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# Agricultural landscape dynamics in the Mediterranean: Lesvos (Greece) case study using evidence from the last three centuries

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## ABSTRACT

Landscapes in the Mediterranean have undergone many significant changes in the last centuries. 'Traditional' Mediterranean agricultural landscapes with features such as dry stonewalls and terraces are connected with the agricultural roots of most modern Mediterranean societies. Today, these characteristics are in decline when they are not destroyed, due to the changes in the land use management systems of the last 150 years, caused by developments in production and social structure. In this paper, the dynamics of the changes are examined on a specific Greek island. Lesvos, which has an economic and landscape history typical of many Mediterranean cases. Their economic development based on agriculture and food processing created a landscape with terraces and stonewalls, which is nowadays considered 'traditional'. After some major political, economic and technological developments had reduced the competitiveness of Lesvos's economy, population declined and landscape characteristics were degraded. The examination of these changes with a descriptive model of landscape transformation offers some insight in the dynamics of landscapes and their characteristics in the Mediterranean today for present and future developments.

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## 1. Introduction: the agricultural landscape: definition and transformation dynamics

Agricultural landscapes are usually defined as the visual result of land uses and management systems in an area (Kizos and Koulouri, 2005). Although, such *productive* definitions are adequate for the analysis of agriculture and animal husbandry in an area, they lack a broader perception of landscape level analysis. Such an analysis should include an ecological dimension, since landscapes are habitats of organisms and

species and changes in farming practices reflect immediately on biodiversity (Forman and Godron, 1986; Wascher, 2000; Stobbelaar and van Mansvelt, 2000); and a *symbolic dimension*, as a landscape is a medium of representing, structuring and symbolizing environments (Antrop, 2006) for users who live in, visit, consume, imagine it, etc. (Appleton, 1996; Terkenli, 2001) and agricultural landscapes represent symbols and ideologies (Palang et al., 2005).

Agricultural landscapes change. If long-term transformation processes are considered constant,<sup>1</sup> then short- and

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<sup>1</sup> Long-term processes such as climate change, evolution, continent formation, etc. refer to time scales of millennia and geological time (Vos and Meeke, 1999; Marcucci, 2000).

medium-term processes<sup>2</sup> represent systems of interactions between natural environment (flora, fauna and abiotic resources) and man-driven actions (Naveh and Lieberman, 1984; Van Mansvelt, 1997; Marcucci, 2000; Baudry et al., 2000), or the macro result of micro (farm level) and macro actions (Deffontaines et al., 1995; Wascher, 1999; Commission of the European Communities, 1999; Commission of the European Communities, 2000; Wood and Handley, 2001).

The analysis of a specific landscape should cover the natural system (biotic and abiotic factors such as flora, fauna, climate, geology, relief, soils and precipitation) and the characteristics of the landscape (land uses, landmarks, productive structure, constructions, etc.). Furthermore, it should take into account the socioeconomic system, with economic, political, cultural and social factors<sup>3</sup> (Naveh and Lieberman, 1984; Wascher, 1999; Muir, 2003) and local and global influences, such as policies, markets, technology changes, etc. This model or others similar in conception has been used in different disciplines to describe past human–nature interactions on landscapes and literature has been growing in various disciplines such as: landscape archaeology (Jameson et al., 1994; Barker et al., 1995; Van Andel, 1998; French and Whitelaw, 1999; Pope et al., 2003; Bintliff, 2005), ecological history (McNeill, 1992; Horden and Purcell, 2000; Grove and Rackham, 2002), landscape history (Hoskins, 1955; Rackham, 1986; Rackham and Moody, 1996; Muir, 2000) and agricultural landscape change (Molinillo et al., 1997; Hietala-Koivu, 1999; Wood and Handley, 2001; Latorre et al., 2001; Kristensen et al., 2001; Pinto-Correia and Vos, 2004).<sup>4</sup> Although most of these approaches remain descriptive and provide guidelines that are not based on a solid ‘landscape theory’ (Antrop, 2006) but rather on the structure of the conceptual model used itself (this is common criticism, e.g. Harris (2005) as criticism in Horden and Purcell (2000) and Butzer (2003) in Grove and Rackham (2002)), they are still a way to investigate the historical and geographical changes of a landscape, as landscapes are historical entities and the investigation of the past is vital to understand contemporary dynamics (Kizos and Koulouri, 2005).

In this paper, a similar descriptive model is used to trace and understand the changes that have occurred in the Lesvos agricultural landscape. Land use changes and landscape elements are considered – such as terraces, fences and farming infrastructure – in the last three centuries. Emphasis is given to these centuries, as they witnessed Lesvos becoming an important industrial and commercial centre and then its economic and population decline and this change affected the landscape greatly. This description demonstrates the case of

Lesvos is typical of many Mediterranean cases and helps to understand better agricultural landscape dynamics in the area.

Data used in this paper come from observation and a wide variety of published and unpublished local sources. Most are local documents already published or books (Delis, 1901; Evagellou, 1933; Grigoriou, 1952; Settas, 1962; Kabouris, 1978; Kontellis, 1985; Moutzouri, 1986; Papoutsanis, 1986; Gougoulas, 1991; Taxis, 1995; Avagianos, 1995; Paraskevaidis, 1996; Tzimis et al., 1996; Tsalikis, 1998; Tragellis, 1999). The rest of the sources are either official published data (ESYE, 1971, 1981, 1991, 2001; Houliarakis, 1973), or literature for Lesvos (Giourga, 1991; Anthopoulou, 1993; Sifnaiou, 1996; Enepekidis, 1997; Karidis and Kiel, 2000; Kizos, 2003; Kizos and Spilanis, 2004; Kizos and Koulouri, 2005). The reliability of these sources varies. Most local sources are examined critically and compared carefully. Reliable and consistent official data are available only for the 20th century.<sup>5</sup> Especially for landscapes, we have used data from previous research based on questionnaires to farmers (Kizos, 2003; Kizos and Spilanis, 2004).<sup>6</sup> All land use and landscape data are evaluated and verified by our personal observations in a seven year period (1997–2004) of field research on various locations on the island.

## 2. The case of Lesvos

### 2.1. Agriculture and agricultural landscapes in the Mediterranean

Before presenting the case of Lesvos, a short sketch focused on similarities rather than on differences among changes in agricultural landscapes of eastern Mediterranean localities is given with particular emphasis on the last centuries. This presentation provides a general canvas upon which the specific changes of the Lesvos case are placed and discussed.

#### 2.1.1. History of land uses and practices

The first important similarity is the climate. The Mediterranean is characterized by dry and hot summers and short winters, with major differences in seasonal precipitation and important differences among localities (Martyn, 1992; Grove and Rackham, 2002). Vegetation consists of evergreen maquis, phrygana and pine–oak forests (Allen, 2001; Rackham, 2003; Mucher et al., 2003), with noticeable differences from North to South and from West to East, namely more arid ecosystems, less forest and more savanna, following the precipitation differences (Grove and Rackham, 2002).

The patterns used in most eastern Mediterranean landscapes of the 17th to the 19th centuries include vines, olives,

<sup>2</sup> The former refer to months or years and include land use changes, management practices changes, fires and other natural disasters, etc.; the later refer to decades and centuries and include erosion and deposition, population change, technology changes, etc. (Vos and Meekes, 1999; Marcucci, 2000).

<sup>3</sup> Economic factors may include land value, products, industry, imports–exports, etc.; political can include local power structures, ownership and inheritance patterns, etc.; cultural may include tradition, local values, etc.; and social may include social organization, age structure, population change, etc.

<sup>4</sup> This list of references is far from exhausting and Mediterranean oriented.

<sup>5</sup> With the exception of some reliable population estimates like the ones offered by Houliarakis (1973), Sifnaiou (1996) and Karidis and Kiel (2000).

<sup>6</sup> The sample included 304 farmers stratified according to landscape zone (see next section) and age. In each strata, selection was random according to the spatial distribution of farms from the 1991 farm census. Questions included land use, landscape features abundance on farms and management practices. For more details see Kizos and Spilanis (2004).

orchards and gardens closer to settlements. Cereals and pulse are the main calorie providers, in biennial or 3-year cycles of fallow and/or crop rotation.<sup>7</sup> In plain and fertile areas, industrial and intensive cultivations are introduced (cotton, tobacco). Animals kept are mainly sheep and goats (used for cheeses, meat and wool) with different transhumance practices. Other animals include pigs, cattle and pack animals (horses, donkeys, mules, oxen). Mountainous, barren or inaccessible land was grazed by sheep and goats. Forestry was integrated with agriculture and animal husbandry and forest management included: (a) tree planting;<sup>8</sup> (b) pollarding, coppicing and other practices for wood fuel and timber (Grove and Rackham, 2002; Nitsiakos, 1995); (c) hunting; (d) collecting wild fruit and nuts;<sup>9</sup> (e) collecting tree parts;<sup>10</sup> (f) cultivating cereals and pulse in Spanish *dehesas* and Portuguese *montados* (Pinto-Correia and Mascarenas, 1999; Gomez-Limon and Fernandez, 1999); and (f) grazing and even periodic fires that assisted regeneration and management (Grove and Rackham, 2002).

The main characteristics of these management systems were: the integration of agriculture and animal husbandry; the combination of intensive and extensive management practices; transhumance and common management (in village, settlement or hamlet level) of cultivated and grazing lands (Gasparis, 1997; Pinto-Correia and Mascarenas, 1999; Firmino, 1999; Gomez-Limon and Fernandez, 1999; Horden and Purcell, 2000; Pinto-Correia and Vos, 2004).

Production before the 20th century was oriented towards self-sufficiency with diversification (of production and land uses), storage (of raw or processed products) and redistribution (to markets) (Horden and Purcell, 2000); which lowered risks and insured strong connection with markets in the dense communication networks of the area (Braudel, 1993; Asdrahas et al., 2003).

Change on the whole is important for most rural Mediterranean areas after the first quarter of the 20th century and reaches a climax after 1950, with great spatial differences among countries, and also among localities. These changes include (Pratt and Funell, 1997) intensification of both agriculture and animal husbandry (i.e. mechanization, irrigation, chemical fertilizers and plant production products along with the abandonment of terraces for agriculture and more livestock, imported feeding stuff for animals), while all the collecting activities are abandoned along with most managed forests. Management of the new mechanized and industria-

lized farming systems is based on production for markets with external inputs for plant protection, conserving soil fertility and imported feeding stuff for animals. In areas with limited fertility or resource availability (especially irrigation water) such as islands and mountains, these systems marginalized most cultivation. The simultaneous changes in production and transportation in Mediterranean societies changed the industrial geography of the wider region by favouring continental areas and ports while marginalizing islands. Along with the general rise of industry in European Mediterranean, those developments reinforced migration to urban areas and caused widespread rural exodus. The land use changes that resulted are very important with reduction of cultivated land, increase of grazing land and settlements, especially in tourist islands and coastal areas. In some cases, these socioeconomic changes and the abandonment of agriculture led to the recovery of natural vegetation in a degree not met for some centuries (for an example Rackham, 1990). Apart from the exodus, as in most Western countries, the modernization of agriculture caused a number of problems in productive (over-production), social (population decline in rural areas), policy (protection of national products over global markets) and environmental (pollution, overuse of resources, degradation of biodiversity, erosion) terms (Pratt and Funell, 1997; Grove and Rackham, 2002).

#### 2.1.2. *Landscape elements and transformation processes*

The landscape elements that resulted from the above management systems and land uses on the Aegean islands and in the greater part of the eastern Mediterranean (apart from settlements which have not been considered here) can be classified in five categories (Rackham and Moody, 1996; Kizos and Spilanis, 2004):

1. Terraces, which were constructed in order to increase cultivated land and preserve natural resources (soil and water). Although their spread in the past is questioned, they are reported as back as the 5th century BC (Foxhall, 1996) and even earlier in the Iron Age (Grove and Rackham, 2002). They appear all over the Mediterranean (Jameson et al., 1994; Barker et al., 1995; Grove and Rackham, 2002) in three types (Rackham and Moody, 1996): *step*, which can be in straight line or along contours; *braided*, which zigzag on the slope; and *pocket*, which support individual trees. For most of the Aegean islands, the slow but steady population increase until the first quarter of the 20th century, led to their spread in major parts of available areas. Nevertheless, the rural exodus that followed this climax resulted in the abandonment of agriculture on terraces and the slow but steady degradation of their quality, if not their destruction and/or removal. The first two types of terraces supported many different land uses, such as cereals, vegetables, pulses, and other arable crops; vines and trees (orchards, chestnuts, nuts and olives); and grazing lands (sown with pulses or cereals, Kizos, 2003). The last type supported individual trees, especially olives in the Aegean. Terraces are built with dry stonewalls in inverse triangle shape, after the space above has been dug, and then it is filled with soil. Techniques differ according to local materials (rock size, geology) and local traditions.

<sup>7</sup> These cycles included cereals–fallow, pulse–cereals, winter cereals–summer cereals or pulse–grazeland with many different pulses and wheat, barley (more suitable for less fertile, mountain or steep fields), maize and rye for cereals (Kostis, 1987; Gasparis, 1997; Bournova and Progoulakis, 1999; Grove and Rackham, 2002; Petmezas, 2003; Asdrahas et al., 2003).

<sup>8</sup> For example, the introduction of chestnut cultivation even on islands such as Corsica, Sardinia, Crete, Lesbos (Grove and Rackham, 2002).

<sup>9</sup> For example, acorns are very important for pig husbandry and consisted important exports of many small islands (Kizos and Koulouri, 2005).

<sup>10</sup> Three examples include *retsini* from pines for wine preservation (Dalby, 2001), bark from cork-oaks for corks and bark from oaks for leather processing (Grove and Rackham, 2002).

2. Fences, which are of two types: hedgerows and dry stonewalls. Hedgerows are common in mountain landscapes but very rare on the Aegean islands and the driest parts of the Mediterranean, where they are seen in windy plains as wind and grazing protection of arable land, vines and small orchards. Dry stonewalls are very common in coastal areas and islands as protection from grazing or for marking rangeland-fields limits (Rackham and Moody, 1996; Gasparis, 1997). Differences may refer to height; thickness and extra material used to increase height, namely bushes, branches and today wire (Kizos, 2003). When they separate grazing lands they are usually placed across the contours, whereas when they separate fields they are rectangular. Modern fences are made of wire and often replace fallen stonewalls.
3. Footpaths that range from simple passages through fields to paved and broad paths. Today, they are either replaced by dirt or asphalt roads or abandoned and covered by vegetation.
4. Agriculture and animal husbandry infrastructure, which includes many different elements such as (Rackham and Moody, 1996; Gasparis, 1997) storehouses, animal yards, dwellings, constructions for harvesting, irrigating, watering animals or processing products (threshing floors, wine presses, windmills, water mills, wells, tanks, etc.). These constructions are part of the local architectural and craftsmanship tradition and an important source of income for local craftsmen who build them (for an example Nitsiakos, 1995). Local differences are important, with the most commonly used material in coastal areas and on islands being dry stonewalls. The decline of traditional management systems, new and cheaper building materials and the scarcity of craftsmen, have led to the degradation of

their quality or to the replacement of stone with 'modern' materials such as concrete, metal, etc.

5. Rural constructions, which are non-house constructions, mainly temples, churches, etc. Local variances and differences are important as well.

In this paper, some of the above changes are sought in Lesvos' agricultural landscape, a large Greek island, in the last three centuries. Land use changes and landscape elements are considered (terraces, fences and farming infrastructure).

## 2.2. Agricultural landscapes in Lesvos Island

Lesvos is one of the biggest islands in the Aegean (1632.8 km<sup>2</sup>), with a population of 89,935 (in 2001). The main settlement is the capital Mytilini (36,196 inhabitants in 2001, or 40% of the total). The number of farms has been reduced recently (20%, from 22,799 to 18,132 in 1971–2001), but agriculture is still quite important, especially in rural areas.

An existing typology to distinguish Lesvos's agricultural landscape zones uses climatic, geological and land use criteria (Kizos, 2003), to distinguish three zones (Fig. 1): The 1st zone is the *grazing lands zone*, consisting mainly of barren grazing lands (>50% of the area) in which soils of limited nutrient availability lie on recent lava and other compressed volcanic residuals (tuff) and are recent compared to the rest of the island (Higgins and Higgins, 1996). The 2nd zone is the *olives zone*, consisting primarily of olives and pine forests and the 3rd zone is an *intermediate zone*, which includes elements of both other zones (grazing lands, arable land, olives and pine or oak forests). The visual characteristics of the zones also differ. In the grazing land zone, there are lots of animal husbandry constructions and dry stonewalls

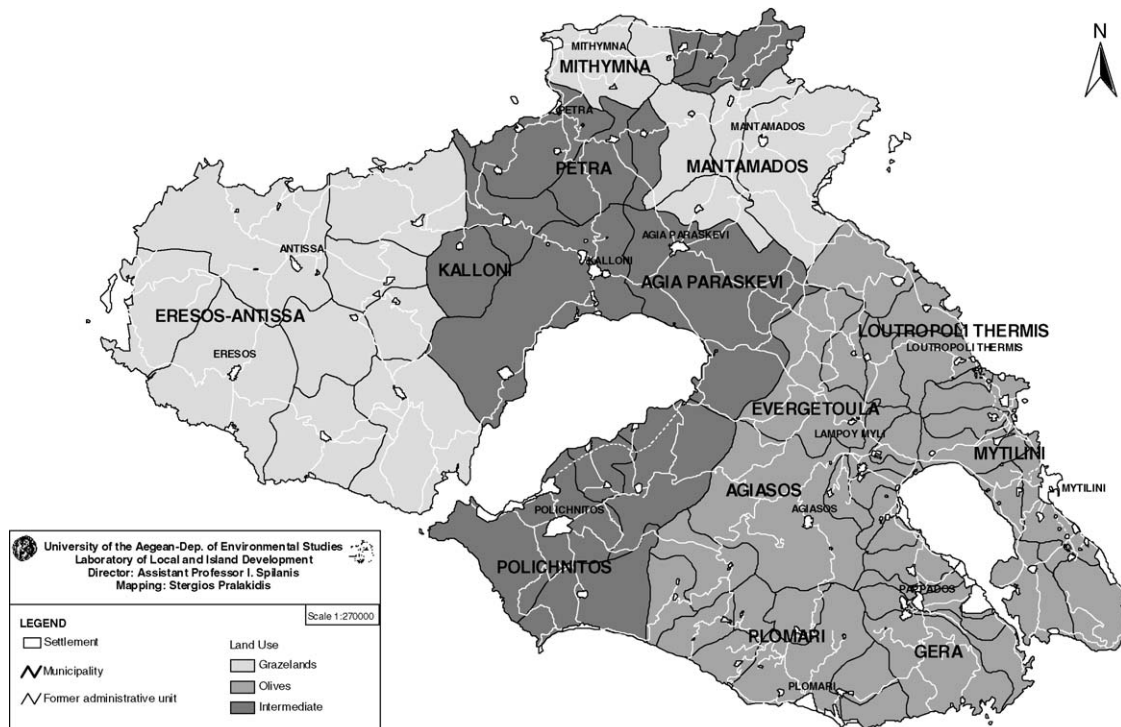
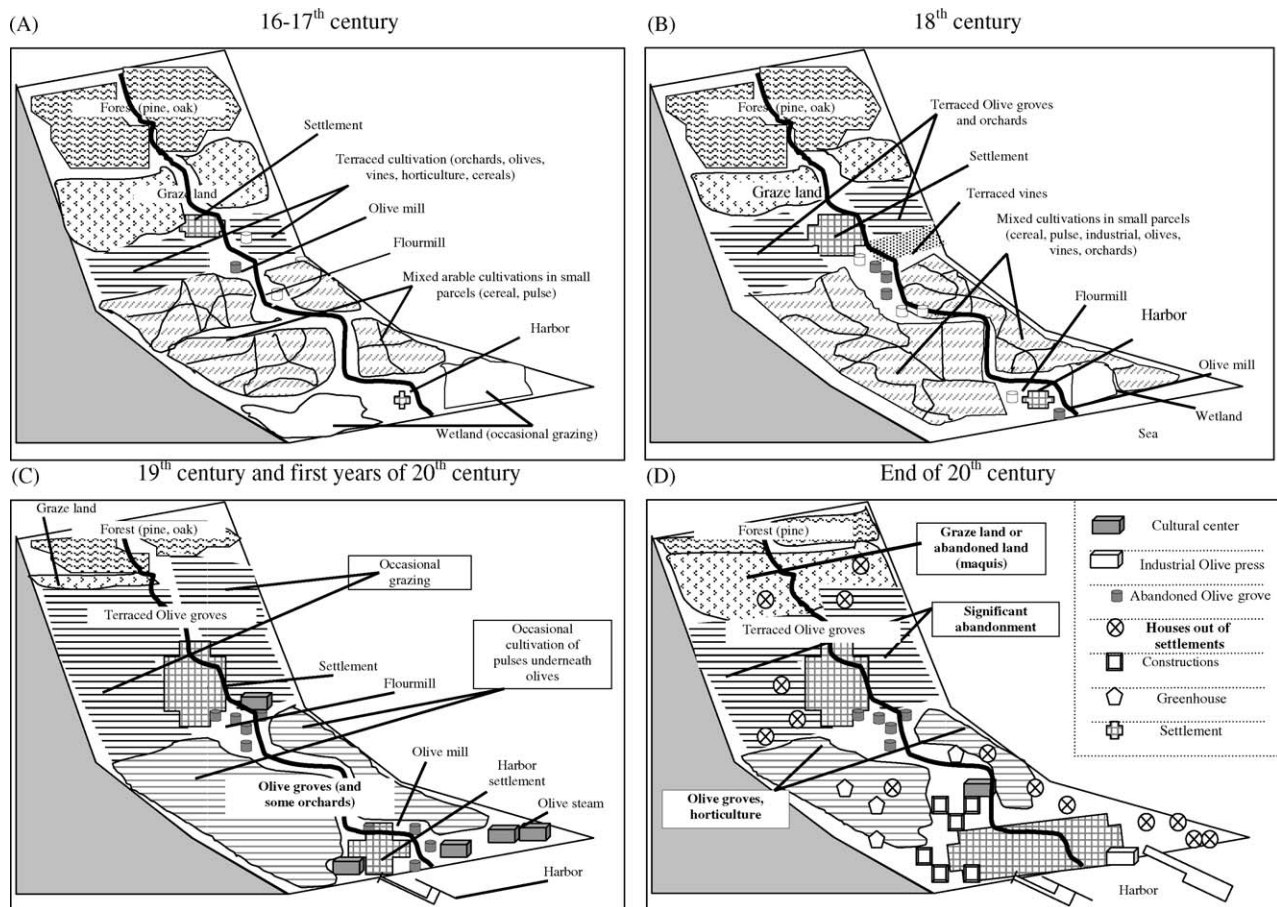


Fig. 1 – Land use zones in Lesvos.



**Fig. 2 – Ideal Lesvos olive landscape types (17th–end of 20th century).** Source: adapted from Kizos and Koulouri (2005). Figure depicts changes in an imaginary landscape slope in eastern Lesvos (olives zone, does not correspond to landscapes in the other two zones). It spreads from 500 to 700 m to the sea (in the bottom of the figures) corresponding roughly to 1:5000–1:10,000 scales. Many of the changes can be met in other parts of the Mediterranean as well. The grey area represents the hill and depicts altitude. The limits of the landscape are artificial. The legend in figure (D) stands only for it and does not apply to the rest three figures.

separating the relatively large patches. There is also an increased presence of wire fences, the presence of scattered (mainly oak) trees and dominance of garrigue, while there are still some terraces, remnants of agricultural practices that stopped after the 1950s (i.e. ploughing and harvesting cereals and pulses). In the olive trees zone, terraces are the dominant element with the significant presence of stone storehouses and fences, while patches are small. In the intermediate zone, there are elements of the other two zones along with increased presence of arable land in plains.

### 2.3. Landscape changes in Lesvos: spatial and temporal differentiations

Previous research (Kizos and Koulouri, 2005) has demonstrated how economic driving forces changed Lesvos' olive agricultural landscape, changes idealized in Fig. 2. In the following section, major changes in population and land uses are discussed along with their effects on landscape characteristics.

#### 2.3.1. Agriculture, animal husbandry and land use change

All available data on agriculture and animal husbandry on Lesvos before the 19th century indicate that Lesvos' landscape was characterized by greater diversity in land use terms than that of the 19th and 20th centuries and the current one (Kizos and Koulouri, 2005). Before the Genovese Gatellouzi rule (1354–1462, Delis, 1901), 'commercial' cultivations, such as vines and olives were limited. The Gatellouzi appear to be the first to introduce significant olive and vine groves for their commercial value, although their actual size is probably small compared to later expansion. Animal husbandry was based on sheep and goat husbandry as today, but with smaller total numbers and wider distribution.

During the first centuries of Ottoman rule (1462–1912), different land uses included cereals, pulses, industrial plants and grazing lands for sheep and goats (Karidis and Kiel, 2000). As far as specific localities, in the Kalloni Gulf area, as well as cereals, pulses, olives, vines and tobacco that were cultivated after the end of the 17th century, cotton was also cultivated and horticulture practised. On the contrary, in the Eressos area, sheep and goat husbandry predominated along with figs

and nuts. Oak and pine forests were also reported in uplands in both areas (Kizos and Koulouri, 2005). Mytilini and Gera were the main centers of olive cultivation.

The 19th century (when the island was still under Ottoman rule) marks the rapid economic development of Lesvos followed by population increase. Economic development was based on the island's position in the Black Sea trade and industrial development (olive oil, soap and leather processing) on the island,<sup>11</sup> boosted by new steam technologies. At the end of the century, the basic exports of the island were 10,000,000 kg olive oil annually (it is about the current production of a good year), 3,800,000 kg soap and 200,000 kg figs (Karidis and Kiel, 2000); while the imports were mainly cereals. The end of the 19th century marks also the generation of some big olive farms in Mytilini and Gera area.<sup>12</sup>

The 20th century marked Lesvos' annexation to the Greek State (1912) and a major economic crisis that broke out in 1922, when refugees from Asia Minor were 'exchanged' with Muslim inhabitants of the island and the borders for all transactions, movements and investments were closed down. As mentioned earlier, the greater socioeconomic context such as the introduction of steam ships and motorboats that made stops in small ports unnecessary and the improvement of land transportation deepened the crisis. The result for Lesvos was the closing of almost all industrial and trading activities on the island and a major population exodus.

These developments affected land uses greatly. Almost all cultivations except for olives declined (in 1959 olives represent 96% of the total area of groves, in contrast with 88% in 1933). Apart from cereals, pulses and vines disappear, these changes indicate a deeper and fundamental change in Lesvos' agriculture, a gradual halt in practices that combined different land uses, agriculture and animal husbandry (fallow, seasonal movements, mixed farming). On the other hand, sheep were tripled: from 70,000 in 1911 to 267,000 in 2001 (Kizos and Koulouri, 2005), along with grazing lands. Nowadays, lots of olive fields are 'mildly abandoned' (Kizos, 2003), meaning that only when production is satisfactory are the olives collected and little or non other cultivation management is practised.

### 2.3.2. Population

Population before and during the Gatellouzi rule is estimated at 40,000 inhabitants at the most. It doubled between 1488 and 1521, and continued to increase with fluctuations throughout the 18th century (Kizos and Koulouri, 2005). Population data for the 19th century reveal an explosive growth after the 1830s (from 1800 to 1890 by 152% and from 1840 to 1890 by 90%). The beginning of the 20th century marked the maximum level of 140,000 people in 1913 and again in 1928. The exodus began afterwards, slowly at first and much more rapidly after the

1940s (–35% between 1940 and 1981). After 1981 the population stabilized at 90,000 inhabitants, almost half of whom live in Mytilini and nearby settlements.

### 2.3.3. Landscape changes

Until the end of the 18th century, the agricultural landscape of Lesvos presented most of the Mediterranean characteristics discussed above, namely mixed land uses being predominated by small parcels and cereals. Terraces most likely were used primarily for cereals, grazing lands and groves. The slow but steady increase of olive groves with the expansion of agricultural land and the conversion of arable land into olive cultivation marked the gradual landscape transformation with the expansion of terraces in groves, stone constructions for olives storage, the increase of olive mills and the decrease of forests, as terraced olive grove parcels began to 'climb' upwards on the mountain sides replacing forests. The 19th century stabilized and reinforced these transformations (Karidis and Kiel, 2000). However, after the first quarter of the 20th century, the rural exodus brought significant reduction of land use diversity: olives and savanna type (Grove and Rackham, 2002) grazing lands dominated the landscape. Forests increased in the mountains, as mountainous and/or less productive fields were abandoned. In the plains, agriculture was intensified by pumping and watering arable animal feeding stuff or greenhouses. In addition, in coastal areas housing and tourist uses compete with agriculture for land. On the whole, the 19th century transformations can be held responsible for a major part of the current landscape characteristics and appearance, despite significant modern changes.

### 2.3.4. Landscape elements changes

Previous research results from questionnaires to farmers (Kizos, 2003; Kizos and Spilanis, 2004) are used here to examine changes of terraces, fences and farming infrastructures. All data are evaluated and verified by our personal observations.

**2.3.4.1. Terraces.** Terraces are mainly present in olive groves in all landscape zones (80, 92 and 86% of olives lie in terraces for grazing land, olives and intermediate zone, respectively, Kizos and Spilanis, 2004; Koulouri, 2004). Terrace quality in olive groves is intermediate according to the farmers and observation partly verifies this claim. It is worth mentioning that farmers who have said that their olive terraces are destroyed graze them, thus confirming the sheep and goats role in deterioration. On the other hand, very few farmers have admitted that they actually maintain their terraces or built new ones when they plant new olives. Only in the grazing land zone where small areas of new olives are planted, some have declared that they have maintained the old terraces of the previous land use (grazing land or oak savannas). We have nevertheless found terraces that are maintained very efficiently and professionally in the olive zone in fields close to roads, even if most olive terraces and especially those in remote and/or mountainous fields seem neglected. Arable lands on Lesvos were cultivated in plains or without terraces in mountains, except for grazing land areas where they were tilled and sowed with cereals or legumes used for animal feed

<sup>11</sup> The development of industry began back in the 18th century with four interrelated factors: the increase of olive production; the prosperity of the owners of olive mills' and traders and their willingness to invest in new technologies; the Ottoman state reforms (Sifnaïou, 1996; Savorianakis, 2000); and the high international olive oil prices.

<sup>12</sup> Most of which today have either been divided in smaller fields or owned by banks (via seizure) or by the church who rent them and receive part of the oil.

**Table 1 – Fences in Lesvos landscape zones**

	Zone 1 (grazing land) (%)	Zone 2 (olives) (%)	Zone 3 (intemediate) (%)	Total (%)
<b>Olive groves</b>				
No fence	7.1	16.8	23.4	16.1
Wire	54.8	68.3	46.8	57.0
Stone	16.7	5.9	18.1	13.3
Stone and wire	15.5	7.9	11.7	11.5
Stone and wood	6.0	1.0	0.0	2.2
<b>Grazing lands</b>				
No fence	5.6		18.3	10.6
Wire	43.7	90.0	31.7	41.8
Stone	25.4		35.0	27.7
Stone and wire	21.1	10.0	15.0	17.7
Stone and wood	4.2		0.0	2.1
<b>Rest uses</b>				
No fence	62.0	23.0	17.0	25.2
Wire	38.0	65.0	72.0	64.0
Stone		4.0	5.5	4.3
Stone and wire		8.0	5.5	6.5
<b>Arable land</b>				
No fence	5.3	66.7	32.4	25.4
Wire	63.2	33.3	59.5	59.3
Stone	21.1		5.4	10.2
Stone and wire	10.5		2.7	5.1

Source: adapted from Kizos and Spilanis (2004). Data refer to farmers' research with total 279 cases of farms with olives, 141 cases of farms with grazing lands, 59 cases of farms with arable land and 70 cases of farms with rest uses (vines, tree crops, etc.).

until the 1960s (a practice mentioned by Rackham and Moody (1992) on other Aegean islands as well) and terraces are the dying marks of that practice.<sup>13</sup> Data for terraces presence in grazing lands reveal that they were important (7.2% for the island and 14% for the grazing land zone, Kizos and Spilanis, 2004), but cultivation in terraces on the island is abandoned and terraces deteriorate due to grazing of sheep and goats. Farmers have declared that terraces are destroyed in about 80% of their grazing lands, and there has been no farmer who actually maintains terraces, a fact that is confirmed by observation. Therefore, if the last terraces in grazing lands were abandoned in the 1950s or 1960s, their low quality reveals that they were originally of lower building quality, and observations illustrate that those found in the grazing land zone are shallow, and rather loosely built. This is understandable, as terraces in the grazing lands zone had to be built in much shallower soils to reduce the steepness of the slope, while terraces in groves and especially olives have to provide more soil to the tree (Rackham and Moody (1992) observe the same differences in other parts of the Aegean). Other terraced land uses include orchards (mainly chestnuts, some cherries, pears and apples), but the areas are small compared to the total cultivated area of the island (0.3%).

**2.3.4.2. Fences and stonewalls.** Fences on Lesvos are divided in two categories: stonewalls and wired fences. Most current fences are wired in all land uses, while only about 20% of the cultivated areas and the grazing lands are unfenced. Stonewalls are older than wire fences in general and thus the presence of more stonewalls in the grazing lands zone, where

fencing is essential management tool, is expected (Table 1). The difficulty of constructing and maintaining stonewalls has led to a number of combinations with wire (adding wire on top of the stones) or bush branches that add height and are renewed periodically. On the contrary, wire fences, which are modern constructions, are abundant in olive groves for two reasons. First, older bigger farms were divided after the land reformation scheme was completed (ended in 1932, Varvarosos, 1949) or the fields were divided by inheritances (who still continue to divide them). Second, is the issue of security of production and equipment (pumps, nets, etc.). A farmer commented that it is no coincidence when six neighbouring farmers pick up olives on the same day. Each of these farmers passes by to make sure that his/her neighbours pick only their own olives on clear winter days and weekends. All six farms were strongly fenced with high wire.

Local differences in structure and style of stonewalls in the land use that they enclose are important, inter and intra landscape zones. For example, in the mountainous area of Polichnitos, which is famous for its cereals and even today produces flour from local barley and wheat, arable fields are enclosed by stonewalls. The other example is the Mandamos area, where traditionally more cattle are raised, with its tall stonewalls, separating grazing lands from olive groves and oak savannas.

**2.3.4.3. Farm infrastructure.** Local differences of stonewalls in structure and style are very important inter- and intra-landscape zones for farm infrastructures too. They differ according to the land use, the material they are constructed from (apart from stone, such as cement bricks, bricks, metal, etc.), and the availability of local stones and rocks. In olive plantations, most constructions are storehouses, with

<sup>13</sup> According to local sources the last farmers who cultivated cereals in grazed terraces abandoned the practice in the 1980s.

**Table 2 – The landscape of Lesvos (16th–20th centuries)**

Period	Population	Zone (locality)	Land use diversity	Main land uses, animals	Landscape elements	Quality of landscape elements (interviews, observation)
Before Gatellouzi (up to 1354) <sup>a,b,c,d,e,f</sup>	30,000–40,000 <sup>a</sup>	–	Significant	Cereals, pulses, olives, vines, figs, oak, grazing lands, horticulture sheep, goats, pigs, cattle	Flourmills, stonewalls, terraces	
Gatellouzi period (1354–1462) <sup>a,b,c,d,e,f</sup>	30,000–40,000 <sup>a,g</sup>	–	Significant	Cereals, pulses, olives (+), vines (+), figs, oak, grazing lands, horticulture sheep, goats, pigs, cattle	Flourmills, olive mills, wine-presses, stonewalls, terraces	
Ottoman period before 19th century (1462–1799) <sup>b,c,d,e,f,h,i,j,k</sup>	60,000 <sup>g,j,e,l,f</sup>	Mytilini kaza (olives)	Significant	Cereals (wheat, barley), pulses (beans, chickpeas, field-beans), sesame, flax, cotton, vines, olives, figs, mulberries, almonds, pines sheep, pigs, cattle	Flourmills (–, 99 in 1548, 40 in 1671), olive mills (+, 10 in 1548, 116 in 1671), terraces (+), storage stone constructions (+), buildings (+), settlements (+)	
		Eressos (grazing land)	(?) probably significant	Cereals, pulses, figs, oak, grazing lands, horticulture sheep, goats, cattle	Flourmills, barns, animal husbandry constructions	
		Kalloni area (intermediate)	(?) probably significant	Cereals, pulses, tobacco (17th century), cotton, horticulture, pines sheep, goats, pigs, cattle	Flourmills, storage stone constructions, buildings, settlements	
Ottoman period (19th century) <sup>b,c,d,e,f,h,i,j,k</sup>	60,000–101,000 <sup>e,f,g,j,l</sup>	Olives' zone	Reduced	Cereals (–), pulses (–), vines (–), olives (+++), oak (?), pines (–), figs (?), sheep (?), cattle	Olive mills (+, 190 in 1888), steam olive presses (12 in 1888), terraces (+++), storage stone constructions (++), buildings (++), settlements (+++), coastal settlements (++)	
		Grazing lands' zone	Reduced	Cereals (–), pulses (–), figs (?), Oak (?), grazing lands, horticulture, olives (+), sheep (+), goats (+), cattle	Flourmills (–), olive mills (+), animal husbandry constructions (+)	
		Intermediate zone	Reduced	Cereals (–), pulses (–), tobacco (+), cotton (+), horticulture (+), olives (+), pines (?), sheep (+), goats (+), cattle	Flourmills (–), olive mills (++), storage stone constructions (+), buildings (+), coastal settlements (++)	



Table 2 (Continued)

Period	Population	Zone (locality)	Land use diversity	Main land uses, animals	Landscape elements	Quality of landscape elements (interviews, observation)
Greek state period (20th century) <sup>c,d,k,m,n,o,p,q,r,s,t,u,v</sup>	140,846 (max. 1913), 87,151 (1991), 89,935 (2001) <sup>g,u,w</sup>	Olives' zone	Reduced	Olives (+, in 1959 96% of groves), greenhouses (++) , horticulture (+), grazing lands (+), oak (+), pine (++) sheep (+)	Olive mills (–, 79 in 1908, 0 in 1998), steam olive presses (+–, 113 in 1908, 0 in 1998), modern olive presses (+, 80 in 1998), terraces (+ until 1940's, – after), stone constructions (–), buildings (+++), mountain settlements (–), coastal settlements (+++)	Terraces (–, in cases +), stonewalls (–), stone constructions (–), paths (–)
		Grazing lands' zone	Reduced	Olives (+), horticulture (+), legumes (+), grazing lands (+), oak (+++), pine (+), sheep (+++), goats (+)	Olive mills (–), modern olive presses (+), terraces (–), stone constructions (–), constructions-buildings (+++), mountain settlements (–), coastal settlements (++)	Terraces (–), stonewalls (–), stone constructions (–), paths (–)
		Intermediate zone	Reduced	Olives (++) , legumes (+), greenhouses (++) , horticulture (+), grazing lands (+), oak (+), pine (++) , sheep (+++), goats (+), cattle (–)	Olive mills (–), modern olive presses (+), terraces (?), storage stone constructions (–), storage constructions (++) , buildings (+++), mountain settlements (–), coastal settlements (+++)	Terraces (–, in cases +), stonewalls (–), stone constructions (–), paths (–)

(+): moderate increase; (++) : increase; (+++) : major increase; (–): moderate decrease; (–) : decrease; (–) : major decrease; (?): not known (note: symbols are not proportional). Source: Kabouris (1978).

<sup>a</sup> Source: Delis (1901).

<sup>b</sup> Source: Taxis (1995).

<sup>c</sup> Source: Paraskevaidis (1996).

<sup>d</sup> Source: Tzimis et al. (1996).

<sup>e</sup> Source: Enepekidis (1997).

<sup>f</sup> Source: Karidis and Kiel (2000).

<sup>g</sup> Source: Gougoulas (1991).

<sup>h</sup> Source: Moutzouri (1986).

<sup>i</sup> Source: Papoutsanis (1986).

<sup>j</sup> Source: Sifnaiou (1996).

<sup>k</sup> Source: Kizos and Koulouri (2005).

<sup>l</sup> Source: Tsalikis (1998).

<sup>m</sup> Source: Evagellou (1933).

<sup>n</sup> Source: Grigoriou (1952).

<sup>o</sup> Source: Settas (1962).

<sup>p</sup> Source: Kontellis (1985).

<sup>q</sup> Source: Giourga (1991).

<sup>r</sup> Source: Anthopoulou (1993).

<sup>s</sup> Source: Avagianos (1995).

<sup>t</sup> Source: Tragellis (1999).

<sup>u</sup> Source: ESYE (1971, 1981, 1991, 2001).

<sup>v</sup> Source: Kizos and Spilanis (2004).

<sup>w</sup> Source: Houliarakis (1973).

different forms and shapes throughout the island. The oldest ones are made of stone and were used as winter homes for many families, especially when fields were away from the settlement. Such constructions are remote and in general do not form hamlets or other smaller settlements. Stables found in olive groves are modern constructions.

In grazing lands, stables are the most common characteristic, followed by storehouses and watering ponds. The fact that many grazing lands are not owned and have to be rented restricts the construction of stables and makes farmers keep their stock in temporary structures. Stables are quite modern and even those made of stone are of good quality, whereas storehouses in grazing lands are of lower quality. In other land uses, constructions are scarce. What is worth noticing is the relative absence of threshing floors, a fact revealing early cereal abandonment. Also of importance is that even if today one wants to build a stone construction, the cost is too high and specialized craftsmen hard to find.

The main findings of the above observations are summarized in Table 2.

### 3. Conclusion: a changing landscape

This paper has made a first attempt to describe and access changes in landscape and landscape characteristics that result from changes of local and global economic, social, political and cultural conditions. The case of the Lesvos landscape, although typical of the general trends in Mediterranean landscape changes, has offered indirect and partial implementation of this process, as the available evidence is fragmented and insufficient, and our personal observation can only cover some of the evidence gaps. Despite this, the results offer some insight into transformation processes.

What first stems as important is that even if economy is placed as the main driving force behind landscape transformations, more light has to be shed on the other natural and social dimensions of the descriptive model used. Natural constraints are very important, and these constraints become conspicuous when Lesvos' landscapes are classified in types. Handicapped areas in terms of climate, soil depth and productivity were less densely populated and oriented towards many small productions and sheep-goat husbandry. On the other hand, favoured areas (i.e. plains, more fertile soils) were used by denser populations oriented towards more 'commercial' productions than self-sufficiency small productions. This does not imply natural determinism and indeed the evidence presented in this paper illustrates that — as in many different Mediterranean contexts and settings (Jameson et al., 1994; Barker et al., 1995; Rackham and Moody, 1996; Horden and Purcell, 2000; Grove and Rackham, 2002; Pinto-Correia and Vos, 2004) human management systems can overcome some of the natural handicaps and provide complex survival and production strategies with delicate and complicated management practices. Neither does the economic predominance imply that political and cultural aspects are not important to determine changes. Quite the contrary, political and cultural factors are very important, interacting with nature, society and economy.

While the above are taken into consideration, the predominance of economy in landscape transformations has

been growing with 'modernized' productions and 'modern' societies and this becomes evident from the Lesvos case. These changes are very important for the future of Lesvos and Mediterranean landscapes in general. Modern processes that re-evaluate landscapes and their characteristics as cultural resources of an area and as ideological 'tanks' of values, traditions and meanings are gaining ground. Such trends are more evident in areas disadvantaged by modern standards, where more 'traditional' landscape management systems and characteristics are found, still used or abandoned. In the Lesvos case (which is a disadvantaged area, fact that is recognized by the Less Favoured Areas Scheme of the European Union that provides aid for farmers in such areas) it seems that traditional characteristics of its economic prime and population maximum are now being considered as remnants and monuments of a 'golden', wealthy and 'traditional' age, when both landscapes and society were 'better' than today.

The 'traditional' elements of the landscape (terraces, stonewalls, paths, farm infrastructures and buildings) are not preserved and as a consequence they are either destroyed or have deteriorated and although farmers claim that they care about their quality, they rarely do something to preserve it. This is more evident in the case of the elements that are made of stone, because the construction and maintenance of these elements requires experience and skill and nowadays is expensive to find and pay experienced and skilled craftsmen. These difficulties are greater for farm infrastructure, where expertise is vital, while modern material, building styles and techniques are cheap, easy to find, transport and can be built by unskilled workers or the farmers themselves. Stonewalls are easier to make, but most of the recent ones that we have seen are built in different styles than older ones. They are more 'harmonized' and 'symmetrical' and the stones are not usually local; they are smaller, sometimes stabilized with concrete and cut into rectangular shapes, in contrast with the older stonewalls which were made of local stones in accordance with local traditions. Terraces are not very easy to maintain either, as important damages in the walls may require digging and new stones. Our informants complain that modern terrace builders use stonewalls techniques, seemingly less stable than older ones. In any case, terrace craftsmen are also scarce and expensive.

Apart from the elements, the four different ideal 'images' of Lesvos' olive landscapes that are drawn here depict some of their most important changes. The most important changes that have been discussed are the decreasing diversity of cultivated land uses; the spread of pine, oak and maquis forests in the mountaintops and in higher altitudes, or in remote and inaccessible areas; and the spread of settlements and houses — buildings in coastal areas.

These trends will continue in the future, as the underlying reasons of their driving appear unchanged. Therefore, two issues are of importance for the future: First, the quality of the stone elements will continue to deteriorate, since the preceding analysis has clearly demonstrated that landscapes and characteristics are preserved only when they are *functional* (i.e. when used in production). The current trend in preserving cultural landscape characteristics, and indeed whole landscapes, will surely help in preserving parts of the former

landscapes, but only locally and in small percentage compared to Lesvos in its prime. Second, these landscape changes have deprived Lesvos and generally the Mediterranean of local knowledge in areas like stone building, land and animal management. This is a major loss in productive, ecological and symbolic terms as more and more the true potential of local varieties and management systems is realized in modern production systems.

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