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Same Land Cover, Same Land Use at the Large Scale, Different Landscapes at the Small Scale: Landscape Change in Olive Plantations on Lesvos Island, Greece

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ABSTRACT *In this paper, agricultural landscape change at the small scale (for example, at the farm and field level) is studied to conceptualize the processes that change these landscapes (such as features, forms and functions) according to the decisions that farmers make. The case study is olive plantations on the island of Lesvos, Greece. The five-year differences in land cover, land use and landscape at the small scale of a number of olive fields in the same area are studied in three dimensions: symbolic, productive and ecological, with data that come from the observation of practices and vegetation measurements. A conceptual framework is constructed that links the changes of six different landscapes at the individual olive field level with specific management choices of farmers. Findings demonstrate that although olive plantations are of the same land cover and land use class as at the large scale, diverging practices create different landscapes at the small scale along a continuous line with many intermediate cases. The findings also demonstrate that the whole system is dynamic, with the different small-scale landscapes changing into each other continuously due to different practices. Understanding this dynamic diversity requires studying human interventions at the right scale, the one that corresponds to the scale of the changes at the farm.*

KEY WORDS: Landscape change, olive plantations, Lesvos, Greece

1. Introduction: Small-Scale Agricultural Landscape Change

Landscape studies are a fast growing area of research involving ecological, economic and cultural disciplines (Palang *et al.*, 2005; Tress *et al.*, 2006). Although 'family trees' of landscape science can be drawn (Antrop, 2006), it is still fragmented with poor integration of the different disciplines involved (Tress *et al.*, 2006) and one of the most disputed issues is the matter of scale. Biological, planning, practical and empirical disciplines (e.g. landscape ecology and architecture, geo-informatics, agronomy, etc.) usually use 'landscape level' scales for studying various spatial

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processes and can span from regions to areas of certain size or some specific quality. On the other hand, most theoretical disciplines (e.g. cultural geography, aesthetics) by de- and re-spatializing the landscape (Terkenli, 2005) tend to use 'smaller' scales that refer mostly to what people can understand and perceive through their senses.

Here, we study small-scale agricultural landscape changes. Although this is not entirely new to landscape studies (some examples in the literature include Kristensen, 1999; Hietala-Koivu, 1999; Kristensen *et al*., 2001, 2004; Busck, 2002; Quetier *et al*., 2005) it has not yet received the attention we believe it deserves. Reasons behind this could lie in the fact that most research today for agricultural landscapes is driven by the need to evaluate the effects of policies on landscapes, such as work compiled by the European Union (CEC, 2000; EEA, 2001; EEA *et al*., 2005) or the European Centre for Nature Conservation (ECNC) (Hoffman, 2000; Wascher, 1999, 2000a, 2000b; Jongman, 2004). We believe that although other scales are necessary for understanding the landscapes and the relationships between what they contain, small-scale research is vital for a better conceptualization of the processes that change landscapes. In this study, we focus on short-term processes (months or years) and actions at the farm level, for which the farmer decides. This focus eases the understanding of the decisions that farmers make and the ways that these decisions act upon specific landscape features, landscape forms and functions.

Another concept introduced for evaluating the production potential, the ecological and the symbolic value of a landscape is its quality (Van Mansvelt, 1997; Kizos & Spilanis, 2004).

Production potential refers to the types and value of productions and services in and of a certain landscape. Besides farming, more products and services have to be considered, such as landscape conservation, recreation, environmental protection, housing, etc., as the importance of the 'post-productive countryside' (Marsden, 2003) and 'multifunctional agriculture' grows in the EU.

Ecological value refers to biodiversity and resources conservation at landscape level. Although a number of approaches in Europe have proposed different methods for defining and estimating indexes (Wascher, 1999, 2000b; CEC, 2000; EEA, 2001; Buchs, 2003; Opdam *et al*., 2003; Swift *et al*., 2004; EEA *et al*., 2005, among others); prepared typologies (Wascher, 2000a); raised questions and sought methods (Giampietro *et al*., 1997; Hoffman, 2000; Munroe *et al*., 2004); or employed empirical methods of estimations (Grove & Rackham, 2002) there is still no common ground in the concepts, methods and evaluation criteria.

Symbolic/aesthetic quality estimations are generally based upon aesthetic evaluations of landscapes from population groups. A number of different approaches are being used, most of which involve interviews and other social sciences techniques (focus groups, questionnaires, use of pictures or drawings, mental maps, in-depth interviews, personal observation, etc.). Results of these techniques are generally assessments of aesthetic preferences and/or symbolic value of landscapes, but are local and group-specific (the literature includes Bourassa, 1991; Arriaza *et al*., 2004; Kaplan & Austin, 2004; de Val *et al*., 2006; Pavlikakis & Tsihrintzis, 2006; Tveit *et al*., 2006, among many others).

Therefore, the definition of criteria for each of the three dimensions is case-specific, depending on local ecosystems, productive structures and symbols. In this paper, small-scale agricultural landscape changes are studied on the island of Lesvos

in the North Aegean Region, Greece. Olive plantations are chosen as the case study due to the fact that today in the Mediterranean different management practices at the farm level (Beaufoy, 2000) provide radically different landscapes at the small scale of the same land cover and use at the large scale. Olive plantations are only one of the land uses and land cover classes in the Mediterranean with this gradient from intensive to extensive use within the same locality or even on fields lying side by side. The specific conditions of the Mediterranean, with differences in natural conditions (such as soil availability, soil fertility, precipitation) and management systems within small distances contributes to this gradient. Here, the differences in five years in land cover, land use and landscape at the small scale of a number of olive fields in the same area are studied in the three dimensions discussed above: symbolic value, productive potential and ecological quality. The objectives are on one hand the conceptualization of small-scale landscape changes according to the decisions of farmers (i.e. the correspondence of initial and final landscapes at individual field level with specific management choices of farmers) and on the other hand the evaluation of these changes at the small scale on the basis of these criteria.

2. Small-Scale Landscape Change in Olive Plantations on Lesvos Island, Greece: Data and Methods

2.1. Olive Cultivation on Lesvos Island

Lesvos is the biggest island in the North Aegean Region (1632.8 km^2), with a population of 89 935 (in 2001, 40% in the capital Mytilini). The number of farms has significantly reduced recently (20% from 1971 to 2001), but agriculture is still quite important in terms of the jobs and incomes it provides, especially in rural areas. A typology of its agricultural landscapes with climatic, geological and land use criteria (Kizos & Spilanis, 2004) arrives at three zones: grazing lands (for sheep), terraced olive plantations and intermediate landscapes. In this paper, the landscapes examined are in the olive plantations zone near Mytilini. It is a homogenous landscape regarding land cover and use; it is considered as 'traditional' for the island with a rich history.

While it is true that the presence of olive cultivation on Lesvos has a long history, its significance in the island's economy and land use has risen rapidly after the eighteenth century (Kizos & Koulouri, 2006). In the eighteenth and nineteenth centuries it became almost a monoculture in the eastern part of the island and drove industrial and economic development. Economic prosperity brought rapid population increase (by 152% from 1800 to 1890). The twentieth century brought economic crisis and the beginning of the rural exodus that accelerated after the 1940s (leading to a population decline of -35% between 1940 and 1981).

Rural exodus resulted in significant decline of most land uses other than olive plantations since the 1930s (Kizos & Koulouri, 2006). The reasons for this are: a) olives may be cultivated with limited management practices (such as clearing and pruning in non irrigated areas). Harvesting is concentrated on a limited time period and can be negotiated 'at leisure' (at weekends and afternoons); b) Olive oil has still a considerable market value and can be sold even by the farmer or can cover household needs and thus produce indirect incomes; c) The 'nature' of olive

production is biennial (fruit every other year if not irrigated and fertilized), a fact that helps part-time farmers not to collect or to collect without hired labour on these years and save money; d) Most plantations represent an important investment, especially if they lie on terraces. As abandoned fields have a smaller real estate value, many farmers keep the trees and the fields in good condition to raise their value.

Most olive plantations[1] lie on small, mountainous and sloping fields which are all terraced (built with dry stonewalls), either in pocket style (a single terrace in part of a circle around one tree; Grove & Rackham, 2002) or in a parallel-braided style. In many cases, mixed styles are encountered. The understorey is very rarely cultivated with arable crops and today it is often not even grazed. The result of this monoculture is a continuous landscape, characteristic of Lesvos and part of its local identity (Lesvos is considered in Greece as one of the localities with 'good' and abundant olive oil), interwoven with small settlements and patches of pines and/or maquis vegetation in rocky areas and hilltops. The abundance of pocket terraces is a unique characteristic of olive cultivation for Greece, as in other areas olive trees are usually cultivated in plains or on other types of terraces. Management practices are kept low in most cases and as a result the landscape may be considered as semi-natural, offering a rich variety of habitats for different species of flora and fauna (Allen, 2001). Recent research has demonstrated that in the last decades some olive plantations have been abandoned (Kizos & Koulouri, 2006). There are though different 'degrees' of abandonment, as the next section of the paper demonstrates, with many different landscapes of the same land use and land cover often lying side by side.

In 2001 agricultural censuses recorded 14 375 olive farms (95% of total farms) that covered 45% (38 951.8 ha) of the total Utilized Agricultural Area (UAA) and roughly 30% of the total area of the island. Surprisingly, the total number of trees is unknown. Estimations based on subsidies data raise them to 10.5 – 11 million, with an average density of 250 – 280 trees/ha.

The Municipality of Mytilini which is the object of this study includes eight smaller settlements besides Mytilini, all of which serve as suburbs, a fact that creates significant housing pressures on cultivated land, namely olive plantations that cover more than 80% of UAA.

2.2. Concepts

Olive plantations were classified into six different types. The first three types are derived from Beaufoy (2000) and the OLIVERO project (Xiloyanis *et al*., 2004), while the last three were introduced by the authors:

i. *Low-input traditional plantations* and scattered trees that are often with ancient trees and typically planted on terraces, which are managed with few or no chemical inputs, but with a high labour input. The tree density is low and differs along locations from 40 to 250 per ha. Trees are usually pruned and terraces with supporting walls are common. The management of the understorey usually involves grazing and/or mowing and/or tillage, frequent or occasional. Fertilization practices range from none to manure and/or chemical fertilizers; pesticide use is minimal or occasional; irrigation is not usual, although it is

becoming common. Harvesting is usually performed by hand, or may be left in years of little harvest and typical yields are in the range of 200 – 1500 kg/ha. Consistency of annual yield is low, due to fertilization and irrigation practices. Labour requirement is very high in harvesting, pruning, maintenance of terraces and walls, scrub control, etc.

ii. *Intensified traditional plantations*, where there is a tendency to increase the tree density in traditional plantations by planting between existing rows. They follow to some extent traditional patterns but are under more intensive management (systematic use of artificial fertilizers and pesticides; more intensive weed control and soil management; irrigation; and increased tree density). Their typical locations are hills and rolling plains, with tree densities between 80 and 250 per ha. Trees may be younger with regularly pruned canopy, while terraces with supporting walls are common in some hill areas. Management of the understorey involves repeated cultivation and/or herbicides; fertilization by chemical fertilizers and pesticide use. Irrigation is increasingly common and harvest is by hand or mechanical. Typical yields range from 1500 to 4000 kg per ha, with a low consistency of annual yields and high labour requirements for harvest and pruning.

iii. *Intensive modern plantations* that are of smaller tree varieties, planted at high densities and managed under an intensive and highly mechanized system, usually with irrigation. A second type of modern plantation uses 'bushes' in dense rows, resembling vineyards, which are almost totally mechanized. Their typical locations are rolling and flat plains. Tree densities are around 200 – 400 per ha. The trees are short-stem varieties, terraces are very rare. The management of the understorey involves repeated use of herbicides; chemical fertilizers usually applied through irrigation and/or leaf sprays; pesticide use; irrigation is usual (drip systems). Harvest is usually mechanical with typical yields ranging from 4000 to 10 000 kg/ha; high consistency of annual yield and low labour requirements.

iv. *Housing* landscapes that are former olive fields where one or more houses are built. These houses may be homes, second homes or tourism units and usually come with other constructions such as garages, roads, parking, pools, playgrounds, kiosks, etc. They may also involve industrial or trading constructions, a practice often encountered on the sides of main roads. This is not an 'olive plantation' landscape, although some olive trees may be retained and harvested, but as it is one of the 'final' landscapes in the approach used (Table 1) it is included in the classification of olive plantation types.

v. *Abandoned* landscapes that are former olive fields without cultivation and without olive harvest for a number of years. Different degrees of abandonment are encountered and the resulting landscape differs according to the time period that the field is abandoned and the location (soil, altitude, water, etc.). Some abandoned fields are colonized by pines as well as by oak and maquis.

vi. *Neglected* landscapes that are fields 'between' cultivation and abandonment. Besides collecting the olives, little other management is practised, although periodic clearing of the understorey may be encountered. Visually, they are closer to abandoned than cultivated fields. This landscape type represents different practices from abandoned landscapes on the part of the households

Table 1. Combinations of small-scale landscape change and type of change

Initial landscape	Type of change	Final landscape
Housing	–	Housing
Abandoned	Clearing for cultivation	Low-input traditional plantation; or Intensified traditional plantation or Intensive modern plantation
	–	Natural vegetation
	Clearing for housing	Housing
Neglected	Clearing for cultivation	Low-input traditional plantation; or Intensified traditional plantation or Intensive modern plantation
	Clearing for housing	Housing
	–	Abandoned
Low-input traditional plantation	Abandonment of cultivation	Abandoned
	Semi-abandonment of cultivation	Neglected
	Clearing for housing	Housing
	Change of cultivation practices	Intensified traditional plantation or Intensive modern plantation
Intensified traditional plantations	Abandonment of cultivation	Abandoned
	Semi-abandonment of cultivation	Neglected
	Clearing for housing	Housing
	Change of cultivation practices	Low-input traditional plantation or Intensive modern plantation
Intensive modern plantation	Abandonment of cultivation	Abandoned
	Semi-abandonment of cultivation	Neglected
	Clearing for housing	Housing
	Change of cultivation practices	Low-input traditional plantation or Intensified traditional plantation

that manage them, as in the case of neglected landscapes the olives are still picked, occasional pruning may still be practised and parts of the understorey around the foliage of trees may be lightly cleaned occasionally to ease the laying of the nets and the picking of olives; while in 'abandoned' landscapes no practices are encountered. The visual impact of these differences is also evident in the appearance of the trees, the understorey height and its vegetative composition: olive trees turn 'wild' in abandoned landscapes by losing foliage, decreasing the size of leaves and growing branches from the lower parts of the trunk that make them appear like tall bushes; while olive trees in neglected landscapes appear closer to cultivated, pruned trees. The height of understorey bushes increases for the same soil and water conditions and the vegetation composition also differs, with pines and evergreen oak being encountered more often in abandoned landscapes.

This typology represents a considerable simplification of real conditions and the borders between the different types may appear fuzzy at times, a common feature of other land cover and land use classes in the Mediterranean. Nevertheless, the types

represent different systems of olive production and provide a basis for estimating economic and environmental performance.

There are five types of change for these landscapes: a) clearing for cultivation; b) clearing for housing; c) abandonment of cultivation; d) semi-abandonment of cultivation; and e) change of cultivation practices.

Clearing for cultivation involves the clearing of abandoned or neglected fields. Clearing for housing involves the removal of trees and other existing characteristics (terraces, storage buildings, stone walls, etc.). Abandonment of cultivation refers to the stopping of all management practices for more than four to five years. Semi-abandonment of cultivation refers to the stopping of all management practices besides collecting the olives, occasional pruning and rarely periodic clearing of the understorey. Finally, the change of cultivation practices may refer to any of the three possible pathways of change: from low-input traditional to intensified traditional; from low-input traditional to intensive modern; from intensified traditional to intensive modern; and the opposite. The different combinations of types of landscape and types of change include a large number of alternatives (Table 1). Housing landscapes are the only ones that cannot change, as once the constructions are built the area cannot be reclaimed by agriculture, at least for short- and medium-term time periods.

The characterization and evaluation of change is performed on the basis of i) productive, ii) environmental and iii) symbolic criteria:

i) For productive criteria, the evaluation can be performed with the use of overall production. With this criterion, semi-abandonment of cultivation is negative but less than abandonment and even less than clearing for housing. On the contrary, clearing for cultivation obviously increases production as does intensification of management practices (Table 2).

ii) For environmental criteria, the evaluation is performed on the basis of the use of external inputs (fertilizers, plant production products, mechanical input); the use of resources (water and soil management); other cultivation practices (understorey management, terraces creation or maintenance, grazing, removing of rocks) that affect the ecological quality of the habitat that each field supports (vegetation and fauna diversity, soil erosion and soil organic matter). In Beaufoy's frame (p. 41) low-input traditional plantations have potentially the highest natural value of cultivated fields (biodiversity and landscape value, due to features such as terraces, old trees, stone walls, floral diversity) and most positive effects (such as water management in upland areas) as well as the least negative effects on the environment (but are also the least viable in economic terms and hence most vulnerable to abandonment). The intensified traditional and modern intensive systems are inherently of least natural value and have potentially, and in practice, the greatest negative environmental impacts, particularly in the form of soil erosion, run-off to water bodies, degradation of habitats and landscapes and exploitation of scarce water resources. Consequently, low-input traditional plantations are considered the 'better' landscape from this point of view. Therefore, clearing for cultivation is a positive change in environmental terms if the resulting cultivation is that of low-input traditional plantations. If it is that of intensive management, then it is

Table 2. Summary of environmental characterization of olive fields' change on Lesvos

			Semi-abandonment of cultivation			Change of cultivation practices	
Parameter	Clearing for cultivation	Clearing for housing	Terraces maintained	Terraces collapse	Abandonment of cultivation	Intensification	Low input plantation
Vegetation diversity	-	---	++	++	-	---	-
Fauna diversity	-	---	+	+	0	-	0
Soil erosion	-	--	+++	++	--	+	+
Soil organic matter	-	---	+++	+++	+++	--	-
Rock fragments	0	-	-	-	-	--	0

Note: +: positive change; -: negative change; 0: no effect; ?: unknown.

considered negative. Semi-abandonment of cultivation may also involve different impacts. If there are terraces in the field and they are maintained, then the change can be considered as very positive; while if the terraces are not maintained it is less positive. Clearing for housing is the most negative change, as the habitat is greatly disturbed and in the best case a part of the former field will now be a garden (Table 3).

Abandonment of cultivation has diverse effects. In general, when cultivation practices stop and no other disturbance such as fire or grazing follows, a typical vegetation successive process takes place and annuals, perennials, shrubs and trees are established (Allen, 2001) depending on local soil and moisture. At the same time olive trees lose their 'cultivated' character and turn 'wild'. Beaufoy (2000) estimates that nine to 15 years are enough to turn abandoned olive groves to dense Mediterranean shrublands. According to Koulouri and Giourga (2007), biodiversity of shrub vegetation increases with abandonment (Shannon's index value of 0.91 for cultivated fields, increasing in short-term abandonment to 0.93 and up to 1.20 in long-term abandonment fields), but a few species dominate the landscape, on Lesvos *Thymus capitatus* or *Cistus creticus* for short-term abandonment, covering up to 60% of the area; and *Quercus coccifera* and *Cistus creticus* in long-term abandoned fields, covering up to 80% of the area. The overall effect can be regarded neutral as shrubs diversity increases with abandonment and annuals diversity decreases. Regarding soil erosion, Koulouri and Giourga (2007) find that in steep gradients ($>25\%$), soil erosion is increasing after abandonment because of vegetation cover changes: the dense protective cover of annual plants decreases, shrub vegetation cover increases along with bare soil surface below the shrub's foliage. Combined with the collapse of terraces that is common, the result is deficient soil protection and increased soil particles removal. On very steep slope gradients ($>40\%$), gradient is the main factor determining soil losses, surmounting land use effect. But, on the whole, all erosion values are kept low, compared to similar areas, probably due to the fact that even cultivation rarely involves tillage. Soil organic matter increases with abandonment and this is positive for ecosystem functions. Rock fragments in the soil increase with abandonment (stones are removed in cultivated fields) resulting in worst soil properties. Effects on overall fauna diversity are unknown (some species benefit and others are negatively affected). Terraces collapse in abandoned fields and all positive effects are lost. Finally, grazing can have significant effects of the rest parameters used here, especially when grazing pressure is high: in low-input cultivation and neglected landscapes it generally has negative effects on diversity and soil erosion, as grazing animals usually help in the collapse of terraces, but these effects are less negative as abandonment increases (Table 2).

iii) For symbolic criteria, the evaluation is based on the assumption that the continuous landscape of terraced olive plantations of low-input or slightly intensified management, low building densities with small and low buildings of stone is the 'better' landscape. This is assumed as there is a strong connection of olive cultivation in this specific landscape with the 'identity' of the island and its people, who consider olive cultivation as something 'natural' for them and an

established 'tradition', something that "we found from our fathers and will leave it to our children" according to a farmer. Therefore, the most negative type of change is clearing for housing, as most if not all the trees are cut or removed, the site is heavily reconstructed. Moreover, housing almost always involves tall buildings that stand out of nearby fields and alter the whole image of the landscape visually and aesthetically for the worse. Abandonment of cultivation has negative impacts that can de different according to the type of abandonment. Thus, it is more negative when fields are abandoned for longer time periods as this kind of abandonment involves other trees (pines, oaks, pistachios) growing among the olives and gradually the field turns into 'wild' area, a forest. For a short period of time, the impact can be regarded as less negative, as the field loses its 'character' gradually. Finally, clearing for cultivation and change of cultivation practices can also have mixed impacts on symbolic terms. If the resulting cultivation is that of low-input traditional plantations, then it can be considered as positive; while if it is that of intensive management, then it is negative, but less so than other changes, except semi-abandonment (Table 2).

The driving forces behind these changes are many and diverse (Kizos & Spilanis, 2004; Kizos & Koulouri, 2006):

a) One is housing pressures, which surprisingly result in clearing olive fields before removing the trees. This is the outcome of Greek building legislation that allows building outside settlements only on non-forested agricultural land of size no less than 0.4 ha, while building on forested land is prohibited. Therefore, farmers clear in advance fields that will be built to ensure that the land is not considered as forested.
b) The poor economic performance of low-input olive farming today. In the olive cultivation case it can result in part-time farming due to high labour costs and low farmer prices. Farmers (especially part-timers) may choose to minimize practices at a level where they can control expenses and have a level of production to cover their needs. This creates indirect incomes for households, as retail olive oil prices increase (but not farmer prices) and additionally they can sell to friends and relatives at a lower than market but higher than producer price. Full-time farmers find it hard to intensify in the specific setting (lack of irrigation water, sloping fields, etc.).
c) The subsidy of the Common Market Organization (CMO) for olive oil of the Common Agricultural Policy of the EU. In the new CMO (effective from 2007), the subsidy is decoupled from production to a large extent and will be given as additional farmer income instead, regardless of production for a five-year period. The effects of this policy on the choices of farmers regarding cultivation-abandonment are unknown and although some claim that it will increase abandonment, the reality of choices and practices of olive farmers today as presented here seems to indicate that this may not be the case.
d) Attachment to land and family tradition in olive cultivation can not be ignored, as many families want to keep at least the more productive or easily accessible fields cultivated, even at economic loss.

e) Finally, the unattractiveness of agriculture as an economic activity in Greece today results in aged owners and abandonment even of olive plantations. This force is as strong close to a large urban centre where other forces are stronger, but important in other areas of the island.

2.3. Methods

Data come from observation and measurements in 18 olive fields close to the settlements of Loutra and Alifanta (Figure 1) in the Municipality of Mytilini.

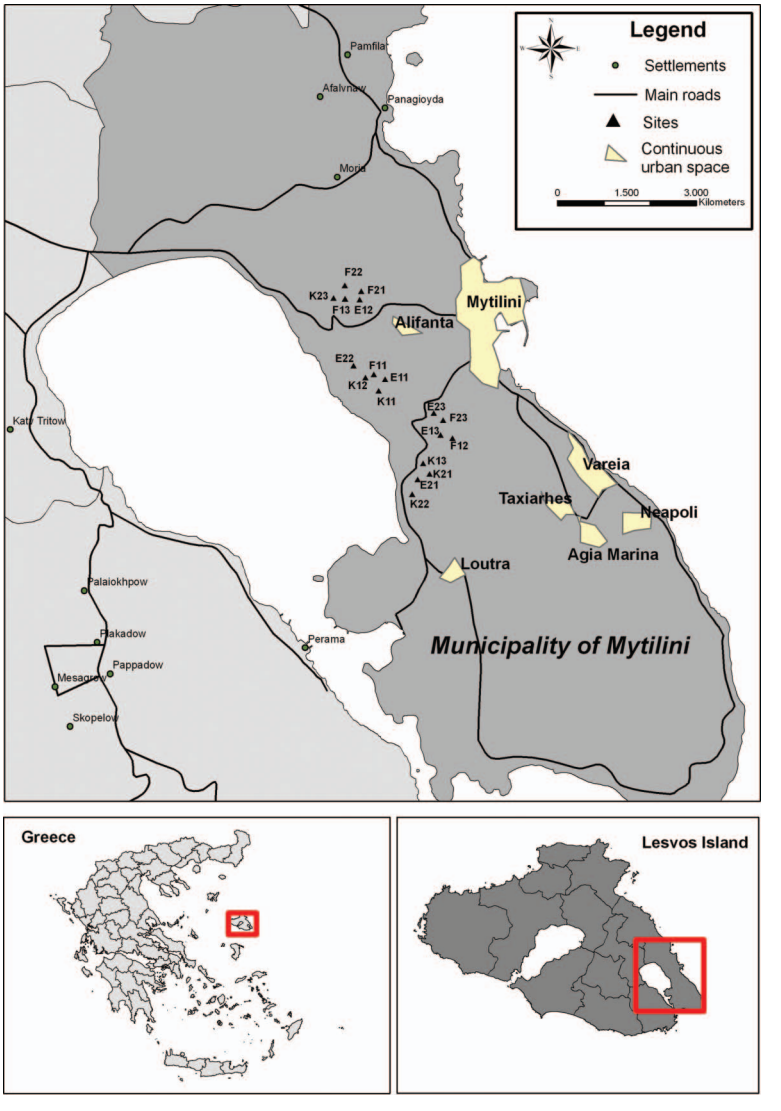


Figure 1. Location of the study areas.

The first recording of land cover, land use and the type of landscape took place in spring 2000 and the second in winter/spring of 2005. The former observations (in 2000) were for a field experiment for water soil erosion and runoff on terraced olive plantations with different degrees of abandonment (Koulouri & Giourga, 2007). An abandonment typology was used classifying fields in three categories: a) cultivated; b) short-term abandonment; c) long-term abandonment. For each category, nine areas in different fields were chosen (18 areas in total of 10 m $\times$ 10 m) where species and vegetation cover were recorded and Shannon indexes were calculated. Cultivated fields bore low densities of small height shrub or were clear with presence of annuals only (corresponding to one of the three cultivated landscapes in the typology used here). Short-term abandoned fields presented developed shrub communities of medium height and occasional presence of small pines (corresponding to negligence landscapes in the typology used here), while in long-term abandoned fields fully developed and dense shrubs were found, some in tree height and developed pine trees (corresponding to abandonment landscapes in the typology used here). The quality of terraces was also estimated and they are in general better preserved, taller, lengthier but not denser on cultivated than abandoned fields, as slope gradient appears to affect mostly their density. The experimental plots and the measurement devices were also photographed. The later observations (in 2005) included visits of the same fields, photographs, recording of changes regarding land cover and land use, along with recording of cultivation practices (if any) and maintenance of terraces.

3. Results: Spatial and Temporal Changes

All of the cultivated sites are low-input traditional plantations lying on terraces and the overall trend is no change (Table 4). This has positive productive impact, as production is neither increased, nor reduced and positive environmental and symbolic impacts that would be greater if terraces were maintained as well. This similar overall trend does not exclude differences though. Some of the sites are grazed (e.g. site K11, where the appearance of *Asphodelus spp*. plants in both recordings indicates grazing pressure) and in some the management of the understorey is neglected and bushes are developing (e.g. site K21), at rates that depend on the specific characteristics of the site (slope gradient, rocky surface, soil depth, etc.).

The abandoned sites are either neglected landscapes (four sites) or abandoned landscapes (two sites). Here changes are taking place, with the most common one being the clearing of the understorey and the cultivation of the fields (three of the six cases, Table 4), with positive impacts on production, less so to the environment as terraces are not maintained and positive to symbolic aspects of the resulting landscape, as all of the three cases are low-input traditional plantations. In one case, abandonment continues (E21), although the olives are collected and the trees are pruned in a typical case of semi-abandonment for an extended period of time. Nearby fields are cultivated in low-input traditional plantations with managed understoreys in the typical case of a mixed landscape of the same land cover and land use. Impacts are negative for productive and symbolic aspects of the landscape and positive for environmental aspects.

Table 3. Summary of characterization of olive field change on Lesvos

Type of change	Productive	Environmental	Symbolic
Clearing for cultivation			
Low-input management	+	0	+++
Intensive management	+	--	-
Clearing for housing	---	---	---
Abandonment of cultivation	--	-/?	-
Semi-abandonment of cultivation			
Terraces maintained	--	+++	-
Terraces collapse	--	++	--
Change of cultivation practices			
Low-input management	+	0	+++
Intensive management	++	---	--

Note: +: positive change; -: negative change; 0: no effect; ?: unknown.

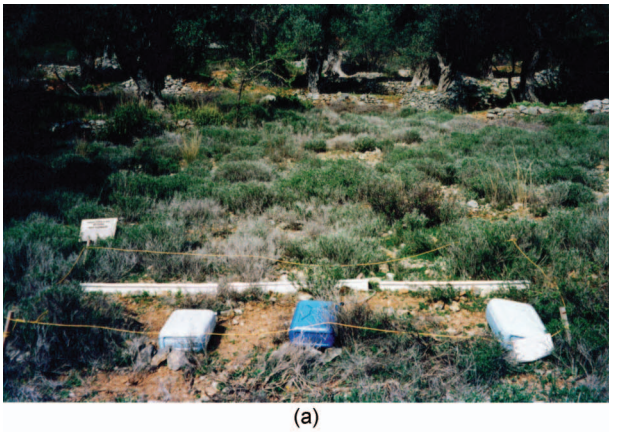
Table 4. Summary of olive field change on Lesvos

Type of change	*N*	%
Clearing for cultivation	9 (5)	50.0 (27.7)
Clearing for housing	2	11.1
Abandonment of cultivation	1	5.5
Semi-abandonment of cultivation	(4)	(23.3)
Change of cultivation practices		
No change (cultivation)	6	34.4
Total	18	100

Note: Four cases can be regarded as semi-abandonment *and* clearing for cultivation.

The other two cases are no longer fields. In the case of site E22, the formerly open field has been strongly fenced with wire, the understorey has been cleared and a house is under construction in the right top corner. The field remained productive at the time of the visit (February 2005) and appeared still so in a following visit (spring 2006) with the house almost finished and inhabited. The site is being transformed close to the house, but not many olive trees are cut. It is a rare case of a house co-existing with an olive plantation, at least at the time and therefore the productive impact is lower than other housing cases. The other case (site E23) is close to site E22 and a different house is built there, with much more landscape transformation works, abandonment of the management of the understorey and cutting a lot of olive trees (Figures 2a and 2b). This is a typical case of a house that overtakes the olive plantation and production is abandoned, while the extent of the works undertaken results in a landscape far removed from what it was initially.

The long-term abandoned sites were all abandoned landscapes initially, but in all cases, the understorey has been cleared in the five years and the field cultivated again in low-input traditional style between the two visits discussed here, but again terraces are not maintained in any case. Although similar, the cases are not identical. In the



(a)

(b)

Figure 2. Research site E23: a) E23 in 2000; b) E23 in 2005.

F11 case (Figures 3a and 3b) the clearing was complete by cutting and burning all bushes, while some olive trees were cut as well, for reasons unknown that could relate to them becoming 'wild' trees again, to the introduction of new and better trees or to the serious injury of them during the massive clearing, as is the case with damaged terraces during the clearing. This fact puts in doubt the real intentions of the clearing. A recent visit (spring 2006) has not revealed introduction of new trees or building of the site, the olives were collected and preparations are made for its fencing. In the nearby F12 site, the clearing via cutting and burning is less massive and some bushes have already appeared again. In the rest of the cases, the clearing took place in 2001 or 2002 and the fields have not been cleared again since, but the olives are collected. The appearance of the fields today is one of low-input traditional plantation that is neglected. This reveals the great diversity of cases that can actually appear in the field and can not always be covered even by small-scale typologies such as the one developed here. The productive impacts of the clearing are positive for all

Figure 3. Research site F11: a) F11 in 2000; b) F11 in 2005.

cases, as olives are now collected in all sites. The symbolic impacts are positive as well, but less than 'proper' low-input plantations, as the understorey management is minimal and terraces are damaged. Environmental impacts are mixed, as the terraces are not maintained, but the semi-natural character of the sites in this semi-abandonment state produces positive biodiversity effects.

The findings are summarized in Table 4 (the six cases of cultivated olive plantations that have not changed are placed in a separate category). These findings indicate that in the areas examined that are close to an urban centre, olive fields are not abandoned, but cultivated in a low-input style, with minimum cultivation practices. Pressure from the urban centre is evident, but not too high on the particular areas that are not very close to continuous urban space, but part of a sparse built up space, mixed with olive plantations, pine forests and maquis shrublands. These pressures will intensify in the future, as is already evident in areas closer to the city that are continuously expanding at the expense of olive fields.

In Table 4, the last four cases of 'clearing for cultivation' (F13, F21, F22 and F23) are counted in this category, although they can be considered as 'semi-abandonment of cultivation' as well.

4. Conclusions: Same Land Cover, Same Land Use at the Large Scale, Different Landscapes at the Small Scale

The findings in this paper raise some important points for two different but related issues in landscape studies: a) different landscapes in the same land cover and land use; and b) small-scale landscape change.

The first issue is very important for landscape studies in general. It is true that most scientific generalizations and abstractions entail a degree of uncertainty when 'real world' cases need to be assigned in the abstract categories they create. But, the olive plantation examples presented here show that such uncertainties can be very important in the spatial analysis that all landscape studies require. The six olive plantation landscapes that are presented here can (with the exception of housing) be assigned in the 'olive cultivation' landscape type for the scale of Lesvos (Kizos & Spilanis, 2004). The closer examination of the fields that are included in such a general 'olive cultivation' landscape type at the small scale reveals though that the different cases are indeed different landscapes at this scale, with varying productive, ecological and symbolic role, character and quality. Intensively managed olive plantations are on one side of a continuous line of different olive landscapes and olive trees inside a forest on the other, with many intermediate cases, while housing is essentially a different landscape altogether. Therefore, it is clear that scale changes dramatically landscapes of the same class.

Olive plantations are not the only example of such a dramatic small-scale landscape change in the Mediterranean, with Mediterranean forests being another (Grove & Rackham, 2002). The same landscape type and land cover (e.g. oak forest) can support different land uses (e.g. grazed or non-grazed forests) and very different landscapes (e.g. thick or sparse trees; high trees or low bushy plants, etc.). Counter-examples include arable land, which is clearly defined as landscape type, land cover, land use and small-scale landscape. The fact remains though that small-scale analysis yields very different landscapes of the same land cover and use.

The second issue, small-scale landscape change, is connected with the first one in the sense that it is the choices of the people that manage the landscape in small scale that create this diversity in images, forms and functions. The driving forces behind these changes are not discussed here in detail, but some broad lines are evident from the differences in management and types of change. Such driving forces act in different ways upon farmers and their households and their decisions vary, leading to different practices and different landscapes, even for fields of the same household.

The findings also demonstrate that apart from the great diversity of landscapes in the same landscape type at any given time (here olive plantations), the whole system is also dynamic. This means that the different small-scale landscapes of the same landscape type change into each other continuously due to these human interventions. To understand therefore this dynamic diversity and its changes, human interventions have to be studied in the right scale, which is the one that corresponds to the scale of the changes, here the farm. In this paper, a system of

three dimensions is developed that can be used to understand small-scale landscape change and evaluate the different landscapes. The findings of the field research clearly demonstrate this diversity and the dynamics of the system and seek to evaluate change, although more research is required for more positive results. This research should incorporate productive, ecological and symbolic aspects of landscape change.

The issue of scale has been central to the line of argument of this paper. Varying scales yield different landscapes. If land cover and land use are suitable for classifying landscape types or landscape areas, then management practices appear as the most suitable level for classifying small scale landscapes. Therefore, large-scale approaches to landscape typology that seek to produce standardized approaches (such as the CORINE), provide valuable information on landscapes, but a finer-scaled analysis of the difference within the standardized categories may be very important for their correct interpretation, understanding of change and evaluation. Other examples in the literature from non-Mediterranean settings make this argument stronger (Kristensen, 1999; Hietala-Koivu, 1999; Kristensen *et al*., 2001; Busck, 2002; Quetier *et al*., 2005). The methods of studying such changes and their impacts involves observation, interviews with farmers, soil and vegetation analysis, biodiversity estimations, interviews with other users of the same areas, etc. and therefore are interdisciplinary and at the heart of the current discussion for the content and the methods of modern landscape studies and a 'landscape science'.

Note

1. The term 'plantation' (that implies recent cultivation) is used instead of 'grove' (that implies older cultivation) in accordance with the work of Beaufoy (2000) and the OLIVERO project (Xiloyanis *et al*., 2004) that use it to describe both older and new plantations. In the case of Lesvos, the plantations are mixed with new trees planted on older groves and some altogether new plantations and the distinction between a 'grove' and a 'plantation' is not always straightforward.

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