomising a loss of endogenous adaptive capacity. As a result, many communities were not self-reliant in dealing with land degradation problems and continued to be dependent on the municipality/regional level to implement land degradation alleviation measures.

Overall, the loss of social memory and learning pathways associated with managing land degradation emerged as a critical factor constraining stakeholders from effectively responding to land degradation issues at community level. It would, therefore, not take much to tip the balance beyond irreversible thresholds of both community decline and worsening land degradation in most communities. As a result, it is important to strengthen 'potential for change' from the social capital perspective, which is directly linked to the openness and flexibility of the system. This is related to the willingness and capacity of individual stakeholders, groups and institutions to change, which may promote development and acceptance of innovations. Where policies were implemented to help improve education, learning, knowledge transfer and conservation of traditional knowledge (e.g. MP, ARB), they have contributed strongly to the potential to initiate changes and improve adaptive capacity. Key aspects of these policies have to include knowledge- and awareness-raising schemes, training courses (e.g. MP forestry courses) and education (e.g. ARB cooperative) that help build 'positive' social memory and thereby raise community resilience.

The fact that some social capital aspects are still moderately well developed (e.g. stakeholder communication, trust and pride in area) suggests that positive *residual social memory* could be further harnessed in future to improve land degradation responses. Key arenas for more targeted policies in all study sites, thus, involve targeted policies that help keep more young people in the communities and to improve intergenerational exchange of information and skills relevant for land degradation alleviation. In some cases loss of social memory can be reversed, e.g. through return migration of young people or when community stakeholders manage to come together with a common vision for harnessing remaining knowledge about how to combat land degradation and being willing to pass on this knowledge to the next generation.

Acknowledgements

This study was part of the LEDDRA EU Project and the authors acknowledge funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under Grant Agreement no. 243857. The authors are particularly grateful to the 350 interviewees who provided valuable information on land degradation in the 22 communities under investigation and to the two anonymous referees for very constructive comments.

References

Adger WN. 2000. Social and ecological resilience: are they related? *Progress in Human Geography* **24** (3): 347-364.

Adger WN, Hughes TP, Folke C, Carpenter SR, Rockstrom J. 2005. Social-ecological resilience to coastal disasters. *Science* **309**: 1036-1039.

Alados C L, El Aich A, Komac B, Pueyo Y, García-González R. 2007. Self-organized spatial patterns of vegetation in alpine grasslands. *Ecological Modelling* **201**: 233-242.

Alados CL, Errea P, Gartzia M, Saiz H, Escos J. 2014. Positive and negative feedbacks and free-scale pattern distribution in rural population dynamics. *Plos One* **4th December 2014**: 1-17.

Barbayiannis N, Panayotopoulos K, Psaltopoulos D, Skuras S. 2011. The influence of policy on soil conservation: a case study from Greece. *Land Degradation and Development* **22**: 47-57.

Barthel S, Folke C, Colding J. 2010a. Social-ecological memory in urban gardens: retaining the capacity for management of ecosystem services. *Global Environmental Change* **20** (2): 255-265.

Barthel S, Soerlin S, Ljungqvist J. 2010b. Innovative memory and resilient cities: echoes from ancient Constantinople. In: Sinclair P, Herschend F, Nordquist G, Isendahl C. (eds). *The urban mind*. Uppsala: Uppsala University Press, pp 391-405.

Briassoulis H. 2004. The institutional complexity of environmental policy and planning problems: The example of Mediterranean desertification. *Journal of Environmental Planning and Management* **47** (1): 115-135.

Briassoulis H. (ed) 2005. *Policy integration for complex environmental problems: the example of Mediterranean desertification*. London: Ashgate.

Chaskin RJ. 2008. Resilience, community, and resilient communities: conditioning contexts and collective action. *Child Care in Practice* **14** (1), 65-74.

Davidson DJ. 2010. The applicability of the concept of resilience to social systems: Some sources of optimism and nagging doubts. *Society and Natural Resources* **23**: 1135-1149.

Detsis V. 2010. Placing land degradation and biological diversity decline in a unified framework: Methodological and conceptual issues in the case of the north Mediterranean region. *Land Degradation and Development* **21** (5): 413-422.

Fairhead J, Scoones I. 2005. Local knowledge and the social shaping of soil investments: Critical perspectives on the assessment of soil degradation in Africa. *Land Use Policy* **22**: 33-41.

Folke C. 2006. Resilience: The emergence of a perspective for social-ecological system analyses. *Global Environmental Change* **16** (3): 253-267.

Folke C, Colding J, Berkes F. 2003. Synthesis: Building resilience and adaptive capacity in social-ecological systems. In: Berkes F, Colding J, Folke C. (eds). *Navigating social-ecological systems: Building resilience for complexity and change*. Cambridge: Cambridge University Press, pp. 329-352.

Forbes BB, Stammler F, Kumpula T, Meschtyb N, Pajunen A, Kaarlejärvi E. 2009. High resilience in the Yamal-Nenets social-ecological system, West Siberian Arctic, Russia. *Proceedings of the National Academy of Sciences of the USA* **106**: 22041-22048.

Gale D. 1996. What have we learned from social learning? *European Economic Review* **40**: 617-628.

Ghorbani M, Azarnivand H, Mehrabi AA, Jafari M, Nayebi H, Seeland K. 2013. The role of indigenous ecological knowledge in managing rangelands sustainably in Northern Iran. *Ecology and Society* **18** (2).

Healy C. 1997. *From the ruins of colonialism: history as social memory*. Cambridge: CUP.

Imeson A. 2012. *Desertification, land degradation and sustainability: paradigms, processes, principles and policies*. Chichester: Wiley-Blackwell.

Johnston RJ, Gregory D, Pratt G, Watts M. (eds) 2000. *The dictionary of human geography*. Oxford: Blackwell.

Karamesouti M, Detsis V, Kounalaki A, Vasiliou P, Salvati L, Kosmas C. 2015. Land-use and land degradation processes affecting soil resources: Evidence from a traditional Mediterranean cropland (Greece). *Catena* **132**: 45-55.

Kelly C, Ferrara A, Wilson GA, Ripullone F, Nole A. 2015. Community resilience and land degradation in forest and shrubland socio-ecological systems: evidence from Gorgoglione, Basilicata, Italy. *Land Use Policy* **46**: 11-20.

Kizos T, Detsis V, Iosifides T, Metaxakis M. 2014. Social capital and social-ecological resilience in the Asteroussia Mountains, Southern Crete, Greece. *Ecology and Society* **19** (1): 40.

Kosmas C, Detsis V, Karamesouti M, Kounalaki K, Vassiliou P, Salvati L. 2015. Exploring long-term impact of grazing management on land degradation in the socio-ecological system of Asteroussia Mountains, Greece. *Land* **4** (3): 541-559.

Lebel L, Anderies JM, Campbell B, Folke C, Hatfield-Dodds S, Hughes TP, Wilson J. 2006. Governance and the capacity to manage resilience in regional social-ecological systems. *Ecology and Society* **11** (1): 19.

Magis K. 2010. Community resilience: An indicator of social sustainability. *Society and Natural Resources* 23: 401-416.

Olick JK, Robbins J. 1998. Social memory studies: From 'collective memory' to historical sociology of mnemonic practices. *Annual Review of Sociology* **24**, 105-140.

Ostrom E. 2008. Frameworks and theories of environmental change. *Global Environmental Change* **18**: 249-252.

Reynolds J, Stafford-Smith M. (eds) 2002. *Global desertification: Do humans cause deserts?* Berlin: Dahlem University Press.

Rotmans J, Martens P, Van Asselt MB. 2002. Introduction. In: Martens P, Rotmans J. (eds). *Transitions in a globalising world*. Lisse (NL): Swets and Zeitlinger, pp. 1-16.

Sendzimir J, Reij CP, Magnuszewski P. 2011. Rebuilding resilience in the Sahel: regreening in the Maradi and Zinder regions of Niger. *Ecology and Society* **16** (3): 1.

Stump D. 2010. 'Ancient and backward or long-lived and sustainable?' The role of the past in debates concerning rural livelihoods and resource conservation in Eastern Africa. *World Development* 38 (9): 1251-1262.

Tidball GK, Krasny EM, Svendsen E, Cambell L, Helphand K. 2010. Stewardship, learning and memory in disaster resilience. *Environmental Learning Research* **16** (5-6): 591-609.

Von Bertalanffy L. 1968. *General systems theory: foundation, development, application*. London: Allen Lane.

Walker BH, Salt D. 2006. *Resilience thinking: Sustaining ecosystems and people in a changing world*. Washington (D.C.): Island Press.

Ward C, Styles I. 2006. Evidence of the ecological self: English-speaking migrants' residual links to their homeland. *International Journal of Applied Psychoanalytical Studies* **4** (4): 319-332.

Wilson GA. 2012. *Community resilience and environmental transitions*. London: Routledge/Earthscan.

Wilson GA. 2013. Community resilience, social memory and the post-2010 Christchurch (New Zealand) earthquakes. *Area* **45** (2): 207-215.

Wilson GA. 2015. Community resilience and social memory. *Environmental Values* **24** (2): 227-257.

Wilson GA, Quaranta G, Kelly C, Salvia R. 2016. Community resilience, land degradation and endogenous lock-in effects: evidence from the Alento region, Campania, Italy. *Journal of Environmental Planning and Management* **59** (3): 518-537.

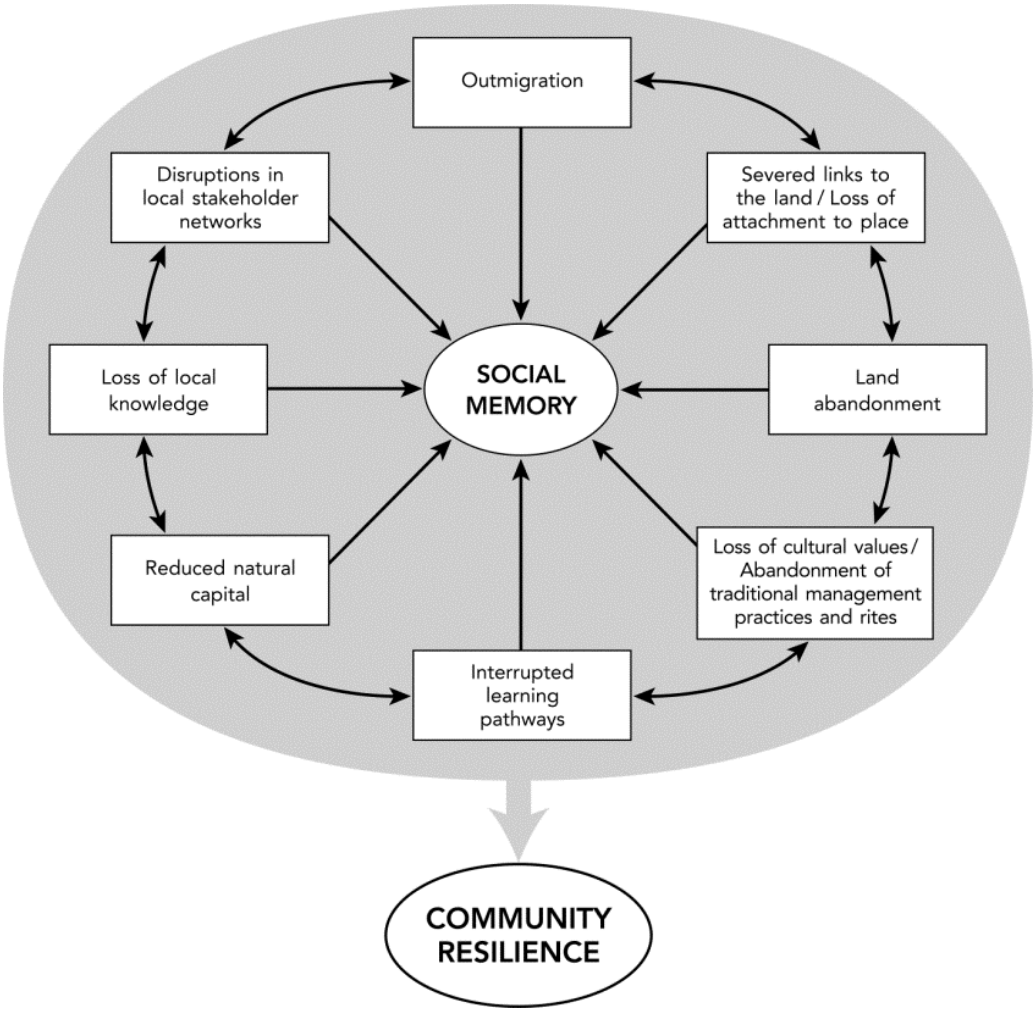

Figure 1: Factors affecting social memory, land degradation and community resilience (Source: authors; after Olick & Robbins, 1998; Stump, 2010; Wilson, 2015)

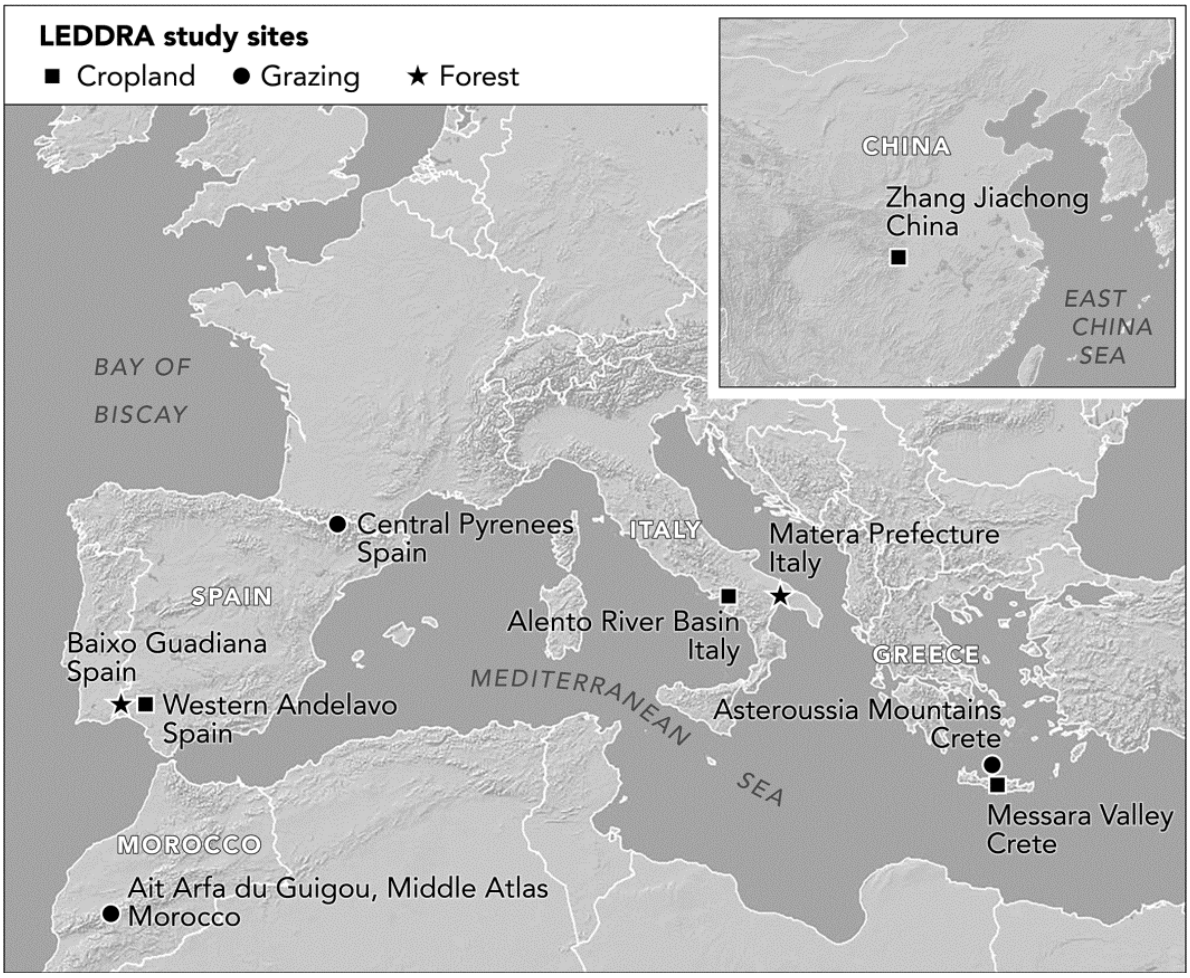

Figure 2: The LEDDRA study sites (Source: authors)

Table 1: Key characteristics of the nine LEDDRA study sites (Source: authors)

	Messara Valley (Greece) **MV**	**Alento River Basin (Italy)** **ARB**	**Western Andelavo (Spain)** **WA**	**Zigui County (China)** **ZC**	**Central Pyrenees (Spain)** **CP**	**Ait Arfa du Guigou (Morocco)** **AADG**	**Asteroussia Mountains (Greece)** **AM**	**Baixo Guadiana (Spain)** **BG**	**Matera Prefecture (Italy)** **MP**
Predominant land use	Cropland	Cropland	Cropland	Cropland	Grazing	Grazing	Grazing	Forest	Forest
Size (ha)	91,000	55,000	13,500	242,700	138,400	61,700	56,100	261,200	343,400
Steepness of terrain (%)	0-35	25-60	5-40	8-40	20-60	10-50	20-55	10-40	5-35
Average annual rainfall (mm)	500	900	600	1250	1350	600	650	500	600
Land degradation issues									
Loss of fertility	✓	✓	✓	✓		✓	✓	✓	
Soil organic matter decline	✓	✓		✓				✓	✓
Soil compaction and sealing	✓	✓	✓						
Landslides		✓							✓
Land loss to urbanisation/ Development		✓		✓	✓			✓	
Aquifer depletion	✓		✓					✓	
Impacts of land degradation									
Biodiversity loss		✓	✓	✓	✓	✓	✓		✓
Loss of agricultural production	✓	✓	✓	✓	✓	✓	✓	✓	✓
Land abandonment	✓	✓	✓		✓	✓	✓	✓	✓
Outmigration	✓	✓	✓	✓	✓	✓	✓	✓	✓