

# Chapter 2

## Land Degradation and Security Linkages in the Mediterranean Region

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**Abstract** Impacts of land degradation on the technical, social, economic, and cultural environments of the Mediterranean region are discussed under their security aspects, including the risks caused by climate change and the possibilities of mitigation.

**Keywords** Land degradation · Mediterranean · Security · Climate change · Politics

### 2.1 Introduction

Land degradation in regions with marked water scarcity, like the Mediterranean region, is seen as a trigger for security problems in the social, economic, and cultural context. For this reason, NATO, together with the OSCE, organized an international conference in Valencia, Spain in late 2009 to discuss the security aspects of the impacts of land degradation, desertification, and water scarcity in the Mediterranean region (Rubio et al. 2009). In the following paper, some of the results related to soil and land degradation will be reported (see also Blum 2009; Kapur et al. 2011).

### 2.2 Land Degradation

“Land” normally means a physical entity in terms of its topography and spatial nature, including the natural resources such as soils, minerals, water, and biota that the land comprises (UNEP 2001). The six main forms of land use are described by Blum (2005).

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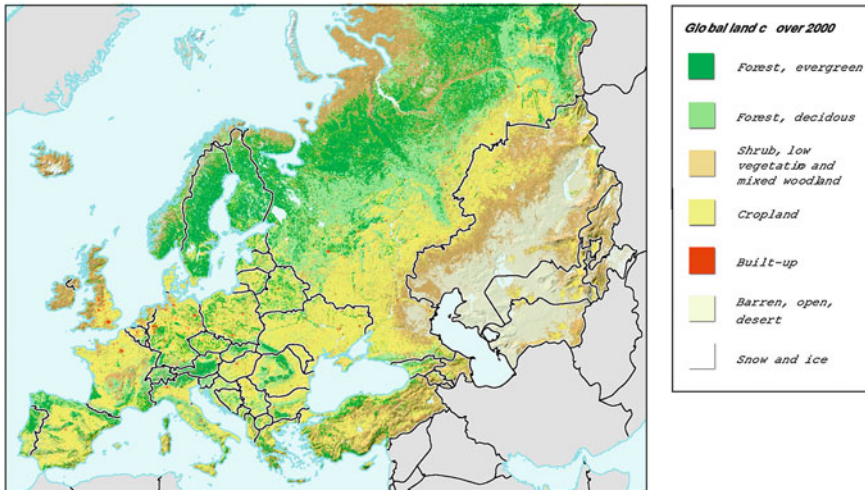
Land degradation is mainly caused by two types of unsustainable land use:

- sealing of land through urbanization and industrialization, excluding all further uses of soil and land such as biomass production, filtering, buffering, and transformation, as well as the function of soil as a gene reserve;
- unsustainable use of specific land functions, such as tourism and agriculture, causing erosion, compaction, contamination, and further soil deterioration.

The problem of sealing becomes visible by comparing Europe's natural resources at daytime with Europe's built environment at night, showing that large parts of Europe are sealed by urbanization, industrialization, and transport, from which emissions are released on the adjacent land surfaces (see Figs. 2.1 and 2.2). Figure 2.3 gives a detailed view of the increase in artificial areas in the coastal zones of the Mediterranean region between 1975 and 1990 by percentage, and the projected increase in urban population between 1990 and 2025 (EEA 2001).

These pictures indicate that sealing prevents all other uses of soil and land, especially biomass production, filtering of rain water, buffering, and biological transformation, as well as its function as a gene reserve.

Figure 2.4 shows in more detail the process of sealing of a landscape, taking southern Germany as an example, with towns, villages, and roads of first and second order connecting urban and peri-urban settlements, at a scale which is indicated in the picture.



**Fig. 2.1** European natural resources in daylight. Source <http://www.eea.europa.eu/data-and-maps/figures/distribution-of-natural-resources-in-the-pan-european-region-for-selected-issues-2>



**Fig. 2.2** Europe's built environment at night. *Source* <http://www.en.wikipedia.org>

Sealing for urbanization, industrialization, transport, and tourism is causing security problems in two ways:

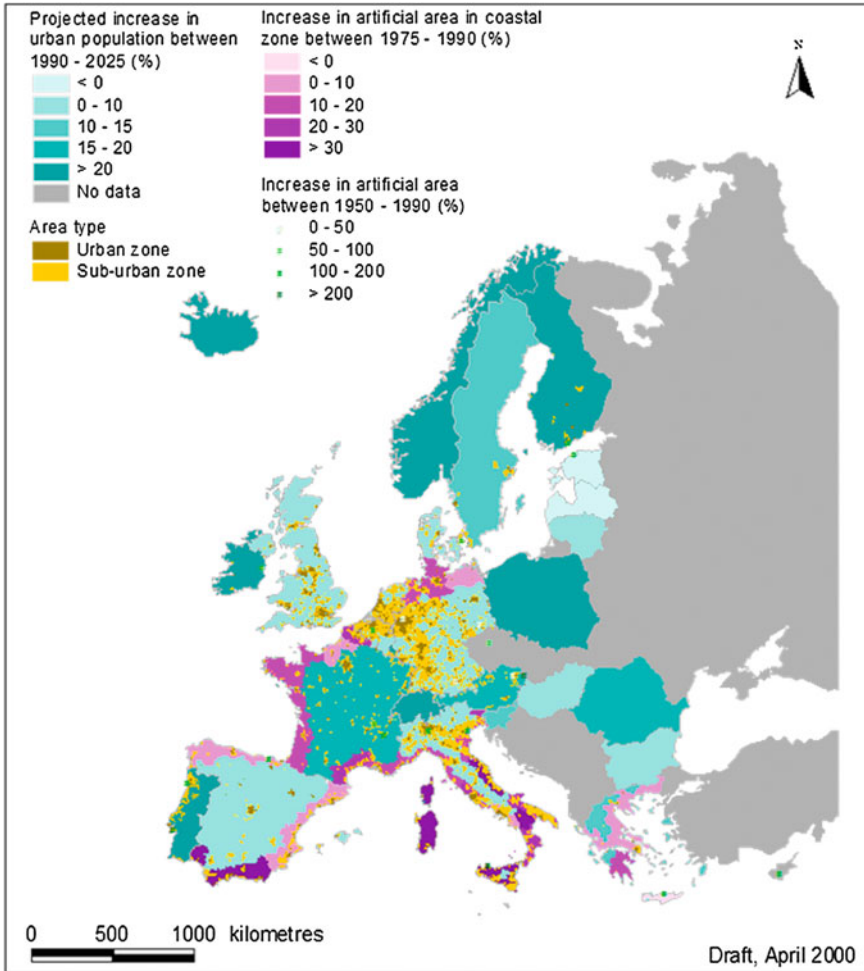
1. Ecological-technical problems are:

- impedance of rainwater infiltration, causing surface run-off, with the danger of flooding and the loss of rainwater storage in areas where this water would be urgently needed;
- high evaporation and water losses to the atmosphere from urban surfaces sealed by asphalt, concrete, and other dense materials, such as roofs, streets, and parking lots;
- increased temperature levels due to storage of radiation energy in constructions;
- production and accumulation of refuse and emission of dust and gases; and
- increased and concentrated demand for water in competition with other uses, e.g. agriculture.

For this reason, extensive tourist areas in the Mediterranean basin must be regarded from the aspect of security linkages.

2. Social, economic, and cultural problems are caused by:

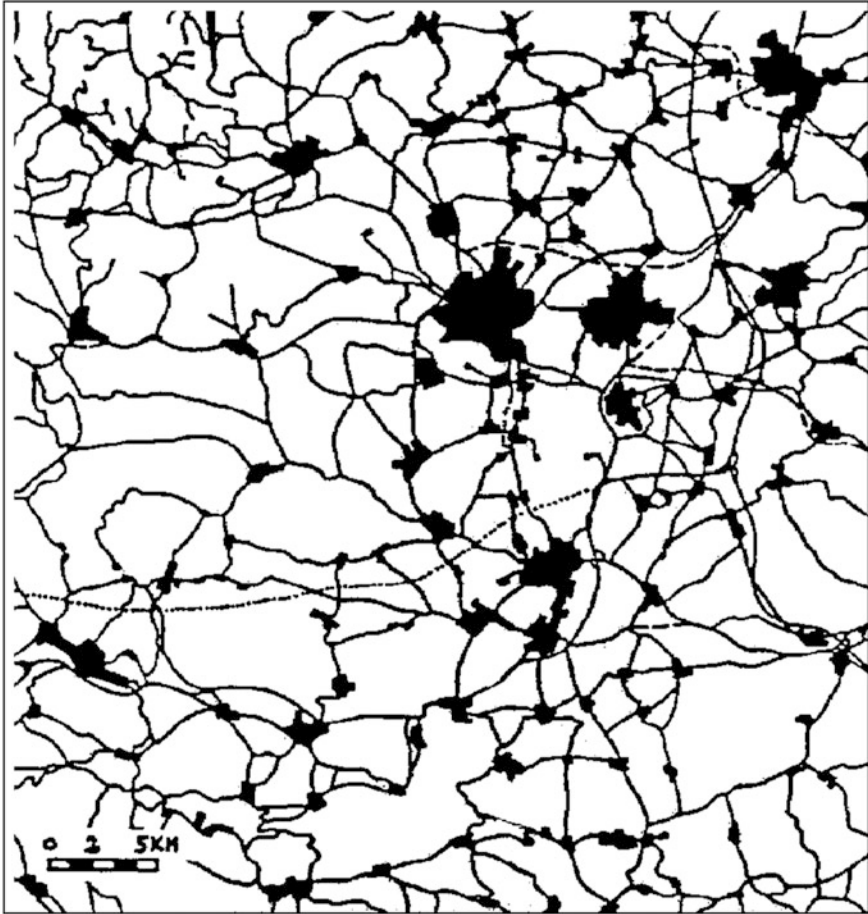
- disappearance of natural landscapes formerly used for recreation, agriculture, and forestry;



**Fig. 2.3** Increase of artificial areas in the Mediterranean coastal zone 1975–1990 in %. *Source* <http://www.eea.europa.eu>

- loss of livelihood for farmers and pastoralists through the loss of crop- and pastureland; and
- emergence of new social groups, especially in urban and peri-urban agglomerations, with problems of integrating into the existing social and economic environments.

Besides sealing as an exclusive form of competition, urban and peri-urban agglomerations cause important impacts, through physical and chemical loads, on the adjacent agricultural and forest lands, on the atmospheric pathway, on the waterways, and through terrestrial transport (see Fig. 2.5). These processes are still going on and have even been accelerating in the last decade, contaminating land

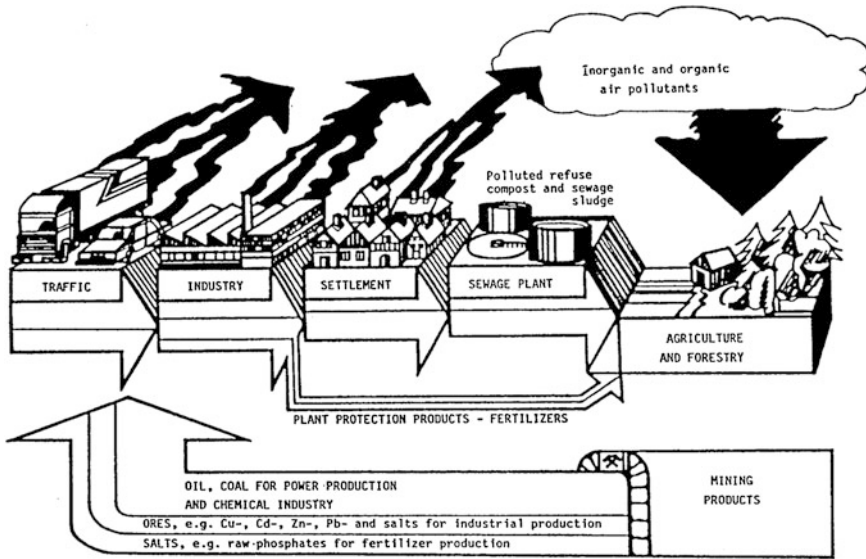


**Fig. 2.4** Sealing the landscapes in south-western Germany (note scale of 5 km). *Source* This author

and water surfaces with heavy metals and toxic organics at an intensity never observed before (Blum 1998, 2006).

An extreme form of land degradation is desertification, occurring under arid and semi-arid climatic conditions, characterized by a lack of rainfall during long periods of the year and a deficit in the water balance. These areas are specifically vulnerable to land degradation caused by forest fires, overgrazing, unsustainable agricultural cropping or urbanization, and industrialization (Blum 2006).

Desertification is mostly related to water scarcity caused by a severe water deficit. Moreover, a special problem in areas with water deficit is salinization through irrigation without sufficient drainage. Further problems occur through imbalanced water availability in upstream and downstream areas of water reservoirs. People upstream often have limitations on their land use, being forced to



**Fig. 2.5** Soil contamination through excessive use of fossil energy and raw materials. Further impacts of land degradation are caused by tourism (Previtali 2011), mining activities (Faz Cano et al. 2011), and especially by unsustainable agriculture. Figure 2.6 shows impacts on soils through compaction, accumulation of contaminants, e.g. pesticides, through the use of manures and fertilizers, through sewage sludge deposition, through soil erosion, through loss of organic matter, and through other causes (Blum 2007a). Unsustainable agricultural land use through the centuries can change and even ruin entire landscapes, as can be seen in many areas north and south of the Mediterranean (cf. Fig. 2.7). *Source* Blum (1988)

avoid soil erosion and subsequent sedimentation of the water reservoir, whereas people downstream are profiting from the water accumulated by the dams. Under such conditions conflicting interests exist, and these have to be solved by politics and decision-making.

Recently, new conflicts have arisen though the competition between the production of food on one side and of biofuels such as ethanol and biodiesel on the other, aggravated through water scarcity since water is needed for both production lines.

Looking into the impacts in order of urgency reveals that land and soil losses through sealing, mining of soil material, and soil erosion by water and wind, as well as intensive pollution of soils by heavy metals, xenobiotics, radioactive compounds, and advanced salinization and acidification and deep-reaching soil compaction are irreversible, in the sense that they cannot be reversed in a time span of about a hundred years or four human generations.

This judgment is important for defining priorities in combating land degradation and related security problems which may increase and accelerate with time, causing large-scale security issues.

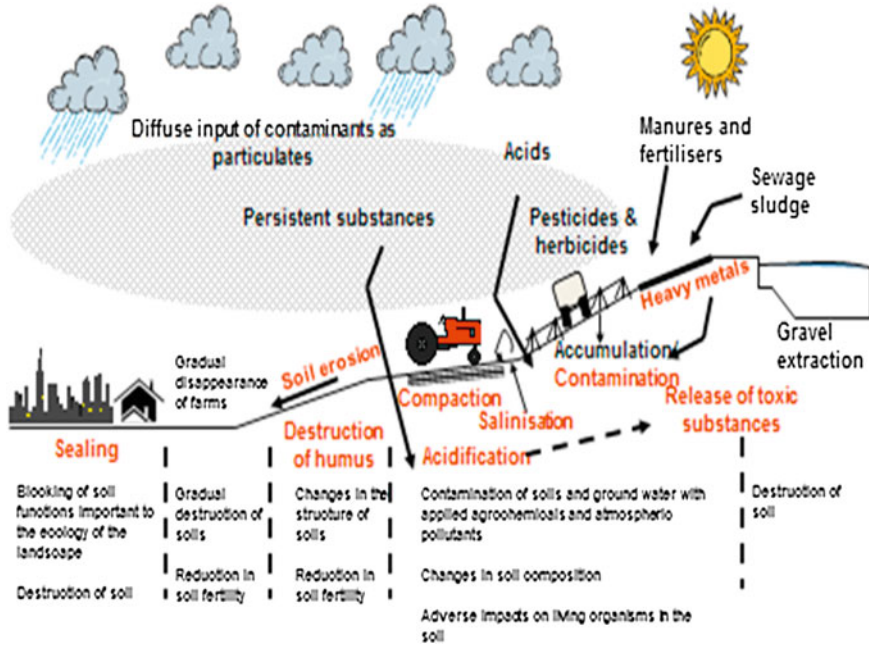


Fig. 2.6 Impact of agricultural and other human activities on soil. Source Eu.JRC.IES.Ispra/Italy

### 2.3 Security Problems Related to Water Scarcity

Water scarcity is typical for countries in the Mediterranean Basin because of its specific climatic conditions. Competition for the use of the scarce water resources already exists in areas with intensive agricultural irrigation, which consumes on the average more than 70 % of all available freshwater resources and leaves only less than 30 % for domestic and industrial purposes, not counting severe water losses through deficient water distribution systems such as pipes, where often up to 25 % of all available water is lost. The share of irrigated arable land in the Mediterranean region can be seen in Fig. 2.8 (FAO 2006).

Under these conditions, tourist activities during the dry season with a high demand for water can come into conflict with the needs of the local population, especially for agriculture and gardening. Moreover, unsustainable water use through agriculture with insufficient irrigation techniques causes loss of water reserves and salinization, and has an additional adverse impact on estuarine and coastal environments.

In some Mediterranean regions, it can increasingly be observed that rivers are no longer supplying groundwater resources. On the contrary, the groundwater resources are providing water for the rivers, which is a strong signal that the water balance is heavily disturbed. These processes are part of the desertification process



**Fig. 2.7** Extreme land degradation through long-term agricultural activities in western Algeria:  
*Source* Photograph by the author

and raise important issues of security, because under the prevalent and possible future climatic conditions, the results may be irreversible and can therefore endanger the basis of life of large parts of the population (Blum et al. 2004).

To summarize, security linkages can arise from two different kinds of impact:

- natural environmental imbalance leading to natural disasters such as extreme meteorological conditions, forest fires, and landslides;
- human-induced environmental impacts such as the depletion of natural resources, especially of soil and water, the loss of biodiversity, the sealing of land by urbanization, industrialization and tourism, and as an overall result of human activities climate change, which is a global result of innumerable locally defined processes.

For their impact as well as for the security problems they cause, two parameters are of paramount importance:

- the dimension of space, meaning, for example, the spatial scale of urbanization, of soil contamination, of landslides, and of forest fires and other events;
- the dimension of time, meaning the pace at which the impact-driven processes occur. For example, it is very important to determine whether sealing of large areas by urbanization occurs within a few years or within decades.

In this context, the impact of climate change might cause severe future risks.



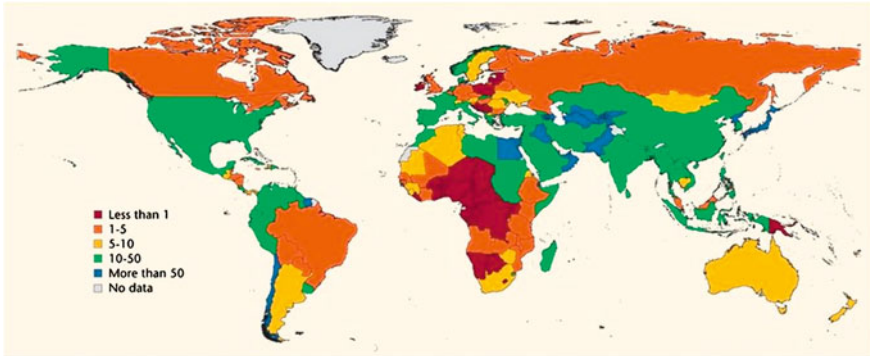


Fig. 2.8 Share of irrigated arable land. Source [www.unesco.org](http://www.unesco.org)

## 2.4 Climate Change and Future Risks

Looking at the *Intergovernmental Panel on Climate Change* (IPCC) scenario up to 2100, it becomes clear that not only CO<sub>2</sub> emissions but also the increase of CO<sub>2</sub> in the atmosphere and the resultant temperature rise are severe threats, especially to the Mediterranean region (see also Steffen et al. 2004). The overall indications are that the mean annual temperature in the Mediterranean Basin will increase, whereas the mean annual precipitation will decrease. A special case study for the Mediterranean coastal area is given by Fujinawa (2011).

If the distribution of irrigated land in the Mediterranean Basin is considered (Fig. 2.8), it becomes clear that in the Mediterranean region, several countries, for example Egypt, which is almost totally dependent on irrigation, will severely suffer from the decrease in water resources (see also Parry et al. 2004; Fischer et al. 2005).

## 2.5 Solving Security Issues by Bridging Between Science, Politics, and Decision-Making

Impacts on social and economic systems caused by land use and water scarcity and the resulting conflicts have to be controlled by politics and decision-making, because sustainable use of land, e.g. through spatial and/or temporal harmonization of the uses in a given area, to avoid or minimize irreversible impacts, as well as imbalanced distribution of water resources, is not a scientific but a political issue (Blum 2006, 2007a, b). Two decision patterns can be distinguished:

- top-down decisions, in which the top-ranking decision-makers manage the infrastructure;

- bottom-up approaches, in which the local population formulates its demands and asks the leaders to take action.

As stated before, all land use and water scarcity issues are complex and have ecological, technical, social, economic, and cultural dimensions. Therefore, it is necessary to define indicators which can be used as an information base for understanding and managing these complex systems.

Such indicators can be cultural, social, economic, or technical. Examples of ecological indicators are: soil quality, water quality, biodiversity, and human health; examples of technical indicators are: access to the land and availability of tools; examples of social and economic indicators are: economic wealth and access to social resources by the local population; a cultural indicator could be the educational level in a certain region (Blum 2004).

The criteria for these indicators are fourfold:

- they must be policy-relevant and focus on the real demands;
- they must be analytically sound, based on good science, and demonstrate a clear cause-effect relationship;
- they must be easy to interpret and understandable by farmers and stakeholders at the grassroots level as well as by decision-makers and politicians;
- they must be easily measurable and therefore feasible and cost effective in data collection, data processing, and dissemination.

With the help of such indicators it should be possible to mitigate and alleviate future security problems, and so diminish the security linkages caused by unsustainable land use and water scarcity in the Mediterranean region.

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