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Farming System Transformation Impacts on Landscape: A Case Study on Quality Wine Production in a Highly Contested Agricultural Landscape

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Abstract: This paper is an attempt to synthesize the conclusions of a series of consecutive research projects along a common thread. It focuses on the landscape impacts of a gradual transformation undergone by a low input and bulk wine producing system into a quality wine system. This transformation took place on the island of Santorini, in Cyclades, Greece, during the last four decades in a highly contested landscape. A polarization in the power game has been identified, with two poles having different priorities and perceptions about the two issues at stake: agricultural landscape and wine quality. In the course of this process, both synergistic and antagonistic transition dynamics are encountered, transforming significantly the balance of driving forces. Our analysis suggests that market forces influenced landscape change to a far greater degree than policy measures implemented on the island. Developments in the international markets for tourism and quality wine have played a crucial role in land use change and farming intensity. Public intervention in the form of both regulatory land use planning policy and incentive measures like Rural Development Policy, including an agri-environmental measure, targeted to the vineyards of Santorini, did not seem to have an equally important impact. Integration of landscape maintenance practices within the wine quality regime could create beneficial synergies.

Keywords: landscape dynamics; driving forces; transition; quality wines; Santorini; Greece

1. Introduction

Various challenges and changes in agri-food systems have been increasingly analyzed through the ‘transition to sustainability’ perspective over the last two decades¹ [2,3]. Geographical diffusion of production and dependence on the natural environment (space and resources), along with the use of diverse technologies instead of a dominant technology, are some of the features that differentiate transitions in the agri-food sector from transitions in other domains [4].

Transformation processes, when the level of study is appropriate, could be reflected in specific landscape changes, especially when they involve changes in land use and intensity management practices [5–10].

¹ Part of the information used in this paper was collected during the course of the project FARMPATH- Farming Transitions: Pathways towards regional sustainability of agriculture in Europe, a project co-funded under the European Union’s Seventh Framework Programme for research, technological development and demonstration GA 265394. This information was used in a previous paper by Vlahos et al. [1] presented during the 12th International Farming Systems Association Symposium. Furthermore, information and data has been drawn from the project ENVIEVAL—Development and application of new methodological frameworks for the evaluation of environmental impacts of rural development programmes in the EU, a project co-funded under the European Union’s Seventh Framework Programme for research, technological development and demonstration GA312071.

In systematic reviews on landscape changes, the driving forces behind them have been distinguished between proximate and underlying driving forces. Proximate driving forces arise through human actions at the local level, while underlying forces are characterized by scholars as those that reflect global trends in either the sociocultural, political, or economic domains, or global changes in natural conditions [11–15].

A distinction between conversions of land use and changes in land management intensity could be functional, since one can encounter both phenomena in the case under study. Jepsen et al. [16] suggest that land management intensity (e.g., input use, productivity increase) has not drawn enough attention in the literature, partly attributing this relatively lesser attention to lack of spatial data. Even in the cases where land use intensification has been the focus, this was limited to studying the expansion of cash crops and irrigation, leading to a simplification of landscape and loss of genetic, species, and ecosystem biodiversity [15,17,18]. The special case of vineyards, when dealing with the effects of agricultural land use changes on landscapes, is very well documented. Vineyards constitute an iconic case of cultural landscapes, denoting *terroir* as a hybrid notion incorporating physical and human dimensions [19]. They also have an additional quasi-public good attribute that local actors may possibly individually exploit, in a healthy competition, namely, the reputation of locally produced wines [20].

Santorini ranks, in most tourism-related websites, within the world top-10 lists of island touristic destinations, having established strong links with international tourism markets. Tourism on this island nurtures a series of conflictual and co-operative relationships with other sectors and domains, especially agriculture, with clear repercussions on its valuable but fragile landscape. The role of tourism as a driving force for land use change has been studied extensively. Using a complex adaptive system perspective, development in tourism destinations can be understood as a multilevel, co-evolutionary process, involving diversification in touristic products, which requires, *inter alia*, networking activities among actors and various niche-innovations [21]. Therefore, this approach, integrating the tourist character of the island as a driving force, could prove quite useful in the case of Santorini, especially when the creation of a touristic niche market acquires a pivotal role, in order to understand landscape dynamics [22].

Lambin and Mayfroidt [6] suggest that “land use change is non-linear and is associated with other societal and biophysical system changes”. In order to comprehend the mechanisms of land use change and analyze the interplay between actors, driving forces, and landscape, the typology of approaches suggested by Hersperger et al. [23] is very useful. The approach selected has been the one where actors are placed in the center of the analysis. In that approach driving forces “are complemented by individual factors, such as knowledge, experiences, and belief systems, all playing a part in the decision making process” [24].

On the other hand, quality in wine production is the focal point of a major restructuring process of the whole wine sector, around which a confrontation takes place, on the basis of the application and re-interpretation of different quality contents. After the 1980s, a series of novel technologies evolved in the wine industry, such as innovative wine equipment, biotechnology applied to yeasts, biosensors, and alternative wine making techniques [25]. Additionally, Cusmano et al. [26] have stressed the positive role played by the institutional framework in influencing producers’ innovation in New World wine countries.

Deliberate efforts for the development of a quality wine sector in Greece date back to the early 1960s. An initial system of labeling was introduced in 1970s, while after Greece’s accession into the European Union (EU) in 1981, quality in the wine sector was promoted within the overall European regulatory framework. More recently, the Greek wine sector has been characterized by declining trends of overall production and a coinciding shift towards quality upgrading. Total wine production decreased by 23% between the 2004–2009 and 2010–2015 periods (i.e., before and during the severe crisis endured by the Greek economy during the second decade of the 21st century). During the same period, the volume of quality wines increased by 83.2%, while the production of wines without any

quality certification declined by 36.4%. Consequently, the share of all quality wines has more than doubled, from 11.3% to 26.8% [27].

The wines of Santorini Island, in the Cyclades, have been an important part of the attempt of Greek winemakers to enter the global market for quality wines. Twenty-five indigenous grape varieties, adapted to the hot-dry climate, harsh winds, and volcanic soils, are grown on the island. In addition, Santorini remains one of the few places in Europe with its original ungrafted vines, as the volcanic geology made its grape varieties immune to phylloxera [28]. Two farming practices, manifestations of the adaptation to local environmental circumstances, constitute crucial elements for the landscape of the island. The first is the self-propagation of vines, which makes mechanization and the use of equipment almost impossible. The second practice concerns two pruning methods, which are the result of a long process of adaptation to locally specific climatic features i.e., strong winds and dry weather conditions during the summer. Nevertheless, they still reduce productivity, require skilled labor (pruners), and, consequently, increase production costs. As far as the market outlets for wine are concerned, up to the last decades of the 20th century, the wine produced was sold, mainly in the form of bulk, to the nearby islands as well as to the mainland, through informal networks of out-migrants to urban areas in Greece (mainly Athens, the capital and largest urban conurbation of Greece and its port, Piraeus). The local co-operative could afford the only sizeable bottling unit and an elementary marketing mechanism.

High quality wine production aiming at the global market has become, during the period examined, an integral part of the local production system. In the course of this process, a series of innovations have been introduced and established, including the use of new technological and biological means, as well as changes in specific farming practices. The importance of these changes is that they have a direct impact on the landscape since they concern the very practices that have shaped the agricultural landscape of the island for ages.

This study aims at analyzing the landscape effects of a transition of an agri-food system at the sub-regional scale during the last four decades. More specifically, the study aims to explore the transformation undergone by the agri-food system, as well as the interplay of driving forces and actors and the dynamics developed in the course of this transition. The particularity of the specific case is that the changes, transformations, and the driving forces involved have been reflected in land cover and land use intensity, as well as landscape features. The empirical part of the study was based on material mainly collected in the context of co-funded research projects, as well as on previous and continuous follow-up research by the author in the same area.

2. Materials and Methods

As mentioned above, the current paper is an attempt to integrate along a common thread the results of various projects. The scope of these projects has been the study of the evolution of the system around the Santorini vineyard during the last 4 decades. Emphasis in this paper was given to depicting the way this process, through various stages, has been reflected in the agricultural landscape. A distinction between broad land use change and land management intensity was considered necessary in order to better identify driving forces behind the transition. In the specific case two changes have been considered as resulting to an intensification of production practices: first, homogenization since only one variety was planted on the same land parcel and, second, the installation of linear supporting systems and the consequent change of pruning system, which drastically changed the landscape. During the course of these years a multiplicity of methods has been employed to analyze the transformation of the previously existing system producing bulk wine to a system oriented towards the production of quality wine and the impacts of the transition on the landscape of Santorini.

Desk research has been conducted continuously since 2007, drawing information from press releases, articles in newspapers, and printed and electronic reviews, specializing in both wine and agricultural issues, as well as official legislative and administrative documents.

The field research, within the context of the FARMPATH project (Farming Transitions: Pathways towards regional sustainability of agriculture in Europe), consisted of empirical material collection through open interviews. The field research was preceded by a review of the agri-food sector of Santorini, through which an initial draft of a stakeholder map was created. The interviews were conducted during the spring of 2012, and the first draft was modified with the contributions of the interviewees.

Finally, the following local stakeholders were interviewed:

- three farmers;
- two executives from the Union of Agricultural co-operatives;
- an extension officer;
- a private agronomist/oenologist employed in wine-tourism;
- eight winemakers.

During the field research, an aide memoire was used as a guide focusing on the transition process that occurred on the island. Respondents were asked to give their narrative for the development of the transition. They were asked to refer with considerable detail to technical and practical, as well as economic, aspects of the process examined. Particular emphasis was placed on analyzing the existing networks and their evolution during the course of the process. Policy measures relevant to the area and the wine sector, either supportive to the transition or acting as obstacles, formed the basis for the next set of questions and the discussion was complimented with specific reference to young farmers and new entrants in agriculture. The structure of the aide memoire and hence the interviews was common across all case studies of the FARMPATH project (see Supplementary Document). In the case of Santorini vineyard, the initiative analyzed was the attempt to explore alternative marketing channels for local products [29].

In addition to the above, expert interviews in Athens were conducted with a winemaker, a Rural Development Policy Management authority staff member, and two academics. All interviews were taped and transcribed. Interview transcripts were analyzed for the purpose of this paper under the light of land use and management practice changes and/or maintenance as outcomes of this dynamic process of interaction between driving forces and actors since these changes are directly reflected in the landscape [30,31].

A third category of data, concerning landscape changes and policy implementation, was gathered during the spring of 2015, in order to examine the impacts of agri-environmental and rural development policies on the landscape, in the course of the ENVIEVAL project (Development and application of new methodological frameworks for the evaluation of environmental impacts of rural development programmes in the EU). This information comprised land cover data of the northern part of Santorini drawn from satellite images (8 June 2003 and 8 July 2012), downloaded from Google Earth (GE) [32]. A geodatabase, with two land cover maps for 2003 and 2012, was created after a photo interpretation and digitization of the images acquired. The interpretation resulted in six land cover types as follows:

1. Traditional vineyards: vines grown in a disorderly manner at a distance of 2 to 2.5 m, scattered at quasi-random locations and pruned with the traditional techniques of 'girsti' or 'kouloura';
2. Linear vineyards: vines trained horizontally along wires, subdivided into two classes in relation to their planting density:
 - 2a. high density
 - 2b. lower density;
3. Other cultivated land: including all other crop types;
4. Bare land: mainly rocky areas without vegetative coverage;
5. Built-up area.

Reif et al. [33] argue that it is mandatory to have sufficient ground truth data in order to increase reliability. Hence, after the initial classification, a ground truth survey was conducted. Thus, ambiguous features of the image interpretation were used as sampling points for direct observation. After correcting the interpretation mistakes, the preliminary classification of the land cover maps was adjusted and the following land cover classes were determined:

1. traditional vineyards;
2. linear vineyards;
3. area under annual crops;
4. other cultivated area;
5. bare land;
6. built-up area.

3. Results

3.1. Underlying Driving Forces for the Transition

In the case of Santorini Island, three different driving forces can be identified as exerting an important influence on agriculture, land use, and, hence, the landscape. Two of these, namely, the trends of international markets of tourism and quality wines, can be characterized as underlying. On the other hand, one can also identify a set of proximate driving forces, such as policies that have greatly influenced land use and farming practices. The policy measures that have seemed to acquire particular importance are the Common environmental policy, the Common Agricultural (and Rural Development) Policy at the EU level, and spatial planning policy at the national/regional level.

During the timeframe of this paper, the last four decades, there have been various developments that have affected tourism in the island. Firstly, global changes, such as improved transport infrastructure and lifestyle changes, have boosted tourism development. The first wave of tourism development emerged on the island during the early 1980s and mainly affected space and labor, two elements highly contested locally by both farming and tourism. The number of beds offered to tourists in Santorini increased from 8968 in 2002 to 11,955 in 2012 [34]. Land on the islands has always been a scarce resource and, in the Greek islands in particular, where land tenure is characterized by small allotment size and high fragmentation. Increased demand for land for the construction of hotels and other tourism or commercial enterprises resulted in a considerable increase of land prices, including the price of agricultural land. At the same time, attractive salaries were offered to the local labor force in both tourism and construction, therefore absorbing latent unemployment and reducing out-migration.

During the 2000s, however, global changes seem to have had impacts on both the local land and labor market. Within the process of expansion and growth of the tourism industry worldwide, a saturation of certain market segments caused the emergence of strong trends towards the provision of differentiated and diversified tourism services. New forms, such as ecotourism, cruises, wine tourism, or combinations of these, emerged during the 1990s and gained impetus [35]. Big hotels and mega-installations were not sought after any more, hence, demand for land became selective, and even smaller parcels of land acquired increased value. At the same time, the agricultural landscape was qualified as an asset for tourism along with the volcanic landscape and the seascape/view.

On the other hand, another global driving force that affected both the local tourist industry, as well as farming on the island, has been the development of a worldwide market for quality wines in which globalization is manifested through a strong tendency towards homogenization of the taste and the creation of 'international wines' [35,36]. The market for quality wines appears to have expanded rapidly during recent decades, as can be seen by sales and exports data. Thus, various changes occurred in order to facilitate a new way of co-ordination of the wine value chain actors in order to deal with the various external threats or opportunities concerning wine production [37]. Finally, the globally widespread perception of 'localness' and provenance as an element of quality, especially for wine, has been a further factor that seems to have played an important role in the changes that occurred

in Santorini wineries. There are quite a few elements that suggest that geographical indications (GI) provide a considerable value added to wine, e.g., a price differentiation for GI wines [38].

3.2. Agriculture—Tourism Synergies and Conflicts in Santorini

The two interconnected systems, tourism and agri-food (mainly wine production), can be better described by analyzing the synergies and conflicts created during their co-evolution during previous decades. Santorini has been known for its wine production and trade since the ancient times. Almost 100 years ago (1920), vineyards covered 3500 ha, accounting for 84% of the cultivated land [39]. A gradual decline over the years was accelerated by a massive earthquake in 1956 (2250 ha in 1970), followed by the augmentation of tourism in the 1980s resulting in a further decrease to 1492 ha in 1997 [40]. Since then, the area covered by vineyards seems to have stabilized and, according to data in 2012, it covered 1285 ha with wine production reaching 3151 tons [41]. More recent research suggests a reversal of this trend, i.e., an increase of the area under vineyards, at least on the northern part of the island [42].

During the early 1980s, Santorini was increasingly valued as an attractive tourism destination. The process followed a pattern common in Greece: a disorderly establishment of small size tourist installations, starting from the littoral and gradually expanding to other areas. The view, volcano, sunset, beach, and nightlife were the main (if not the only) features of the Santorini tourism industry. There were no strong linkages established with other local agricultural products other than wine, although there were a number that could be promoted, such as small tomatoes, white eggplant, fava, a puree made of *Lathyrus* spp., etc.

The numerous touristic activities, despite their small size, increased pressures on agricultural land uses. In addition, an equally important impact was the increased option-cost of labor, especially for the local youth. Adopting a strategy based on flexibility, households divided their available labor, with older members dealing with the vineyards and the younger occupied in construction and tourism. The latter were, nevertheless, always available during the peak of agricultural activities, particularly the harvest. The small size of businesses in both regimes permitted the smooth flow of labor between the two activities.

The adaptive strategies that followed did not mitigate the impacts on agricultural land use and the local labor market. On the contrary, they continued to result in an impressive sprawl of urban uses and increased land prices, with detrimental effects on the rural and the volcanic landscapes, as well as on the built environment of the island. Gradually, the flourishing tourism businesses attracted further external investment, as well as real estate. Cheaper external labor became also available on the island, thus creating increased competition for local labor.

3.3. The Reconfiguration Process

During the 1980s, one of the largest wine-making companies, based in Northern Greece, started its first attempts towards quality wine production in Santorini. The firm followed the international trend of linking wine with tourism, in collaboration with local bulk wine producers and a co-operative ('Santo Wines') [43]. At the same time, they experimented with traditional techniques used in the area such as the re-utilization of 'canavas', i.e., human-made grottos used for the aging of the wine. This decision seemed to have been influenced by four factors: a generational change within the company; the availability of new technological innovations, especially for the processing of the grapes; associated funding through investment subsidies; and finally, the coincidence with the increase in arrivals of tourists on the island. Acting synergistically, these factors seem to have triggered the gradual transformation of the agri-food regime, starting in 1989, with the establishment by the company of a modern winery and an information center in which visitors could taste and purchase wine [44]. Later (1992), the local co-operative, comprising 2500 farmers, created an independent facility with considerable success, while in 1998 and 2005, under the EU's support schemes, the co-operative modernized its winery and improved its winemaking capacity [Co-op exec, 44]. In this respect, two established actors played a crucial role in the initiation of the process of change: they offered legitimate power and resources as well as considerable momentum to this process [45].

These two efforts, apart from being two successful initiatives, paved the way for a new wave of winemakers, who were mainly younger people with origins on the island, who up to 1980s were migrating for studies or/and work. These returning ‘new entrants in agriculture’, according to the winemakers interviewed, came to the island having already established professional, personal and political, as well as social, networks acquired during their previous occupations. Apart from contacts, new wine-makers had a vision for their business and local wine. All winemakers interviewed inherited their land; three came from families which traditionally produced and/or traded with wine and some inherited installations and equipment. All winemakers hired specialized oenologists, while one of the interviewees, apart from digging a new ‘canava’, also hired an expert who had studied in France and, during her career prior to Santorini, worked in California, Australia, and another quality wine making area in Northern Greece. All the above suggest that the new winemakers displayed a high degree of persistence in quality improvement.

Substantial co-ordination efforts of individual winemakers can be identified in their joint presentations to international fairs and exhibitions and participation in contests, as well as in establishing linkages to mainstream and influential specialized press in both Greece and internationally. Another attempt towards horizontal co-ordination was the ‘voluntary commitment contract’ that all wineries of the island signed with the National Inter-Professional Organization of Vine and Wine, whereby they are bound to protect the fame of the wine and, at the same time, avoid unfair competition practices. Therefore, apart from the multiplication of involved actors, new networks have been created and a remarkable networking activity has taken place.

In parallel with the above developments in the local wine institutional and market arrangements, the global trend towards alternative forms of tourism highlighted the environment and ‘localness’ as important elements of diversification of the tourism product [35,46]. Taking these developments into account, diversification of tourism services locally seemed inevitable. According to estimations of local stakeholders, urban settlements of Santorini, mainly Fira and Oia, during the summer period receive an average of 14,000 visitors daily [47]. The ‘saturation’ of the conventional local touristic market was, nevertheless, perceived by the Santorini wineries as an opportunity for synergies. Currently, there are 13 wineries offering wine-touristic services as well as direct sales. Wine tours are offered to tourists during the entire touristic period, some by specialized agencies (Agronomist/Oenologist). Thus, the introduction of novel practices and the transformation of the agri-food regime contributed to the creation of strong inter-regime links. The importance of this shift to wine tourism has been reflected in the landscape, through the establishment of new linear vineyards, as shall be shown below.

3.4. Proximate Driving Forces: The Key Role of Public Intervention

3.4.1. Policy Measures Promoting Wine Quality

The island of Santorini was one of the first places in which the Greek state tried to design and implement policy measures to promote quality wines. The first ‘Indication of Origin’ for Santorini’s wines was legislated by the European Economic Community (EEC) in 1970 as a result of a Greek request, based on the findings of a number of oenological studies, conducted by the Greek Ministry of Agriculture in 1962, concerning the ecosystem of the island and three native vine varieties [28]. The next decisive step was taken in 1981—when Greece accessed the EEC—with a Santorini wine designated as ‘Vin de Qualité Produit Dans Une Région Déterminée’ (VQPRD) in the EEC market, following requests of the Greek state. Currently, there are three types of wine produced on the island that are registered as wines of Protected Designation of Origin (PDO).

A second policy measure has been the support of investments provided by national and EU funds. Technological innovations in wine making have been available since the late 1970s [48]. The support provided made possible access of wine makers to these innovative techniques by significantly contributing to investment costs. Otherwise, the small size of vineyards in Santorini would render the

quest for investment capital for novel techniques and equipment in wine making a rather difficult exercise, especially since it concerns small specialized businesses, with limited possibilities for expansion in size.

3.4.2. Policies Affecting Land Use and Intensity of Farming

Within the EU rural development policy framework, two policy measures providing incentives to farmers have been implemented during the last two decades. The former, beginning in the 1990s, concerns the support of farming in small islands of the Aegean Sea. Farming on islands is considered of great importance for the maintenance of the social fabric, as well as the traditional Aegean landscape. Acknowledging, hence, the accessibility problems, as well as increased production and marketing costs of agriculture in the islands, the EU provides financial support to farmers. Within this specific policy measure, a scheme for the maintenance of traditional crops cultivated on the islands was launched. Vineyards as well as a number of other traditional crops of Santorini are included in the list of the crops supported. Almost the totality of active farmers on the island received this support [49]. Another targeted agri-environmental measure is aimed at the maintenance of the traditional agricultural landscape of Santorini. Farmers under this scheme are compensated in order to continue pruning and propagating the vines using the traditional and costly techniques as well as to leave uncultivated area in each parcel. More than half of the island's area and farmers participate in this measure. Both these measures seem to have been clear successes, in terms of their acceptance by farmers [50].

A draft Spatial Plan for the whole island, including the agricultural landscape of Santorini, was prepared and proposed in 1998, as part of the national spatial planning policy. It was evaluated by planners as a complete and structured proposal for a comprehensive land use plan, placing restrictions and designating protected areas [34,51]. The draft plan also received vociferous support by all actors and was met with the unanimous approval of all interviewed stakeholders. However, it is not, yet, legally binding since its formal approval and ratification has remained pending since 1998. Another attempt to regulate land use on the island was made in the early 1990s with an ad-hoc 'Plan for the determination of zones for settlement development control of Santorini'. This targeted the most vulnerable zones of the volcanic landscape and archaeological sites. However, this attempt has not been successful in restricting unplanned construction. It created distortions in land market value, hence, it was complemented in 2011 with a Ministerial Decree which temporarily suspended building permits. It was again supplemented, a year later, by a law allowing only authorized repairs and restoration. Further land use control measures, such as the General Urban Plan in 1987 and the Town Plan Study for Fira in 1991 have been limited to the urban environment around the main settlement of the island [34]. Finally, all efforts undertaken by the Ministry of Rural Development and Food to protect either highly productive land or areas characterized as having high natural value and/or areas constituting important agricultural landscapes, have remained at the stage of statements of principles and noble intentions.

The actual landscape impacts of these policy measures cannot be disentangled from those resulting from the significant pressures exerted on land uses by tourism and housing. Thus, the statement by Lambin and Mayfroidt on the multifaceted nature of land use change dynamics [6], as well as the doubts raised Freshwater [52] on the effectiveness of rural development and/or agricultural policies against urban sprawl, have been corroborated. All public policy interventions and rural development, agri-environmental, and spatial planning measures, have not appeared to be effective, especially in the areas where urban pressures have been intense. Census data (1971 to 2011) suggest that the number of buildings in Santorini has increased from 3755 to 13,528, resulting in 11% of the island's land being sealed by construction [51].

3.5. The Interplay between Factors and Underlying Driving Forces

The main conflict between tourism and agri-food regimes has been over land use, a conflict that actually epitomizes frictions among the regimes and the outcome of which largely defined the landscape of the island. As shown, tourism has been a fierce competitor over land use [34]. The

changes of the landscape of the island have been dramatic. The detrimental impacts have not been limited to agricultural landscape. Urban continua have been formed, in serious detriment of both the volcanic and vulnerable small-scale urban landscapes. The deceleration in the construction of hotels and recreation facilities has been followed by a second wave of pressures, namely, that of summer holiday luxury homes. Real estate investors took advantage of the deficient land planning system and shifted their efforts towards luxury housing [34].

Within this land use conflict some important alliances have emerged between the co-operative and the newly established private wineries, at least during the first phases of the transition. An informal arrangement concerning the provision of raw material, i.e., grapes, paved the way for collaboration among them. 'Santo Wines', the co-operative, was founded in 1947 as a mandatory co-operative, in which membership of local grape-growers was obligatory by law. Nevertheless, as emphasized by Iliopoulos and Theodorakopoulou [39] "while legislation permits Santo to demand that at least 25% of its members' produce be delivered to the co-operative, Santo has silently conceded to accept a lower percentage so that local private wineries can secure access to grape supplies, too". A further advancement of this collaborative arrangement between private initiatives and the co-operative took place as a response to a policy measure, potentially detrimental for the island's vineyard landscape. As a part of the 2007 reform of the Common Market Organisation for wine, the grubbing up of vines was promoted but the breadth of its implementation was left at the discretion of the Member State. A co-ordinated effort of the Santorini Co-op, individual winemakers, and the local authorities, annulled the application of this specific policy provision in Santorini by arguing that the traditional vineyard and the landscape is a scarce economic and environmental resource that ought to be protected. This arrangement was applied on an ad-hoc basis, but its success nonetheless emphasizes the potential of more permanent forms of co-operation.

In terms of the interplay between actors and driving forces, it can be further observed that the changing circumstances of international markets have acted as strong drivers that triggered inter-regime frictions in the process of the agri-food regime transformation. Regarding the international wine markets, two competing approaches have been observed. One aims at the homogenization of taste and advocates for the prevalence of grape variety as a quality attribute. The other supports the value of diversity of tastes and the importance of terroir, the latter conceived as "a unique combination of environmental, agronomic and human factors, particular for each wine-producing area" [53,54]. Over these two approaches, two distinct sociotechnical reconfigurations with the consequent institutional arrangements have been formed in Santorini, having a notable effect on both agricultural production process and the landscape.

In the context of the first approach and in order to comply with the new cultivation methods required for the production of 'international wines' (since the mid-1990s), two farming practice changes occurred. First, the need for land parcels to be planted with only one variety in order to better program harvesting vs. the traditional way of mixing different grape varieties, which made it impossible to co-ordinate harvesting even within one holding. This, however, meant that farmers should restructure their vineyards investing resources and time, i.e., incurring an entry cost, in order to participate in the quality production project. Second, early harvesting (middle to late August) is considered essential for securing quality within the international approach. However, this created a serious conflict in the intra-household division of labor, since the demand for labor in the vineyards coincided with the peak of the touristic season. Traditionally, late harvesting (early–middle September), meant that the members of the household occupied in tourism could also contribute to the task [49]. The already conflictual relationship of the two regimes, i.e., tourism and agri-food, seemed thus to be further aggravated. The possibility to establish a synergistic effect by using a contested resource, i.e., labor, in different time periods, was precluded with the change of the agricultural calendar imposed by the quest for quality [22].

The adoption of the first approach, the 'internationalization' of wine, calls also for the 'correction' of certain characteristics of the wines that are not 'desirable' by the actors that are important in the

construction of the ‘ideal’ wine [21]. Thus, technical innovation was adopted by winemakers in the processing part of the value chain. In the first place, their objective was to gain access to markets, especially in the increasingly interesting and flourishing global quality wine market. When access to the market was achieved, they strived towards maintaining their competitive edge through quality. In that arena, the role of ‘terroir’ as a decisive factor of quality is not a fact as incontestable as one might expect [55,56]. Especially in the case of quality wines, the debate on the issues of grape (variety) vs. terroir, in other words on the uniformity of ‘international’ wines as opposed to the diversity of local wines, is open and fierce [35,36,53–57].

Being in a relatively weaker position, farmers have to bear all the burdens of the abovementioned changes in order to maintain access to outlets for their produce. The co-operative, functioning as the last resort buyer for the grapes, can maintain prices at levels that favor farmers. The uneven distribution of burden and the continuing pressure on prices at the farm gate cause a partial alienation of grape producers from the ‘miracle of the Santorini vineyard’, the latter consisting of the worldwide success of local wines.

In that complicated context, the interplay of underlying driving forces with local actors resulted in a polarized system. The first of the two poles comprises the new innovative ‘international’ wineries, which have as their main objective competitiveness and growth, are flexible and adjustable to the changing demands of a very volatile market, and perceive the denomination of origin as merely another element of their marketing strategy. Consequently, they try to force their providers, the farmers, to adapt. They are fierce protectors of agricultural land use but also supporters of changes deemed necessary in order to comply with standards, even if such changes have a detrimental effect on the landscape and the environment in general. The issue here is that the changes in the pruning practices and propagation methods affect the landscape that is so much valued, not only by experts or environmentalists, but also by tourists. Landscape constitutes an essential part of the ‘Santorini experience’, and is hence an asset for the island and the tourism regime. As a co-operative executive stated: “[...]the way [winemakers] are cultivating their vineyards is far from the local tradition, since they use pesticides and, more than that, they destroy Santorini’s landscape by planting them in linear supporting systems” [Co-op rep]. It is, however, argued by researchers that changes that could have a negative impact on natural resources and/or the environment could also undermine the long-term competitiveness of the wine in the global markets [58].

On the other pole lies the co-operative and its allies, the majority of the farmers, whose main preoccupation is the viability of their households. The co-operative manages 60% of the local grape production, which corresponds to 18,000 hectoliters of wine per year. The remaining 40% of the local grape production is bought by local private wineries and then transformed into bottled wine. It has to be noted that 70% of the co-operative’s production is destined for packaged/bottled wine while the remaining 30% is sold in bulk [39]. This means that 18% of all grape production of the island is still transformed as bulk wine. This, according to official protests of individual winemakers, is considered as undermining the whole effort of the upgrading of Santorini wines. Thus, in the structure of the local wine market there is a clear power asymmetry between the co-operative, which is the price leader, and the private wineries that are price takers. The latter have to pay to grape growers a 25%–40% mark-up on the price set by Santo to ensure their supply in grapes [Wine maker]. That is unquestionably reflected in the farmers’ sense of ownership for the Geographical Indication system. In that sense, the fame of Santorini wine is perceived by farmers as a collective good. In addition to that, pluriactivity is an important element of farmers’ survival strategy. Hence, tourism for them is not just providing an outlet for their wine production but also constitutes an additional income source, either through employment in or the establishment of tourism-related businesses; therefore, the agricultural landscape is an essential asset for farmers as well.

It is worth mentioning that in such a ‘power landscape’, the role of institutions has been to a certain degree that of allies to be secured. The polarization has influenced local and regional politics as well as policy implementation. There is a series of public manifestations of this polarization and the

efforts to be connected to different networks, including written protests for or against the actions of the opposite poles and its representatives. Furthermore, various degrees of institutionalization are found in the regimes under study, revealing attempts to accrue social capital. A prominent example of institutionalization is observed in the ‘voluntary commitment contract’ that all wineries of the island have signed with the National Inter-Professional Organization of Vine and Wine.

3.6. Impacts on the Landscape

In their efforts to fully adapt to the requirements of a globalized market, some of the winemakers decided to change the pruning and propagation system on their own land and asked their providers (i.e., farmers) to do the same, otherwise winemakers would stop buying their grapes. The innovations voluntarily adopted by winemakers called for obligatory changes on the primary production side. The effects on the landscape were significant.

In order to estimate land cover changes in Santorini, a study was conducted during late 2014 and the spring of 2015, the latter including a ground truth survey [42]. Two land cover maps were constructed, one depicting the situation in 2003 (Figure 1), and the more recent one of the same area in 2012 (Figure 2).

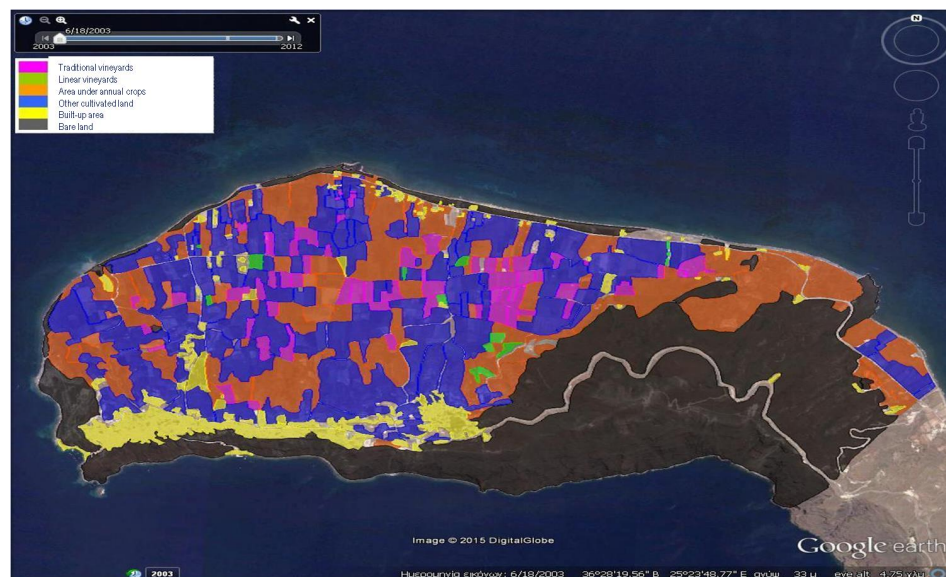


Figure 1. Land cover map of the northern part of Santorini (2003).

The results are shown in Table 1 below.

Table 1. Comparative presentation of land cover distributions to class (2003–2012).

Land Cover Classes	Distribution 2003 GE Data	Distribution 2012 GE Data
Traditional vineyards grown in disorderly and pruned with the traditional techniques of ‘girsti or kouloura’.	65 polygons	64 polygons
Linear vineyards pruned horizontally along stakes or wires	13 polygons	27 polygons
Area under annual crops	102 polygons	70 polygons
Other cultivated land	106 polygons	88 polygons
Built-up area	96 polygons	51 polygons
Bare land	19 polygons	23 polygons

Source: Smyrniotopoulou and Vlahos [42].

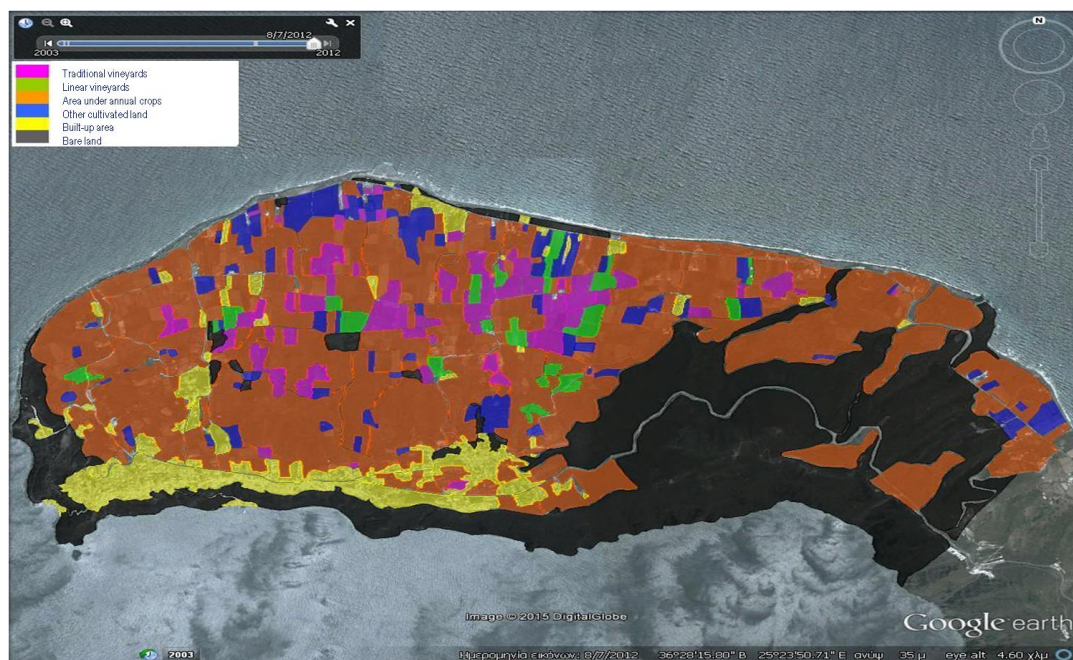


Figure 2. Land cover map of the northern part of Santorini (2012).

Land cover changes that occurred during the 2003–2012 period in the Northern Santorini area (around the community of Oia), are summarized in Table 2.

Table 2. Area under each land cover class for 2003 and 2012 (in ha).

Land Cover	2003 ha	2012 ha	Rate of Change
Traditional vineyards	65.93	77.73	18%
Linear Vineyards	6.68	28.31	324%
Area under annual crops	306.4	646.08	111%
Other cultivated land	404.04	72.55	−82%
Built-up area	74.09	98.92	34%
Bare land	533.57	435.81	−18%
Total digitized area	1390.71	1359.40	−2%

Source: Smyrniotopoulou and Vlahos [42].

The land sealed by construction increased by more than one-third during this 10-year period (Figure 3). A considerable four-fold increase of 22 ha was observed for linear, i.e., intensive, vineyards, while traditional vineyards maintaining the landscape characteristics were expanded by almost 12 ha. A further observation concerns the fact that the area covered by annual crops in this northern part of the island more than doubled with an increase of approximately 340 ha, apparently at the cost of the “other cultivated land” category.

In total, the area covered by vineyards has increased and covered 7.8% of the land in this part of the island, while other annual crops extended to almost half of the area (47.53%) in 2012. One can observe that agriculture has gained importance during this decade. According to the Greek Payment authority, 49% of the annual crops receiving direct subsidies in the Oia area comprise two traditional crops emblematic of the island, namely, the small size rainfed tomato and, more importantly, fava (*Lathyrus* spp.) [59]. These two products have been the focus of a campaign run by the co-operative to promote local products using infrastructure and the market channels created for the Protected Denomination of Origin wines.

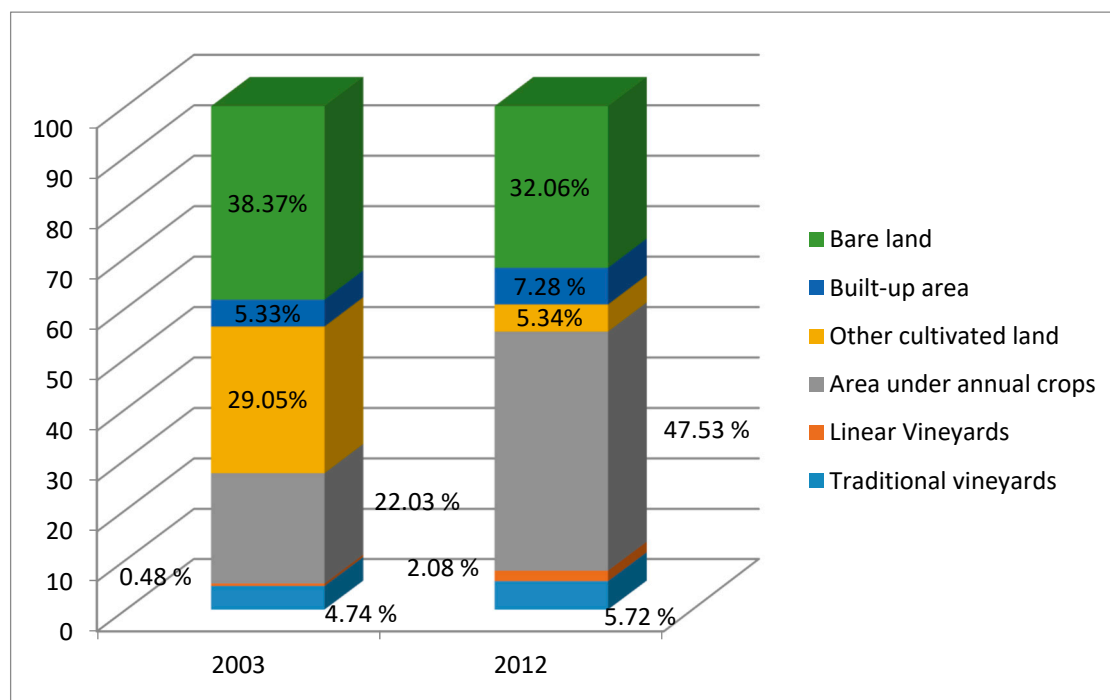


Figure 3. Land cover classes in %. Source: Smyrniotopoulou and Vlahos [42].

4. Discussion

The aim of this paper was to integrate the results and draw synthetic conclusions from a series of research projects around the Santorini vineyard, conducted during the last 15 years. The focus of the discussion that follows is on the identification and interpretation of the interplay between the driving forces and actors and their role as landscape change factors during the emergence of a quality wine system in Greece; in other words, on the kind of transformation that the agri-food regime has undergone, under the influence of proximate as well as underlying driving forces, the inter-regime relationships that have emerged, and the resulting changes of the agricultural landscape. A low input and bulk wine producing system was gradually transformed into a high-quality system through new combinations of old and new elements, pointing to a stepwise reconfiguration pattern instead of a technological substitution pattern. In this process, incumbent actors have acquired new roles, along with a multitude of new actors that have entered the scene.

Using the driving forces typology, one can identify a plurality of driving forces exerting their power and influencing landscape evolution in Santorini. Among the prevailing proximate driving forces, urban/tourist development, removal of landscape elements, and intensification of agriculture, as well as rural development policy schemes (including agri-environmental measures), can be mentioned, with varying degrees of influence. At the same time, a series of underlying driving forces has been identified, under various categories, e.g., driving forces like real estate market and market growth, technological modernization in land management, as well as cultural driving forces such as public attitudes and values and individual/household behavior. The plurality of driving forces affecting the evolution of the agricultural landscape can be explained by the complex nature of the system in Santorini, where tourism/urbanization and agriculture are competing for the use of resources, notably land and labor, while, at the same time, both sectors are deeply integrated in highly competitive international markets, namely tourism and quality wines.

Analysis suggests that the landscape changes under study have been mostly triggered by underlying driving forces, related, in the first place, to tourism development, initiated in the early 1980s, which also affected labor, and shifting later towards the provision of differentiated and diversified tourism services. A second impactful driving force identified has been the development of a worldwide

market for quality wines, and within the ‘quality domain’, the importance of ‘localness’ and provenance as an element of wine quality. A highly contested issue was identified, as two competing approaches within international wine markets have been reflected at the local scale with consequences on the landscape. The first, pursuing the homogenization of taste, advocates for the prevalence of grape variety as a quality attribute. In that case, landscape, local knowledge, traditional farming practices, and social impacts seem to be irrelevant; the whole marketing strategy is detached from the terroir, using the fame of the island as a mere diversification marketing tool. This approach is linked to specific changes in farming practices, namely, changes of the pruning and propagation techniques resulting in a linear form of the vineyards, as indicated by the significant increase of linear vineyards in the mapped area. If this trend continued, an essential morphological characteristic of Santorini vineyard element would be threatened. The second approach deems as important diversity of tastes and is based on the prevalence of terroir as an element of quality. The notion of quality is directly derived from existing farming practices, local knowledge and, therefore, it is embedded in the landscape and deeply rooted in the society.

The changes that took place affected all the links of the wine value chain, starting from the primary production process, causing rearrangements and new types of co-ordination among actors and stakeholders. The reconfiguration of the regime involved a series of technical innovations, along with the creation of new networks and the redistribution of available resources, i.e., the exercise of innovative and transformative power on behalf of both the co-op and the private wineries. Furthermore, the initiator of the whole regime transformation has been one of the major wine companies in Greece, who acted as a new entrant on Santorini Island in 1980s. Thus, a regime actor with constitutive power in other areas of the country used forms of innovative and transformative power in order to enter and get established in this promising area, revealing at the same time ‘synergetic’ power dynamics. Further features of the power game include the exercise of transformative power that occurred in the development of a new structure from the co-op: in order to ensure a permanent presence in both national and international consumer markets, in the course of its expansion, the co-op developed in early 2012 a strategic alliance with a well-established, successful private wine company which is a major wine maker and retailer in Greece.

The importance of the existence of social capital is highlighted by the differences of the degree of acceptance by the local actors of two institutional arrangements. The first is a quality convention (designated PDO wine), initiated by the EU but embedded in the local society, which implicates local actors towards an active protection of a collective good, i.e., fame. Our analysis suggests that no such convention for the landscape was adopted, even informally, by local stakeholders. The fact that the pruning and planting practices are not part of the specifications, compliance with which is necessary in order to gain the PDO label, has no doubt played a role in not inhibiting the trend towards linear planting, supporting of vines, varietal homogenization, and, hence, landscape change. Finally, despite some co-ordination efforts among winemakers, the lack of co-ordination between vine-growers and winemakers seems to have resulted in a further debilitation of their collective position in the land use planning policy.

Analysis of the conflicts that emerged revealed a polarization in the power game, with two poles having different priorities and perceptions about ‘quality’. The first pole comprises the new innovative ‘international’ wineries aiming at extroversion and competitiveness, and thus at continuous innovation as it relates to growth. This pole supports the protection of the agricultural land but not of the traditional landscape of the island. The second pole, comprising the co-operative and the majority of the farmers, aims at viability (household reproduction). They stand for the protection of traditional production methods and the landscape, since these are crucial aspects for tourism and quality attributes for their wines. In this sense, it can be argued that the second pole, despite its own internal contradictions and trade-offs, seems more supportive to sustainability.

5. Concluding Remarks

The whole agri-food system of Santorini Island is at a critical crossroads, with a series of challenges and open issues, such as the debate on the so-called ‘internationalization’ of its wines, the protection of the vineyard landscape, and the improvement of quality. A systematic analysis of the long-term process of transformation of this system can elucidate the mechanisms of change and yield an informed exchange of arguments. A clear indication that the increased competitiveness of Santorini wines in the international arena had an effect on the landscape is documented by the significant increase of linear vineyards in the northern part of the island.

The differentiation between proximate and underlying driving forces was proved to be a very useful analytical tool. Nevertheless, underlying driving forces, through their influence on actors’ actions, have been reflected in their proximate counterparts. This was the case of the modifications to the international market for quality wines that affected local actors at individual and collective levels, triggering the emergence of proximate forces.

Due to the spatial expansion of tourism through the creation of urban continua and the dispersion of housing, the whole island could be considered as having attributes similar to those of an urban fringe. In that sense, the impacts of any policy intervention, attempting to influence decision making concerning agricultural land use, are difficult to assess, especially when the pressures to change land use have their origins in driving forces external to agriculture, as is the case with urban expansion, which is the main driver identified in the case of Santorini. On the other hand, spatial planning, the regulatory policy that could be used in order to restrict the expansion of housing, is characterized by its intermittent and spatially irregular implementation.

Actors’ characteristics and perceptions, such as the sense of ownership of the quality scheme, the existing local knowledge base, and household strategies, as well as identification with the traditional vineyard landscape, have heavily influenced the final outcome under the pressures exerted by proximate driving forces.

The inclusion of landscape protection within the prerequisites for acquiring the Designation of Origin could create synergies. This could take the form of integrating maintenance of practices essential for the preservation of the landscape (namely pruning and propagation techniques), within the obligations of farmers and wine makers, in order for the wine produced to be entitled to the PDO label. Apart from the obvious positive effect on landscape management, it could also add value to the PDO, since landscape protection would be another quality attribute that could be deservedly claimed by winemakers and farmers.

The alignment of land use and management practices with market trends is corroborated by the considerable expansion of annual crops in the same area, where the area covered more than doubled, since approximately half of this area is covered by two of the symbolic traditional products of the island gaining international recognition. Under the influence of the international demand for quality wines and quality products in general, the trend for urbanization of agricultural land seems to have been relatively curbed. On the contrary, the effectiveness of a proximate driving force, i.e., the agri-environmental policy measure implemented for the protection of specific landscape features, was not that pronounced, at least in the northern part of the island where the land cover survey was conducted. The shift to the protection of landscape features, promoted by policies, was much less important than the changes triggered by the market, hence, corroborating the findings of land use change literature. The limits set by the EU for the compensation of farmers for the application of a land use and/or management practice favorable for the environment greatly reduce the effectiveness of policy.

However, one should bear in mind that the 2003 land cover map was produced independently of the 2012 map, in order to avoid bias in interpretation and classification. Hence, classified polygons of 2003 were not used as a reference for the interpretation and classification of the more recent map. That did not allow for an analysis of land cover changes per land parcel, which is a deficiency of the

research, since, on the one hand, it limits the possibilities for interpretation and, on the other hand, any decision for change is made at the farm level and refers to individual parcels.

PDO governance in Greece seems to be significantly lacking. It is managed in a centralized manner, depending on an organization under the Ministry of Rural Development and Food, with no traces of participation by local stakeholders, which further aggravates the conflicts created locally. In the case of Santorini, interested parties, in the absence of a formal negotiation forum concerning issues related to viniculture and wine making on the island, are forced to seek political backing and influence policy decisions through clientelistic networks. Devolution of competences on PDO wines to local boards, as is the case of most wine producing Member States in Europe, could help break this Gordian Knot of intertwined, yet often nebulous interests, opening the discussion to a wider spectrum of actors and resulting in more transparent and participative governance.

Agricultural landscapes have always been the result of interactions of natural conditions and human actions which, in turn, were driven mainly by the needs of the agricultural production process. In the case of Santorini vineyards, the impact of the interplay of driving forces and local actors on the landscape has been significant. The paradox that one can observe is that tourism, although exerting pressure on the built landscape through congestion, could end up playing a protective role in the case of the agricultural landscape, since the specific landscape is considered an asset. The paradox is completed with the pressures exerted by the international quality wine market, acting as a driving force for the degradation of the vineyard on Santorini Island.

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