Cuadernos de Investigación Geográfica *Geographical Research Letters*	2022	Nº 48 (1)	pp. 23-40	EISSN 1697-9540

http://doi.org/10.18172/cig.4850

DESERTIFICATION AND DEGRADATION RISKS VS POVERTY: A KEY TOPIC IN MEDITERRANEAN EUROPE

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ABSTRACT. Land degradation and, subsequently, desertification processes are conditioned by biophysical factors and human impacts. Nowadays, there is an increasing interest by social scientists to assess its implications. Especially, it is relevant to the potential changes and landscape deterioration on population, economic systems and feedbacks of local societies to such adjustments. Assessing social facets should also be related to desertification risks, integrated socio-economic inputs and environmentally sustainable development perspectives. However, investigations about the effects of land degradation conditioned by global socioeconomic-factors from a holistic point of view are scarce. In this review, we pretend to discuss past and recent findings on land degradation risks related to poverty, especially based on Mediterranean Europe. To achieve this goal, we focused on key socioeconomic forces such as developmental policy, production and market structure, social change and population mobility. Our review showed that regional disparities based on complex dynamics of demographic forces (e.g. migration, fertility and ageing) and economic drivers of change (e.g. industrial concentration, urbanization, crop intensification, tourism pressure, coastalization) are keys to understand Mediterranean regions such as Southern Italy, a region exposed to high desertification risk in Europe. We concluded that the overexploitation of territories, soil and water degradation urban expansion, tourism and unplanned industrialization are some sectors and activities which can be highly affected by political and socioeconomic forces leading to unsustainable forms of land management and types of development. Special attention should be paid to social policies, education and training schemes to reduce rural migration and potentiate territorial knowledge to avoid land degradation, considering other social issues such as poverty or centralization. The potential role of win-win policies abating poverty and reducing desertification risk is evident in Mediterranean Europe and achieving land degradation neutrality necessary.

Riesgos de desertificación y degradación vs pobreza: un tema clave en la Europa mediterránea

RESUMEN. Los procesos de degradación del territorio y, consecuentemente, los de desertificación están condicionados por factores biofísicos e condicionantes humanos. Hoy en día, existe un interés creciente por parte

de los científicos sociales por evaluar sus implicaciones. Especialmente, un interés por los posibles cambios y el deterioro del paisaje a consecuencia de la población, los sistemas económicos y las reacciones de las sociedades locales a dichos ajustes. La evaluación de las facetas sociales también debería estar relacionada con los riesgos de desertificación, los aportes socioeconómicos integrados y las perspectivas de desarrollo ambientalmente sostenible. Sin embargo, las investigaciones sobre los efectos de la degradación del territorio condicionado por factores socioeconómicos globales desde un punto de vista holístico son escasas. En esta revisión, pretendemos discutir los hallazgos pasados y recientes sobre los riesgos de degradación de la tierra relacionados con la pobreza, especialmente en la Europa mediterránea. Para lograr este objetivo, nos enfocamos en fuerzas socioeconómicas clave como la política de desarrollo, la estructura de producción y mercado, el cambio social y la movilidad de la población. Nuestra revisión demostró que las disparidades regionales basadas en la dinámica compleja de las fuerzas demográficas (por ejemplo, la migración, la fertilidad y el envejecimiento) y los impulsores económicos del cambio (por ejemplo, la concentración industrial, la urbanización, la intensificación de cultivos, la presión del turismo, la cosificación) son clave para comprender las regiones mediterráneas como el sur de Italia, una región expuesta a un alto riesgo de desertificación en Europa. Concluimos que la sobreexplotación de territorios, la degradación del suelo y el agua, la expansión urbana, el turismo y la industrialización no planificada son algunos sectores y actividades que pueden verse muy afectados por fuerzas políticas y socioeconómicas que conducen a formas insostenibles de ordenación territorial y tipos de desarrollo. Se debe prestar especial atención a las políticas sociales, los esquemas de educación y capacitación para reducir la migración rural y potenciar el conocimiento territorial para evitar la degradación de la tierra, considerando otros temas sociales como la pobreza o la centralización. El papel potencial de las políticas de beneficio mutuo para abatir la pobreza y reducir el riesgo de desertificación es evidente en la Europa mediterránea y es necesaria la neutralidad de la degradación del territorio.

Key words: Land degradation, regional geographical disparities, social processes, Southern Europe.

Palabras clave: Degradación del territorio, disparidades geográficas regionales, procesos sociales, Europa del sur.

Received: 19 August 2020

Accepted: 21 March 2021

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1. Introduction

Environmental changes driven by biophysical factors and human impacts together arise interest among the social researchers (Xie *et al.,* 2020; Chasek *et al.,* 2019; Turner, 1994)**.** Usually, social scientists focus on the potential changes and landscape deterioration due to human activities, assessments of economic systems and feedbacks of local societies to such adjustments (Hussen, 2018; Berry *et al.,* 2019) While spatiotemporal uncertainty at the different scales and environmental risks are the key questions of the processes concerning social dynamics and political actions to be implemented (Nocenzi, 2005), the economic controversy about sustainable growth is still dominant. They are intrinsically defined by a complex synergy between environmental and social drivers (Giampietro, 2019; Bekun *et al.,* 2019). In these regards, Land Degradation (LD) leading to desertification risk is a complex phenomenon, which has received numerous definitions since the last decades (Akhtar-Schuster *et al.,* 2017; Reynolds *et al.,* 2011; Conacher and Sala, 1998). LD reduces soil fertility and leverages environmental and economic movements that define the territory at diverse temporal and spatial scales. In arid and semi-arid areas, land degradation or desertification could turn into potential processes of deterioration such as soil erosion (Borrelli *et al.,* 2016; Coelho and Sala, 1998). Implying a decline in soil fertility and reduced sustainability **(**Arshad and Martin, 2002), LD and desertification lead to an increase in land consumption affecting natural ecosystems

or protected areas (Smith *et al.,* 2020). In this regard, it is interesting to highlight the pioneering research conducted in the Spanish mountain areas, fertile soils close to the coast and rivers or abandoned territories during the 80s and 90s affected by LD processes and an imminent intensification of human activities (e.g. Garcia-Ruiz *et al.,* 1986; Lasanta *et al.,* 1995; Cerdà, 1995; Schnabel, 1994; Garcia-Ruiz *et al*., 1995).

In the past, LD was considered to be a specific issue of some territories due to particular sequences of natural drivers (Francke *et al.,* 2020; Larrey *et al.,* 2020). LD is generally associated to biophysical conditions (soil characteristics, steep slopes, lack of vegetation cover, (e.g. Kou *et al.,* 2016; Cerdà *et al.,* 2021; Boix-Fayos *et al.,* 2001; Vagen *et al.,* 2016) together with drought features when we talk about desertification (e.g. Ahmadi and Moradkhani, 2019; Ciais *et al.,* 2005; Emadodin *et al.,* 2019), but socioeconomic factors can also modify sensitive landscapes (García-Ruiz *et al.,* 2013; Butzer, 2005). Due to the current economic capitalism system (characterized by the importance of an elevated production, offer and consumption) and the over-use of the natural resources by an increase in the population, there has been a drastic acceleration of this process from western Europe in the 16th century to the Mediterranean countries (García Latorre *et al.,* 2001). This cannot be only explained as an explicit consequence of climate change or non-sustainable agricultural practices. It instead advocates that worldwide socioeconomic processes at the local and regional scales affect land degradation (Herrmann and Hutchinson, 2005). Some authors stated that it exists a 'poverty trap' thesis, which is defined as a kind of spiral relationship between poverty and environmental degradation: the poor people are both agents and victims of natural resource erosion (Prakash, 1997; Zambon *et al.,* 2018).

However, we consider that it is necessary to discuss social facets dealing with desertification risk and assessing the integrated socio-economic and environmentally sustainable development. To date, reviews that serve the readers as background to face this topic are scarce and its necessity vital to achieving land degradation neutrality (Collantes *et al.,* 2018; Dallimer and Stringer, 2018). Therefore, in this review, the role of selected social variables on LD processes was extensively debated. Specifically, the possible connection between land poverty and degradation was discussed considering rural areas of Southern Italy as examples, regarded as a desertification hotspot. Also, the desertification process under different social perspectives such as political, sociodemographic and economic ones and the implications of changing human behaviours and lifestyles will be introduced.

2. Regional questions related to LD and disparities

The concentration of rainfall events in heavy storms, long dry periods, high temperatures and evapotranspiration rates (Rodrigo-Comino *et al.,* 2019; Nadal-Romero *et al.,* 2015; García Marín, 2008), lack of vegetation (Fernández and Vega, 2014; Lozano-Parra *et al.,* 2015) and soil characteristics (Asadi *et al.,* 2012; Karamesouti *et al.,* 2015; Kosmas *et al.,* 2016) are the key degradation drivers impacting on land vulnerability at the regional scale. LD in arid and semi-arid areas such as the Mediterranean is affected by the evolution of regional changes and disparities, and their interactions at diverse spatiotemporal scales (García Latorre *et al.,* 2001; Martínez-Valderrama *et al.,* 2016). The most common determinants of land vulnerability include aridity, impoverished soil properties and the consolidation of population and activities in specific points such as coastal areas. This is the consequence of the urban development, migration and some human activities such as tourism, agriculture, transports or mining (Crossland *et al.,* 2018; Baumber *et al.,* 2019; Keesstra *et al.,* 2018). Moreover, land abandonment in rural areas is deteriorating the traditional agricultural system, which especially is more sensible in sloping areas, which may induce critical consequences in marginal rural landscapes (Puigdefábregas and Mendizabal, 1998). Especially, regional-scale investigations highly manifest these dynamics. For example, a multivariate analysis carried out to detect ecological indicators quantifying land sensitivity in Italy at a detailed geographical scale suggest that climate aridity and soil quality are the crucial variables explaining spatial patterns of LD through the highest proportion of variance (Salvati and Zitti, 2009; Salvati *et al.,* 2016). Another indicator highlighted in regional studies is the aridity, which may depict the effect of intensity of LD as the most evident result of climate change patterns (Amit *et al.,* 2006; Carrión *et al.,* 2010; McTainsh

et al., 1989). Physical processes involved in LD are also related to soil properties and erosion rates by water (Dunkerley, 2004; Koiter *et al.,* 2017) or wind (Gholami *et al.,* 2017; Marzen *et al.,* 2015). Finally, the impact of land-use changes and vegetation cover on LD are due to the agriculture and drastic intensification along with sloping or coastal areas (Squire *et al.,* 2015; Holland, 2004) and deforestation in lowlands and hilly zones (Gates and Ließ, 2001; Ruprecht and Schofield 1989), grazing (Abdalla *et al.,* 2018; Greenwood and McKenzie, 2001; Minea *et al.,* 2019) or abandonment in marginal interior land (Rey Benayas *et al.,* 2007; García-Ruiz and Lana-Renault, 2011), as well as unsustainable management of woodlands in mountain areas (Campos *et al.,* 2013). Destruction of natural ecosystems and biodiversity loss also leads to increased overland flows, modifying the antecedent balanced systems by runoff changes and altering the long-term social equilibrium existing in local communities depending on agriculture and forest economy (Brandt and Thorne, 1996; Brandt *et al.,* 2003; Sterk, 2003).

We developed a simplified framework showing the factors that would increase LD in Figure 1 based on specialized published literature (Baumber *et al.,* 2019; Rubio and Bochet, 1998; Knerr, 2004; Cuffaro, 2001; Tanrivermis, 2003; Cerdà 1998; Lal 1990; García-Ruiz *et al.,* 2015; Smith *et al.,* 2015; Thornes, 1985; Poesen, 2018; Tarolli, 2016). Drivers such as crop production, livestock, energy supply, industry, transport activities, mining, tourism, urban growth and climate change are exerting pressure on natural resources. Among economic and social factors, demographic and economic changes, especially in coastal territories affect urban growth and sprawl and migrations. The main populated areas are concentrated in coastal areas with non-sustainable using of natural resources (Duvernoy *et al.,* 2018; Salvati *et al.,* 2019). This is connected to rural depopulation, which accelerates the crisis conditions in traditional and marginal rural territories (Colucci, 2017; Pulido *et al.,* 2019). As a consequence, land abandonment leads to LD in steeper areas, especially, in bare lands. The loss of fertility, biodiversity and landscape fragmentation will also affect water and air quality, water shortage, biogeochemical cycles and human health (Smith *et al.,* 2015; Arnaez *et al.,* 2011; Hoffman *et al.,* 2001; Rodrigo-Comino *et al.,* 2020). Achieving land degradation neutrality and sustainability through scientific and local knowledge, generating human awareness and applying efficient policies is necessary, which allow developing efficient land management plans (Gichenje and Godinho, 2018; Zitti *et al.,* 2015). Organic farming (Rodrigo-Comino *et al.,* 2020) or the whole of the group of solutions named as nature-based ones (Kalantari *et al.,* 2018; Fini *et al.,* 2017) must be carefully designed and applied considering the environmental issue and local conditions.

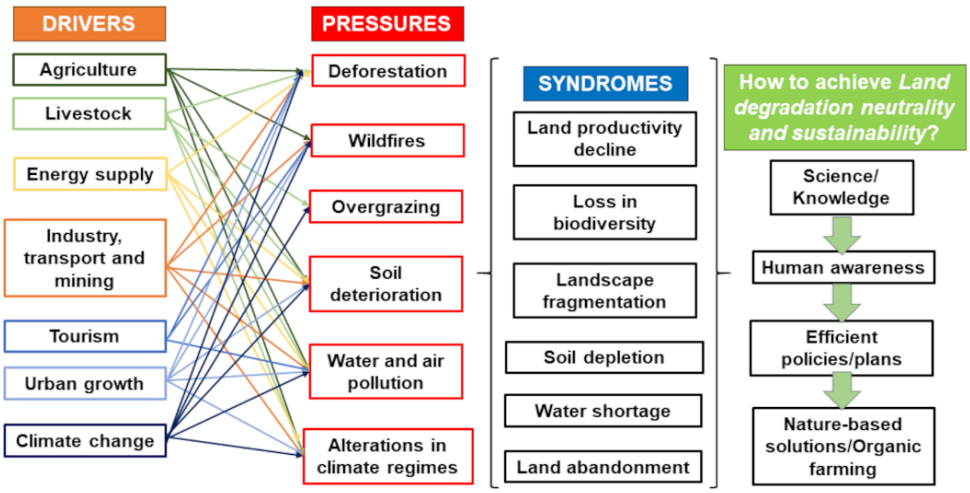

Figure 1. Forces leading to desertification risk and social consequences of poverty.

3. Increasing urbanization impacts

An increase of inhabitants can imply soil sealing by human spread into fertile lands (Bradford *et al.,* 1986; Fini *et al.,* 2017; Singer and Le Bissonais, 1998). Degradation of considered high-quality soils due to the urbanization growth can elevate the risks of wildfire, loss of biodiversity or the contamination of groundwater reservoirs (Askri and Al-Shanfari, 2017; Lotfi *et al.,* 2018; Bandala and Rodriguez-Narvaez, 2019). The tourism influx enhances land consumption of fragile natural areas and the overexploitation of water resources from coasts or mountains (Auernheimer and González, 2002; Bottrill, 2010). Especially, this concern affected land-use systems on the local communities (Philips and Jones, 2006).

3.1. Intensification of agriculture (quality and productivity) and urban sprawl

The intensification of the primary sector due to the use of machinery and low prices in the market represent an increase in crop surface and more elevated frequency of planting areas, which should be referred to the input of capital and labour. However, this is not generalized. The intensification of agriculture is considered by some authors as the major factor of soil and habitat deterioration due to deep-water drainage, irrigation, application of herbicides and pesticides, and tillage but also due to the low salaries and rural inhabitant rights, which promote rural depopulation (Serra *et al.,* 2014). There is evidence suggesting that in rural areas human impacts play a major role in the process of desertification due to overstocking, over-cultivation, and deforestation (Woods, 2009). Specific socio-economic factors that could be highlighted are nature of property rights on land ('environmental entitlements'), the institutions, cultural traditions as well as demographic dynamics. Notably, deforestation, overstocking and over-cultivation, determine a direct impact of human activities on the desertification (e.g. Cuffaro, 2001).

Low productivity is usually associated to arid and semi-arid areas or steep hillslopes which are affected by fluctuations of yields because of irregular pluviometric regimes and poor soils; however, this is also due to the non-sustainable agricultural practices. This tended to affect investments and the interest of novel scientific inputs to conserve land productivity and fertility. Although the priority to allocate development funds to the more productive landscapes could be assumed under economic criteria, policies (where applied) have set in motion a vicious circle with scarce economic and technological support. This would imply retrogressive management and weak economic performances in arid and semi-arid areas, because of the degradation of natural resources. The consequences are an accentuated difference between the rural and urban sectors and the rural itself, making clear "favourable" and "less favourable" land territories, causing disruptive influences on local communities (Suhrke, 1997). This can be also linked to non-controlled urban growth, which is related to LD processes. Urban sprawl in the Mediterranean is affecting natural ecosystems, soil fertility, the sustainability of coastal areas and quality of water resources among others (Barbero-Sierra *et al.,* 2013; Duvernoy *et al.,* 2018). It is understandable that in agriculture-dependent low-income countries land degradation could lead to a weak economic growth because the big share of the economy is made up of agriculture, but in advanced economies, the role of agriculture is very small. Therefore, this argument should be reconsidered in advanced economies as a factor for economic growth.

3.2. Social consequences of land degradation

Dynamics associated with migration, social inequality and underdevelopment are extremely linked with the local resource management. LD process carries out important socioeconomic implications. For example, LD may generate human displacement and induces migration. Because of the process of LD, especially in drylands, people may be forced to abandon the unproductive lands and seek for better income opportunities and a new source of livelihood in urban and coastal areas (Rey Benayas *et al.,* 2007). Notably, different human behaviours may represent, at the same time, a source of

LD. This would be affected by LD itself, suggesting a downward spiral, which is difficult to assess and mitigate through appropriate policies. In addition, other socioeconomic implications of LD stem from adaptive strategies and responses for mitigation to avoid political and institutional issues due to the scarcity of resources and environmental entitlements.

3.3. Migration, depopulation of rural areas and unemployment and social inequality

Rural migration and depopulation represent two different dynamics which could be directly or not linked to LD (Heat and Bingswangerb, 1996; Bilsborrow, 1992). Carrying capacity, population density and desertification risk are controversial and interrelated topics (Knerr, 2004). Past investigated experiences in rural areas of non-developing countries confirmed that arid and semi-arid areas could affect the number of inhabitants not able to conserve their living standards (Stern *et al.,* 1996; Amissah-Arthur *et al.,* 2000). Eroding environmental resources, therefore, does not continue an issue of the population staying there, but spreads to other regions even reaching neighboring territories by disseminating poverty and increasing disparities. This could generate future political or environmental conflicts, e.g. for natural or human resources (Chopra and Gulati, 1997; Drechsel *et al.*, 2001). We could consider that the type of living standard may be conditioned by the natural resources and less by human capabilities. The primary sector can improve land conservation or, on the contrary, can be the main degradation driver. In this situation, stakeholders, rural inhabitants and native natural ecosystems can be considered as victims. In addition, land abandonment could also represent another result of LD generating unbalanced population processes from inland to coastal areas. The densification processes of coastal territories could generate unemployment which may increase in more dense areas. Such process acts especially on vulnerable territorial elements such as women, old and young people, indirectly generating significant contributions to social deviance. Labour markets in rural areas associated with agriculture and rangelands are sensitive to trends in production, productivity and quality. Due to environmental conditioning factors linked to land degradation processes, even the tourism sector could suffer negative impacts by them (Bottrill, 2010; Barbier, 2000).

3.4. Loss of traditional practices, rural culture and poverty

The opportunity for technical support also plays an important role in sustainable land management. Although earlier studies have illustrated traditional skills of farmers able to maintain a high production level over structural aridity, there is little available information, at a wider level, about farmers' experiences in combating desertification. On the other hand, farmers-to-farmers visits should be encouraged to reduce the loss of traditional agricultural practices and to promote the sharing of experiences among communities, giving special consideration to women and youth. Poverty was analyzed considering this as a causal factor but also as a consequence of land degradation. Studies on the geography of poverty are scarce, but they use to insist upon the impoverishment could coincide with droughts, erosion or desertification (Sachs *et al.,* 2001). However, it is not clear if they present a linear or exponential correlation because of the extreme complexity of both phenomena. On the other, it is clearer that most cases of poverty show a mechanism through which institutions, policies or markets can affect land degradation (Powell *et al.,* 2001; Haan and Zoomers, 2003; Reidy, 2000). It intrinsically implies inappropriate public policies and institutional functions, which can cause i) geographical isolation; ii) vulnerability and increase of the occurrence in natural disasters; iii) demographic changes; and, iv) no access to a variety of public, private or social goods or services. The association of poverty and poor societies with marginality could also manifest some conditionals to this issue with clear implications on land degradation. Among them, land expropriation, demographic changes, intergenerational landscape fragmentation, privatization of common lands and expansion of commercial agriculture with reduced labour inputs could be considered as the main contributors' factors of LD because they motivate land abandonment and the reduction of land conservation strategies (Chopra and Gulati, 1997).

3.5. Emerging conflict for environmental resources, territorial dichotomy and social inequalities

The deterioration of the lands is increasing the number of conflicts because more territories have to share their resources. This provokes disparities among urban and rural areas especially about land ownership, cultivable and buildable surface availability or water storage (e.g., for both agricultural and domestic use) and energy source. Conflicts, especially for water resources, appear in developed countries affected to regular drought episodes such as the Mediterranean ones. Such conflicts may enhance migration movements and poverty among inland/marginal populations and represent a severe handicap to achieve land degradation neutrality and the sustainable development goals in arid and semi-arid areas. Human abuse or misuse of territory generating territorial divergences could suppose an important cause of conflicts and land degradation at the same time. In what measure human-related spatial dichotomy affect LD level or which social processes linking to inequality between populations can change desertification trends must be further investigated: i) land property rights; ii) political institutions; iii) cultural beliefs; and, iv) population structure and dynamics. Issues linked to resource unbalance, economic polarisation, and spatial dichotomy considering the possible influence on LD conditions along the Mediterranean basin are hot topics to be studied through a holistic point of view.

In Figure 2, a framework explaining the formation of social and environmental disparities in Southern Europe was designed. Disparities were represented along an elevation gradient, passing from coastal and lowland areas to inland, mountain and marginal ones. Dynamics of both poverty and LD depends on the elevation gradient. Along with a period (t0 and t1), land degradation would increase more in lowlands than in the mountain areas according to especially environmental pressures (e.g., increased aridity condition, poor soils and water resources, urban sprawl, fire impact, etc.) while poverty shows the reverse pattern due to especially social LD pressure. Such a framework allows us explaining different LD spatial patterns and the possible enhanced disparity among coastal and inland areas. Land resource management would depend on the structure of the primary production sector but it may be social unequal. Poverty can enhance to make decisions related to unsustainable methods to exploit resources and goods following a non-sustainable way. It should be tested if active participation occurs, local institutions can effectively manage the land.

Land accumulation and capitalist economic policies can enhance speculation and "throwaway" trends of resource exploitation, which could be ameliorated including strong programs of environmental education and understanding local traditions and religion. A key tool would be devoted to train and disseminate efficient economic incentives for sustainable development techniques to produce crops and animals (Rodrigo-Comino *et al.,* 2020; Hitzhusen, 2006; Nath, 2016). Concomitant factors could motivate poverty and degradation with irreversible soil loss and biodiversity. In arid lands, such condition may be defined as a downward spiral of 'poverty-LD'.

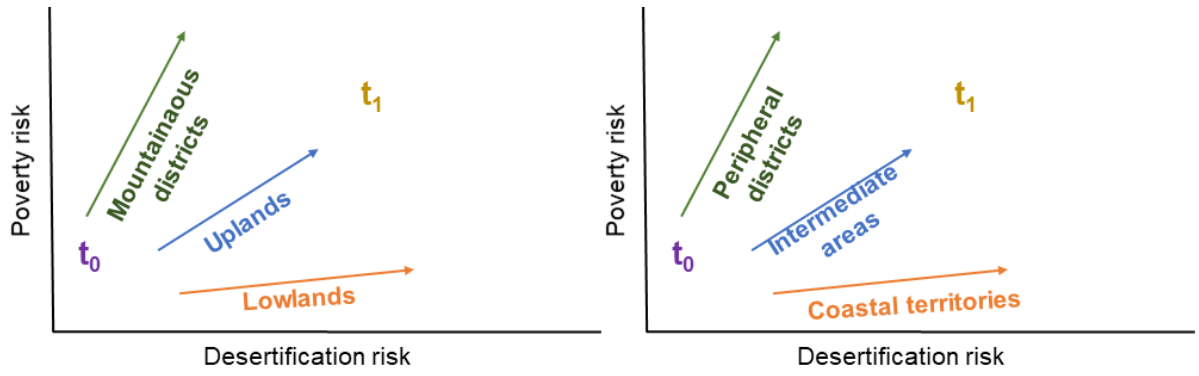

Figure 2. Hypothesis related to the trends over time in desertification and poverty risk in the Mediterranean context

4. Assessing the relationship between desertification risk and poverty: social indicators

Another critical point of the most recent literature on LD is the considerable lack in time series and scenarios analysis on vulnerable areas and the evolution of the main human factors involved. Although a multiplicity of statistical sources can be used in such studies, up to now, it is difficult to find data on human-induced LD trends at long-term periods and countries with different degree of development about (i) industrialisation during the fifties, (ii) intensification of the agriculture during sixties, (iii) higher demographic pressure up to seventies, (iv) increase in tourism pressure and urban sprawling along the coasts from early eighties, and (v) changes in the labour market from early nineties; and, (vi) land abandonment (extensification) of remote and rural areas. Low social variables are generally considered in the frameworks which built-up indexes of LD sensitivity such as the Environmental Sensitive Area (ESA) procedure (e.g. Karamesouti *et al.,* 2015; Kosmas *et al.,* 2016). Standard procedures to fix variables for these indexes should be easily computed at the highest spatial resolution and available, at least, every ten years. Setting up of metadata collection and the collection of multivariate tools (e.g., data mining, neural networks) should be carried out at different scales such as census section, municipality or province. This would make recognizable socioeconomic indicators. Also, the preparation of handbooks of good practices to be disseminated among the relevant authorities with the original datasets, final indicators and associated methodologies would be necessary. According to, a restricted panel of indicators able to depict social factors of LD in Mediterranean Europe is illustrated in Table 1, according to previous contributions on the topic (e.g. Salvati and Zitti 2009; Brandt *et al.,* 2003; Rubio and Bochet, 1998; Salvati *et al.,* 2008). Variables considered in this table are describing the most important characteristics of the society in terms of demographic, economic, and institutional elements.

Table 1. Examples of social indicators able to depict the human factors involved in LD processes.

Social	Demographic	Economic	Institutional/Policy
Poverty Gap Index	Population density	Gross domestic product	Scientific research funding
Unemployment rate	Demographic variation	Tourism density	Regional/local funding
GDP spent on education	Total fertility rate	Industrial concentration	Agri-environmental measures
Crime rate	Net migration rate	Agricultural intensity	Water use policy
Literacy index	Ageing rate	Farm income	Protected areas
Public perception of LD	Urban sprawl rate	Farm subsidies	Urban planning
	Farmer ageing	Crop productivity	Best practices

5. An example of downward spiral between poverty and desertification risk in Italy

In Italy, LD phenomena were visible in many inland and coastal municipalities of southern regions. Nowadays, Northern areas are becoming more sensitive to LD due to extreme drought episodes and the high agricultural intensification (Venezian Scarascia *et al.,* 2006; Munafò *et al.,* 2013). The dichotomy of LD sensitivity between coastal and inland zones increased during the seventies and maintained during the following decades. This was according to a progressive impact of human activities, especially, on the urban areas and more in general, on lowlands. The most sensitive areas include both southern part of the country as well as coastal zones along the Adriatic Sea and on the Po plain. LD sensitivity is moulded by complex geographic factors, where sensitivity increases in internal lowlands and coastal areas and decreases in mountain zones, according to a well-known increase in forests and decrease in human pressure and agriculture (Bouma *et al.,* 1998). Areas subjected to desertification risk are assessed based on a cartographic approach that takes into account mainly

ecological variables. It can be noted that only southern regions, namely Apulia, Sardinia, and Sicily present recent international literature in processes of desertification (Bajocco *et al.,* 2012).

Disparities among regions are well known in Italy not only at the environmental level but especially at the social and economic ones. While northern Italy represents one of the most European developed and rich regions, southern Italy includes regions with a marked growth deficit, high unemployment rate and evident gender disparity, both in the labour market and in participation to institutions and cultural life. Convergence in economic variables was observed among regions until the eighties but decreased in the last decade, suggesting that disparities among north and south still exist from a socioeconomic perspective. By integrating environmental and economic information, such a situation is confirmed by the inverse relationship between the level of per-capita income and LD rate (Fig. 3). Environmental and social drivers can mitigate ecological quality in low-income territories together like southern regions, generating the base background to begin a downward spiral 'Poverty – LD'. Such aspect is confirmed by an analysis of the positive relationship between relative poverty rate and LD rate at the regional level. While showing different levels of desertification risk, southern regions showed poverty rate always higher than 20% associated to a higher risk of desertification, while in many northern and central regions the poverty rate is considerably lower than 10% and sensitivity to LD is low or completely absent (Fig. 3).

To depict a downward spiral impacting natural and social factors, a logical framework (Fig. 4) is proposed here. We especially based on the effect of LD on the primary sector, which already explains more than 10% of the gross domestic product (compared to only 2% in northern Italy). Increasing agricultural intensification and mechanisation may provoke phenomena of LD through low-quality water management and unsustainable irrigation schemes.

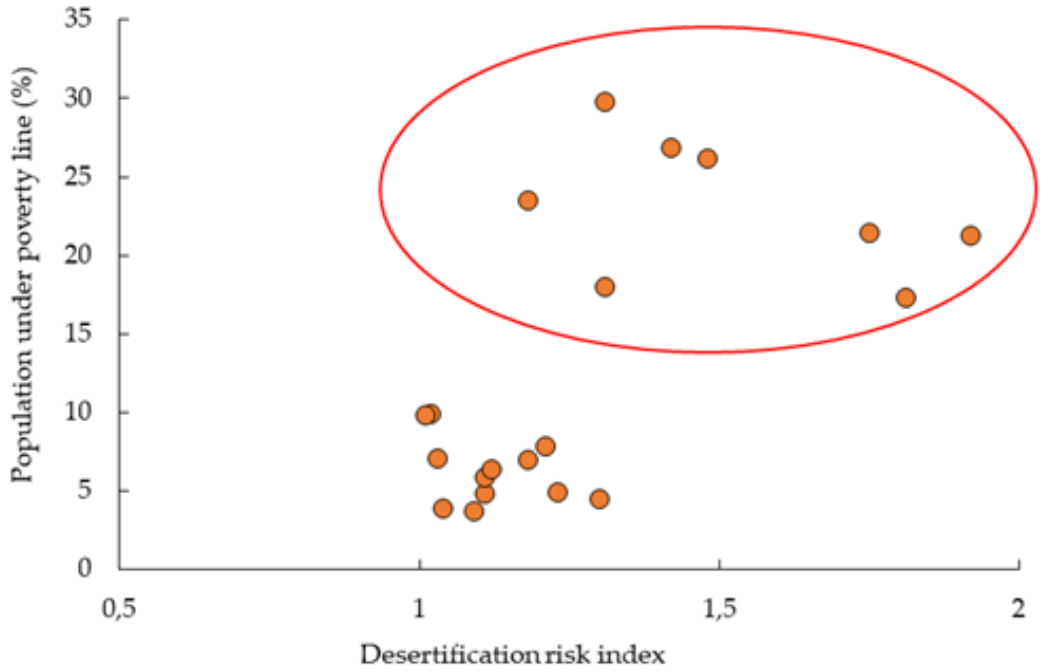

Figure 3. Relationship between desertification risk and population under the relative poverty line in Italy by administrative region (disseminated by National Institute of Statistics, ISTAT) in 2010 (Spearman rank correlation coefficient, rs = 0.54, p < 0.05, n = 20); red circle includes regions from Southern Italy; blue line indicates Central and Northern regions in Italy.

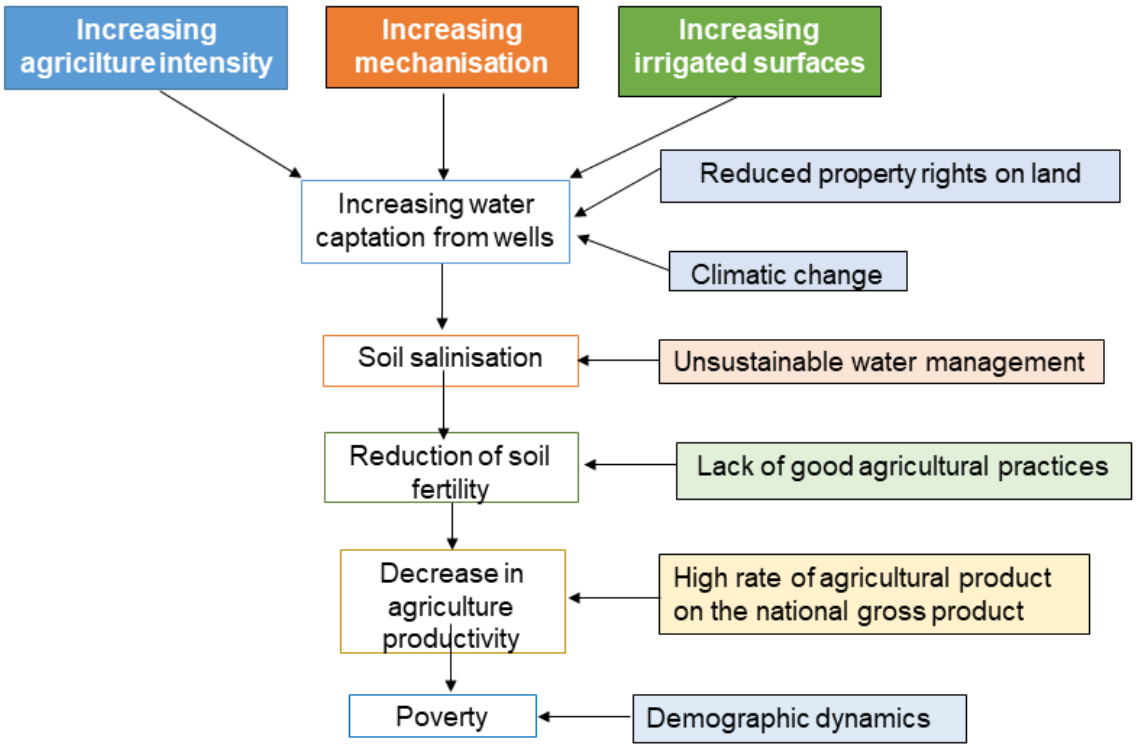

Figure 4. The downward spiral of desertification-poverty in Southern Italy.

At this point, climatic change may exacerbate local situations due to the lack of water resources and water extraction from wells combined with reduced property rights on lands with salinisation risks, subsequently, with a further reduction in land productivity. Compared to northern Italy, a weak application of good agricultural practices and low-sustainable management of land increase the medium-term risk of important economic loss in the primary sector. Since the primary sector significantly contributes to the total income, population movements and a consequent depopulation from inland, marginal areas are a reasonable response to this change. Territorial divergences increase and social disparities appear in rural, inland and coastal areas, increasing unemployment and poverty.

The importance of the interactions among LD and social determinants is highlighted by the analysis illustrated in Table 2. We classified the municipalities of southern Italy in four classes, according to their sensitivity to LD (Venezian Scarascia *et al.*, 2006). For each municipality, we calculated eleven social indicators (see paragraph before) and synthesize them per classes through their average figures weighted by commune surface. We can note that all the indicators, concerning labour market, education and social factors, are consistent in describing worse social conditions in high LD sensitivity areas, compared to the Italian average condition. The unemployment rate, especially those of women and youth, dramatically increase in the municipalities showing higher LD rate, while education levels showed a clear reversal pattern. Among the employees in the primary sector (which strongly increase in municipalities showing higher LD rate), ageing of farmers represents another key problem, especially in most degraded areas. Finally, taken as a proxy of 'social' life quality, crime rate showed the highest figures in the same areas.

Table 2. Relationship between level of land degradation and social variables in Southern Italy (disseminated by National Institute of Statistics, 2010, ISTAT).

Variable	Land degradation				Southern Italy	Italy
	Absent	Low	Medium	High		
Unemployment index (total)	18.6	18.8	20.0	23.3	20.8	11.9
Unemployment index (young)	48.1	48.9	49.2	54.4	50.9	30.7
Unemployment index (females)	24.7	25.5	27.5	32.0	28.5	16.6
Unemployment index (young females)	55.1	57.0	58.2	65.1	60.2	37.1
Employees in the primary sector (%)	12.0	14.0	16.0	14.0	15.0	10.0
Temporary employees in non-primary sector (%)	2.1	3.7	3.4	3.7	3.6	4.0
Population dropping out primary education (5)	11.8	12.3	13.7	14.4	13.6	11.1
Population with tertiary education degree (%)	4.6	5.1	5.0	4.9	5.0	5.0
Elderly index of farmers (% > 55 years)	18.0	20.0	21.0	21.0	21.0	23.0
Farmers with technical degree (%)	18.0	17.0	16.0	17.0	17.0	19.0
Crime rate (per 1.000 inhabitants)	14.6	13.0	17.6	24.3	18.8	20.4

6. Conclusions

Desertification risk is a social problem since land use is a socially constructed term. Reflections about land productivity and soil capacity, cropping systems and sustainable land management are products of a latent process of human-nature interactions. The socioeconomic structure, community integration, class inequality and developmental policy are discussed here in interaction with the theoretical framework of desertification risk. Assuming the underlying causes of desertification risk is directly related to human activities, anthropogenic pressure on natural resources leads to unsustainable ways of producing and living. The overexploitation of territories, soil and water, urban expansion, tourism and unplanned industrialization are some sectors and activities which come from political and socioeconomic forces leading to unsustainable forms of land management and types of unsustainable development. Social policies are important when combating desertification risk, and they can combat poverty and mitigate the impact of social inequality in rural areas. This is vital to achieving sustainable and equitable land. Education and training schemes to reduce rural migration and potentiate territorial knowledge could also help to avoid land degradation, affecting other social issues such as poverty or centralization. The potential role of win-win policies abating poverty and reducing desertification risk is evident in Mediterranean Europe.

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