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Questa è la Versione finale referata (Post print/Accepted manuscript) della seguente pubblicazione:

*Original Citation:*

Linking protection of geographical indications to the environment: Evidence from the European Union olive-oil sector / Belletti, Giovanni; Marescotti, Andrea; Sanz-Cañada, Javier; Vakoufaris, Hristos. - In: LAND USE POLICY. - ISSN 0264-8377. - STAMPA. - 48:(2015), pp. 94-106. [10.1016/j.landusepol.2015.05.003]

*Availability:*

The webpage <https://hdl.handle.net/2158/1013593> of the repository was last updated on 2015-12-14T17:59:52Z

*Published version:*

DOI: 10.1016/j.landusepol.2015.05.003

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Authors' post-print version (2015, April)

**RESEARCH ARTICLE**

**Linking protection of Geographical Indications to the environment: Evidence from the European Union olive-oil sector**

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## **Linking protection of Geographical Indications to the environment: Evidence from the European Union olive-oil sector**

### **Abstract:**

The link between food and the environment constitutes a core issue from the consumer's point of view and in the political debate. Geographical Indication products, due to their association with specific territories and links to specific local resources, can improve economic, social and environmental sustainability.

The present paper investigates the relationship between the legal protection of Geographical Indications and the environment, analysing the Product Specifications of the 107 olive-oil Geographical Indications registered in the European Union. We performed the analysis using a set of indicators related to six thematic areas of potential environmental impact, including tree varieties, intensity of production, phytosanitary and fertilization methods, soil and water management, harvesting and post-harvesting techniques, and environmental awareness.

Results indicate that environmental concerns are not considered to a great extent in the Product Specifications; indeed, they result more from the need to attain specific product qualities than from any direct interest in the environment. In any case, some relevant differences do exist between all six thematic areas (rules on the use of specific rare varieties and on maximum production limits are the most widespread ones in this sense) and between European Union countries (France and Italy are characterised by the highest levels of environmental care).

We identified some cases in which producers recognise that territorial specificities are highly important in shaping the quality of the product, and they consequently pay specific attention to positive environmental effects. Moreover, the data analysis shows a 'greening' of Product Specifications over time, which evidences a trend towards a more comprehensive conception of

typical products and GIs, related not only to organoleptic and hedonistic characteristics, but also to environmental and social ones.

In conclusion, although protection of Geographical Indications cannot be considered to constitute an environmental tool *per se*, it can potentially play a positive role in environmental conservation, acting as a barrier to the increasing intensification of the olive-oil sector and thus preserving traditional farming systems. Indeed, Geographical Indications provide the opportunity for territorialisation of environmental-friendly production rules, taking into account local specificities. The paper also argues that public policies can play a significant role in supporting the producers' initiatives towards “greener” Geographical Indications.

**Keywords:**

Geographical Indications (GIs); Protected Designations of Origin (PDOs); Protected Geographical Indications (PGIs); Agricultural multifunctionality; Traditional farming systems; Olive oil.

**Highlights**

- Environmental rules of 107 EU olive-oil Geographical Indications (GI) are analysed
- Environmental concerns are not very explicitly considered in Product Specifications
- There appears to exist a ‘greening’ of Product Specifications over time
- Protected GIs play environmentally positive roles, albeit indirectly in many cases
- Public policies can strengthen the environmental role of Protected GIs

## **1. Introduction: protection of Geographical Indications and the environment**

According to the Agreement on Trade-related aspects of intellectual property rights (TRIPS) of the World Trade Organisation, signed in 1994, Geographical Indications (GIs) are “*indications which identify a good as originating in the territory of a Member, or a region or locality in that territory, where a given quality, reputation or other characteristic of the good is essentially attributable to its geographic origin*”. Many countries have developed, or are developing, legal frameworks for recognizing and protecting GIs (Barham and Sylvander, 2011). Protection of GIs is conceived as a tool for protecting the legitimate users of geographical names in designating all kinds of goods – although generally referring to agri-food products – against imitations and frauds.

Different kinds of legal tools are used to protect GIs, and these can be expected to have different impacts. The present paper refers to *sui generis* legislation, such as that adopted by the European Union (Barham and Sylvander, 2011), where the producers involved apply for protection of the GI by submitting a request accompanied by Product Specifications (PS). The PS must contain the rules applying to the production process and to the quality of the product, the delimitation of the area within which the GI product is produced and the Control Body that ensures compliance with PS rules.

The economic rationale of GI protection is based upon support for product differentiation by means of a combination of different quality attributes linked to a specific area of production, which – due to clearer information to consumers – allows for price premiums, increased incomes and other marketing benefits. Positive economic effects are expected not only at firm level, but also in agricultural and rural development, particularly in marginal areas (Belletti and Marescotti, 2011). According to Vandecandelaere *et al.* (2009), protection of GIs may support not only the economic, but also the social and environmental sustainability of localised agri-food production systems. Recently, environment stewardship has frequently been evoked by policymakers and supply-chain actors as a justification for GI protection (Thévenod-Mottet, 2010; European Commission, 2009). However, EU legislation (Regulation EC 510/2006,

currently 1151/2012) makes no mention of environmental protection among its specific objectives. Indeed, Thévenod-Mottet (2010) notes that concerns for the environment and biodiversity are not explicitly addressed in any national requirements for the protection of GIs, but acknowledges their potential for acquiring new dimensions as policy instruments. Moreover, Giovannucci et al. (2009) identify a global tendency towards integration of environmental concerns into PSs in recent years.

From a theoretical point of view, many arguments – relying in particular on concepts of multifunctionality, *terroir* and ecological embeddedness – support the hypothesis that protection of GIs exerts favourable effects on the environment, although they may not constitute an environmental tool *per se*. Indeed, GI products are the result of a long-standing process of interaction and co-evolution of cultural practices, farmers' know-how and environmental resources in a particular place, as synthesised by the French concept of *terroir* (Bérard and Marchenay, 1995). Labels of origin (and their protection) – relying on PSs defining the link between the product and this entangled complex of social, cultural and environmental aspects – enhance the survival of typical products and of their production systems. Consequently, these arguments account for the fact that GI products are considered as an expression of multifunctional agriculture and, at the same time, as a tool for preserving it (Belletti et al, 2003): their higher added value can enable internalization of territorial externalities - both the socio-cultural (preservation of heritage, tradition and local know-how, support to family farming) and the environmental ones (Vandecastelaere et al, 2009).

In many countries, the concept of GIs is associated with tradition and small-scale production methods, with the expected predominance of low-intensity methods, as well as fewer environmental effects and more frequent use of local breeds and plant varieties (Riccheri, 2007). According to Bérard and Marchenay (2006, p.111), protection of GIs can enhance biodiversity, but “to accomplish this, it is indispensable to take into account not only the biological characteristics, but also the local knowledge and practices involved”. Indeed, as pointed out by Barham (2003), relevant for GIs is not only *how* foods are produced, but also *where*. This re-

embedding of the product in the social context and natural processes of a specific place opens up the possibility of an increased “responsibility to place” (Barham, 2003, p. 129).

Furthermore, local actors involved in the establishment of GI rules become more aware of the interdependence between their products and the local environment, developing a more accurate perception of the environmental restrictions and dangers involved in the production process (Riccheri et al, 2007) and consequently, they preserve local specific resources. According to Morris and Kirwan (2011), the GI registration process can be expected to have a positive impact upon the key components of ecological embeddedness and, in particular, on the way actors involved in the chain address the ecological elements of food production and how these shape the exchange with consumers. In particular, GI inter-professional bodies involving economic agents operating at the different stages of the local food chain (e.g. *Consejos reguladores* in Spain, *Consorti di tutela* in Italy) can enhance territorial governance processes as a result of collective action. Furthermore, they can encourage dissemination of innovations and knowledge (Sanz-Cañada and Macías-Vazquez, 2005; Mancini, 2013; Cendón et al. 2014) and promote environmentally friendly production systems (Sanz-Cañada et al., 2012).

However, the effects of GI protection on specific environmental aspects can also be negative. For example, Thévenod-Mottet (2010) notes that in some cases, protected GIs hinder genetic erosion when they are based on local plant varieties or animal breeds which would otherwise be replaced with more productive and improved ones, but at the same time success on the market could incite mono-cultural production over more diverse agro-ecologies, or might place too much pressure upon limited resources (see also Boisvert, 2006).

If we turn to the empirical evidence, however, only a handful of studies addresses the relationship between protection of GIs and the environment, and their findings are not conclusive.

Some studies focus on one single product. For example, Bowen and Valenzuela (2009), analysing Mexican Tequila, argue that the negative effects of GI protection result from the failure to link product quality to the characteristics of its *terroir*. Marie-Vivien et al. (2014)

discuss the advantages of protecting a GI based on the reputation of the agroforestry ecosystem and on the history of coffee from Coorg (India), compared with other ecolabels such as Utz-Certified coffee and Rainforest Alliance, because of the adaptability of the PS to local conditions.

Other studies are more systematic and compare a number of different cases. Belletti (2003), focusing on five extra-virgin olive oils in Tuscany, points out that protecting GIs supports the production of non-commodity outputs, including environmental ones, although the protection is insufficient *per se*, because its success depends on the development and marketing strategy in which it is enrolled. Larson (2007) analyses 30 case studies based on secondary data, in both developed and developing countries, claiming that GIs can promote biodiversity conservation both directly, through the use of a specific genetic resources, and indirectly, through management practices that include landscape and ecosystem considerations. However, potential threats are recognised: excluding specific genetic resources from the PSs, limited involvement of small producers and hindered access to markets. The empirical study conducted by Riccheri et al (2007) reveals notable variations among the eight EU case studies analysed. Environmental impacts depend on the product, its production context and upon stakeholders' motivations and strategies which, are translated into rules included in PSs; environmental requirements are rarely explicitly included in PSs, but the analysis performed provides no general conclusions.

Given this framework, in the present paper we attempt to explore the relationship between the protection of GIs and the environment in a systematic manner, analysing the extent to which the rules of Product Specifications take into account environmental issues. The study refers to a specific sector, olive-oil, and to a specific area, the European Union. From a methodological point of view, the study performs a first systematic analysis of its kind of the environmental dimension in GI Product specifications under homogeneous conditions of production and market, and within a common legal framework. The paper builds on the idea that an in-depth analysis of PSs, in particular of the extent to which they take into account environmental concerns, would constitute an important step in examining the potential role of GI protection for



achieving goals of sustainable development. To this end, (a) a framework is created for analysis of the environmental effects of protecting GIs in olive-oil production systems; (b) we analyse the environmental concerns considered directly and indirectly by GI stakeholders in the definition of their PSs. Finally, based on the aforementioned framework, we establish a synthetic indicator to compare the environmental sensitivity of all protected GIs.

Section 2 presents the theoretical framework for analysis of olive-oil GIs, section 3 the research method and section 4 the findings of the analysis of the PSs; section 5 discusses the results. Finally, section 6 draws some conclusions and recommendations on GI policy.

## **2. The framework for analysis of the relationship between olive-oil GI protection and the environment**

The present paper focuses on the olive-oil sector in the European Union. Olive farming constitutes an important land-use sector in the Mediterranean area and has significant social, environmental and economic functions, also representing a major feature of the heritage and socio-cultural life in many regions. Olive groves account for close to 4.4 million hectares in the EU, the large majority of these in Spain (49.3%), Italy (25.7%) and Greece (16.2%) (table 1). The production structure is traditionally highly fragmented. In 2010 there were 1.96 million farms with olive groves, the majority of which were not specialised in olive growing, the principal exceptions being in Andalusia (Spain) and Puglia (Italy), the two EU main production areas.

*Table 1 – Olive-oil sector and PDOs-PGIs in the EU: main features*

There is a number of different olive growing systems (dry or irrigated, mechanised or non-mechanised, mixed or specialised cropping, extensive, intensive and highly intensive), which depend on farm structures and land tenure models. Nevertheless, olive groves located in disadvantaged zones (mountainous terrain and presenting specific disadvantages) account for 88% of total olive groves in Portugal, 71% in Greece, 60% in Spain and 51% in Italy (European

Commission, 2012), where modern techniques are not easily applicable and productivity is low. In these zones there are often few alternatives to olive trees, which can also thrive in poor, stony and non-irrigated soils (non-irrigated olive groves represent approximately 75% of the total). Consequently, olive groves can play a significant environmental role in preventing soil degradation, preserving biodiversity and maintaining traditional landscapes, but at the same time they produce negative externalities, such as soil erosion or pollution (Sanz-Cañada et al., 2012).

Protected GIs are widespread in the olive oil sector (table 1). In the EU, in June 2011 there were 107 protected olive-oil GIs (both Protected Designations of Origin – PDOs - and Protected Geographical Indications - PGIs) in six different countries, most of which are located in Italy (40.2%), Greece (25.2%), and Spain (21.5%). In some countries national laws on olive-oil GIs<sup>1</sup> had already been approved prior to the 1992 EU Regulation and some protected GIs had been registered, but since 1992 EU countries share the same legal framework and working rules. The first GIs protected by EU rules were registered between 1996 and 2000, except for Slovenia, whose only GI was registered in 2007. PDO-PGI boundaries cover a wide area, 26.1 million hectares, six times the total olive tree area: indeed some GIs include almost an entire administrative region, such as the Sardegna PDO in Italy, while others comprise only a few hectares – the smallest PDO is 1,100 hectares.

According to Chever et al (2012), the production value of the olive oil marketed with the use of PDOs-PGIs was on average 215 M€ per year from 2006 to 2008, and 203 M€ in 2010. Sales volumes are concentrated in Spain (44% of the total EU volume) despite the relatively low number of GIs, while in France PDOs-PGIs enjoy the largest share of national olive-oil

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<sup>1</sup> In Italy, a National law on Controlled designations of origin for olive oils was approved in 1992, several months before the first EU Regulation (2081/92). In Spain, a National Regulation dating from 1974 extended to other food products, including the olive-oil sector; the former law on GIs only applied to the wine sector.

production (19%). Nevertheless, PDOs-PGIs differ greatly, both from the point of view of PS design (in terms of level of detail of rules on production processes and of geographical dimension) and of market performance (some PDOs-PGIs have large certified volumes while others have almost none; some reach high prices, whereas in some others prices are comparable to “standard” olive oils). No data are available at European level on the extent to which PDOs-PGIs are actually used by firms, not even on the areas of olive groves registered under these schemes.

Traditional olive-farming systems – a specific category of *traditional farming systems* (Beaufoy et al., 1994; Plieninger et al., 2006) – characterise many areas in the Mediterranean basin. They are usually identified on the basis of a limited density of trees, low-yield and non-irrigation groves (e.g., De Graaff and Eppink 1999; Beaufoy, 2001; Belletti, 2003; Duarte et al., 2008), resulting from a long-standing, often centuries-long co-evolution of olive tree cultivation in a specific local environment (Loumou and Giourga, 2003). Traditional olive farming is considered as a good example of multifunctional agriculture (Cooper et al., 2009; Fleskens et al., 2009), with many associated positive environmental impacts (Beaufoy 2001; European Commission, 2010) such as lower pollution, higher levels of biodiversity (habitat function) and genetic diversity in olive-tree varieties, better control of water runoff and floods, producing lower rates of soil erosion, improved fire-risk control, lower water abstraction, maintenance of traditional landscapes, higher socio-economic effects (income and employment), and preservation of local cultures. These benefits are particularly relevant in marginal soils and areas. In addition, nowadays traditional olive farming is often managed within the framework of environmentally friendly practices, such as organic farming or integrated production methods.

The concept of traditional olive farming encompasses different patterns of olive cultivation depending on local specificities and upon the adoption of innovations compatible with traditional farming principles; for example, Beaufoy (2001) identifies two typologies: low-input traditional plantations and intensified traditional plantations.

Traditional olive farming can be viewed as a good basis for the development of sustainable olive farming, both at farm and at territorial level, because linking a product with specific local resources can generate positive environmental effects. Nonetheless, it must be recognised that certain ‘traditional’ practices, such as burning of pruned olive branches, have negative environmental impacts.

Traditional olive farming systems are under pressure from changing social and economic conditions, which bring farmers to intensify and to replace traditional plantations and local olive-tree varieties with non-native ones. An alternative pathway, frequent in many mountain areas, involves marginalisation of the olive cultivation, which can lead to partial or complete abandonment of land (Allen et al., 2006).

Given this framework, the potential contribution of GI protection to the environment can be twofold. On the one hand, GI protection can improve economic and social conditions in olive-oil production areas by providing access to niche markets where the specific quality characteristics and the reputation of the olive oil is acknowledged, appreciated and remunerated by the market. Consequently, given the strong degree of jointness between the commodity (olive oil) and non-commodity outputs (positive environmental externalities) (Belletti, 2003), GI protection helps to maintain the traditional olive farming system, thus reducing the risk of abandonment and the associated loss of positive environmental effects.

*Figure 1: Different environmental reference levels for the environmental impacts of PSs*

On the other hand, the PS may define specific rules referring to farming practices, which can limit the negative externalities that can result from olive-tree cultivation (e.g. erosion) and/or can enhance positive environmental practices and externalities (e.g. improving biodiversity). Therefore, the premium price paid by consumers for GI-protected products may provide an incentive to olive farmers to adopt more environmentally friendly practices, thus serving as payment for ecosystem services (Farley and Costanza, 2010).

Nonetheless, the environmental effect depends on the positioning of the rules stated in the PS, as compared with the habitual farming practices in the area, which may range from traditional to super-intensive ones. In Figure 1, a Type A PS generates an incentive effect, since it favours a shift to ‘more traditional’ practices, while a Type B PS may prevent future intensification. The magnitude of the final impact on the environment depends on the specific physical and biological conditions of each production area. For example, the effects of a PS rule applying to green coverage will have a greater environmental effect on high-slope plantations.

### **3. Research method**

Taking into account this general framework, the paper focuses on the way PSs establish rules that can be relevant to the environment. To answer whether olive-oil protected GIs focus only on product characteristics or whether they also specify other features relevant to the environment, an in-depth analysis of the PSs of all 107 PDOs-PGIs published or registered<sup>2</sup> in the European Union according to EU Regulation 510/2006 until 30.06.2011 is performed.

According to EU Regulations, PDOs are characterised by a stronger link to their territory of origin, in comparison with PGIs. Of the 107 GIs, 95 are PDOs and 12 are PGIs (11 in Greece and 1 in Italy). These 107 GIs generate 160 records, due to the presence of protected GIs with an internal differentiation of rules established in the PS (e.g. regarding internal geographical boundaries and/or varieties and/or product characteristics). In some cases these sub-GIs bear a specific additional geographical reference (sub-designations) that can, and in some cases must, appear on the label of the final product; in other cases the PS does not provide any specific name to designate the main GI product on the market; for some GIs the main designation

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<sup>2</sup> When the EU Commission considers that the content of the file of the product meets the conditions of EC Regulation 510/2006, the Single Document is published in the Official Journal. If there are no objections from any interested parties, the product is registered in the EU PDO-PGI Register.

therefore does not exist *per se* because the name of the GI can be used only in association with a sub-designation. As a result, these 160 records translate into 102 GIs and 58 sub-GIs (Table 2).

*Table 2: Olive-oil PDOs-PGIs and sub-PDOs-PGIs in the European Union, per country*

Analysis of PSs is hindered by:

- the heterogeneity of the structure and content of the PSs, which vary across countries and in time.
- the fact that PSs contain not only rules, but often descriptions of “what normally occurs” within the delimited area of the protected GI.
- the fact that not all rules stated in the PSs are enforceable, due to their fuzziness. For instance, in the Spanish PDO Les Garrigues it is stated that ‘the oil is extracted from healthy clean olives using appropriate techniques which do not detract from the product’s characteristics’. However, those appropriate techniques are not described in detail, and therefore this rule is not enforceable.
- the heterogeneity of the sources of information available in the official EU database (DOOR: <http://ec.europa.eu/agriculture/quality/door/>), which lists all applied, published and registered PDO and PGI products, and includes the documents published in the EU Official journal during the procedure and other relevant documents. Indeed, the process of GI registration generates two official documents: the PS and the Single Document, the latter synthesising the most important norms of the PS and describing the link between the product and its delimited area of production (its “origin”). Frequently, only the Single Document is published in the Official Journal of the European Union following scrutiny by the Commission<sup>3</sup>.

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<sup>3</sup> According to EC Regulation 510/2006, Art. 6 (art. 8 of the new EC Regulation 1151/2012), the Single Document describes the following: (i) the main points of the Specification (name, description of the product, specific rules concerning the packaging and labelling, a concise definition of the geographical area), (ii) the link between the product and the geographical environment or geographical origin,

- the amendment of the PSs which may take place after EU registration.

The method employed for analysis of the PSs is the following:

- 1) The main reference document used for the analysis is the Single Document posted in the DOOR database.
- 2) As integrative source of information (or in some cases when the Single Document is not available on the website), the full PS is used when available.
- 3) Analysis of the GI rules is based on a check-list of a number of key questions, in order to generate appropriate data for statistical analysis. This check-list and the relevant indicators are presented in Table 3.
- 4) Specific care has been taken to distinguish enforceable rules from (a) non-enforceable rules and (b) simple findings regarding what normally occurs in the delimited areas (e.g. “olives are traditionally picked by hand”).
- 5) When necessary, the analysis of the PS is backed by integrative sources of information, mainly other accompanying documents and/or the authors’ expertise.

This analysis results in a database containing the enforceable rules referring to the different environmental issues for each protected GI. According to the literature – see for example Beaufoy et al (1994), De Graaff and Eppink (1999), Beaufoy (2001), Loumou and Giourga (2003), Allen et al. (2006), Duarte et al. (2008), Fleskens et al. (2009), European Commission (2010) – 13 main topics and corresponding indicators are identified (Table 3). Topics 1 and 2 provide information on the protected GI and the data source. Topics 3 to 13 cover the environmental rules set out by PSs.

Analysis of the PSs takes place at two levels. At the first level of analysis (Table 3, 2<sup>nd</sup> column), the 13 main topics are analysed by means of 27 sub-indicators. At the second level (3<sup>rd</sup> column),

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including the specific elements of the product description or production method justifying the link. The Single Document should have a standardised content and structure that is regulated by EC Regulation 1898/2006.

some of the 27 sub-indicators are given in further detail with other sub-indicators.

*Table 3: The two levels of analysis of the database*

## **4. Results**

The results of the analysis are presented in two distinct ways: according to the topics identified (par. 4.1) and according to the whole environmental care of each protected GI (par. 4.2). The aforementioned topics are grouped into 6 thematic areas which are meaningful in environmental terms: (a) tree varieties (topic 3); (b) intensity of production (topics 4, 5); (c) phytosanitary and fertilization methods (topics 6, 7, 8); (d) soil and water management (topics 9, 10); (e) harvesting and post-harvesting techniques (topics 11, 12); (f) environmental awareness (topic 13).

### ***4.1. Analysis according to the thematic areas***

#### ***4.1.1. Tree varieties***

Both the origin of the olive-tree varieties (indicator 3.2) and their rare character (indicator 3.3) are mainly based on information available in the OLEA database ([www.oleadb.it/olivodb.html](http://www.oleadb.it/olivodb.html)). Since there is lack of data on some varieties, other sources of information are also taken into consideration (Rallo et al., 2005; [www.variedadesdeolivo.com](http://www.variedadesdeolivo.com)). In the OLEA database both the geographical origin (the region the variety is native to) and the dissemination of the olive-tree varieties are mentioned. For the purposes of this paper, we considered a variety to be “native” to a region when this is explicitly mentioned in the OLEA database, or when the variety is diffused in only one NUTS-2 region. A variety is considered to be “rare” when it is not disseminated throughout more than 3 NUTS-2 regions or other countries.

All PSs list specific olive-tree varieties for the production of GI olive oils. In almost all cases (91.2% of the 160 total records) the rules applying to specific varieties are defined in a



quantitative manner, allowing for inspections to be conducted by the Control Bodies. In 35 cases (21.8%) only one variety is admitted, and in 19 of these instances (11.9%) this exclusive variety also originates in this area. In 48 cases (30.0%), five or more varieties are admitted.

Diversification of olive-tree varieties can generally be considered positive for genetic diversity (Sensi et al., 2003). However, this diversification can also be seen as a Trojan Horse operating against native varieties when non-native super-intensive varieties are allowed into the PSs. In a possible process of intensification, the super-intensive varieties (Arbequina, Arbosana, Koroneiki, and Chiquitita) (Therios, 2009) may prevail, thus reducing genetic diversity. Super-intensive varieties are allowed in 30 cases, 22 Greek ones (74.1% of all Greek records) and eight Spanish ones (27.6% of all Spanish records). In 21 of these 30 cases (70.0%) the super-intensive varieties are non-native.

In 116 cases (72.5% of the 160 total records) the PSs specify native varieties among those allowed for production of the olive-oil PDOs-PGIs (Table 4). In general, the local genetic resources are perceived as being highly relevant in linking the protected GIs to their production area. However, in only 75 cases (46.9% of total records) the rules can be considered to be effective, i.e., expressed numerically and therefore verifiable by third parties. In 59 cases (36.9% of total records) native varieties account for over 50% of the total number of olive-trees. Six of the seven French PSs specify effective rules regarding native varieties.

#### *Table 4: PSs and native olive-tree varieties*

A similar situation concerns “rare” varieties, the presence of which in the PSs can be considered as positive from an environmental point of view (Table 5). A total of 104 cases (65.0% of the 160 total records) specify rare varieties but only 68 cases (42.5%) are characterised by effective rules. In 44 cases (27.5% of total records) rare varieties account for over 50%. France is also the country presenting the highest percentage of PSs with effective rules regarding rare varieties (71.4% of the seven French records).

In 89 cases (55.6% of the total records) the PSs are characterised by both native and rare varieties, while there are 30 cases (18.7%) in which neither rare nor native varieties are specified.

*Table 5: PSs and rare olive-tree varieties*

#### *4.1.2. Intensity of production*

Almost half of the PSs contain rules on maximum production per hectare aimed at controlling the quality of the final product; these rules result from the trade-off existing between quantity and quality in olive-oil production. At the same time, [intensified production](#) is considered to pose a threat to the environment, because of the correlated effects between input use (e.g. fertilisers) and pollution and/or depletion of water resources. High-density and input-intensive specialised plantations also have negative effects on landscape and biodiversity: Allen et al. (2006) claim that intensification involves the clearance of ground flora and therefore loss of habitat for plants and allied fauna, also resulting in homogenization of the landscape. In the PSs, rules referring to production intensity focus on the density of plantations and/or on maximum production per hectare (expressed in olive fruit or in olive oil). However, in 133 (83.1% of the 160 total records) and 82 (51.2%) cases, respectively, the PDOs-PGIs do not avail of any effective rules regarding density of plantations and maximum production (Table 6). In 22 cases (13.7% of total records) there are rules referring both to density and to maximum production, whereas in 76 cases (47.5%) neither of these two rules are found. Table 5 indicates that even when rules exist on density and/or maximum production per hectare, these very often establish limits corresponding to super-intensive plantations (see for example the typologies in Beaufoy, 2001 p. 23, and Therios, 2009, pp. 116-117, on which the typology in Table 5 is based) and can therefore be considered as ineffective with regard to preventing environmental damages: this occurs in nine of the 27 cases dictating rules on density, and in 14 of 78 cases dictating rules on maximum production per hectare.

*Table 6: PSs, density of plantations and maximum production*

#### *4.1.3. Phytosanitary and fertilisation methods*

Many of the environmental impacts of olive-tree cultivation derive from the use of chemicals and fertilizers. Rules regarding pest management, weed control, and fertilization are considered in our analysis. In many PSs, “traditional methods” of cultivation are mentioned (e.g. in 55 cases of the 160 for pest management, in 56 cases for weed control, and in 66 cases for fertilization), but no specific rule is enforced. As a consequence most PSs do not regulate any of these three issues (126 cases, 78.8% of total records) (Table.7).

*Table 7 – PSs establishing rules on phytosanitary and fertilisation methods*

Enforceable rules are contemplated in the PSs only in Italy (34 cases out of 80, 42.5%) and Spain (three cases out of 29, 10.3%). The most regulated issue is pest management (26 cases, 16.2%). In 14 cases (8.7%) rules exist on weed control, and in only seven cases (4.4%) on fertilization. In 13 cases (8.1%) two issues are simultaneously regulated. In 34 of the 160 cases (21.2%) PSs refer to organic methods or to integrated ones, as defined in National or Regional codes of practices.

#### *4.1.4. Soil management and irrigation*

Very few PSs set out rules on soil management, whereas in most cases reference is made to the “current situation” and/or to “tradition” (in 43 PSs of the 160 records). Therefore, no mandatory production practices or enforceable rules exist.

For example, in the Spanish Azeite de Mallorca PDO PS, it is stated that: “it is common in Mallorca for olive cultivation to be combined with the rearing of Mallorca-bred sheep, a practice which has the dual function of eliminating weeds and supplying organic fertiliser”.

In the Spanish Sierra Magina PDO, the PS allows for traditional tilling and semi-tilling, stating that traditional methods are defined by the GI Collective Body, which may also allow new methods. Mandatory soil management rules are found in only four instances (2.5%), which refer to French products. In three of these cases the rules refer to the use of grass cover. In the case of the French PDO Huile d'olive de Nice, according to the PS “no tilling may take place in any olive groves from September 1st to the end of harvesting, other than the sowing of green manure, which is permitted up to October 30th. Annual crops are only authorised in irrigated olive groves where the trees are less than five years old”. No PSs refer to the management of terraces, although this is traditional practice in many cultivation areas.

With regard to irrigation the situation is very similar. In 79 cases (49.3%) there is a generic reference to “tradition” or “traditional methods”. Only seven GIs (six in France, one in Italy) establish rules on irrigation, limiting this to particular times of year or to particularly dry years (according to the decisions of the Collective Bodies).

#### *4.1.5. Harvesting and post-harvesting techniques*

Very few PSs set out rules regarding harvesting and post-harvesting techniques. Hand picking is mandatory in only two cases (1.2%). Adjuvant chemicals are prohibited in 19 cases (11.8%) in only three countries (12 in Italy, four in France, three in Spain). No rules exist at all regarding the milling phase and the management of the by-products in particular.

#### *4.1.6. Environmental awareness*

Attention is paid to the environment not only in relation to rules (enforceable or not), but also to awareness of environmental issues expressed by GI applicants referring to explicit and argued considerations expressed in the documents presented for GI application (e.g. PSs, or Single Documents). Five areas involving environmental awareness emerged from the analysis of these documents (Table 8): (a) control of negative environmental effects in the delimited areas of production (e.g. pollution); (b) biodiversity preservation; (c) traditional landscape preservation

and soil management; (d) preservation of water resources; (e) other issues. Only 38 cases (23.8% of 160 total records) express environmental awareness in at least one category. Most cases are found in Italy (24 cases, 30% of Italian records) but also Greece (six cases, 22.2% of Greek records) and Spain (six cases, 20.7% of Spanish records).

Many PSs mention the importance of land management (landscape preservation, very often associated with control of soil erosion on sloping land) and water management in olive-tree cultivation. Moreover, emphasis is placed upon the typicity and biodiversity value of rare olive-tree varieties, as well as the economic contribution of the olive-oil to local economies.

Finally, the links with local history and local culture are also mentioned. For example, the Valdemone PDO (Italy) Single Document states that “Olive-growing is widespread in the Valdemone area, in particular in the hilly area inland. It is of major importance economically and socially and in the context of both the landscape and the environment, owing to its ability to adapt to difficult areas in terms of soil and climate. These are areas where olive growing, together with wine growing, involves the only tree crop available, as they occupy steep marginal land that is difficult to work and constitutes a major component of the rural landscape. The combination of an environment that lends itself to olive growing, and the tradition of olive growing in the area have, over the years, led to the development of a number of varieties named after the areas in which they are most widespread”.

In the Azeite de Mallorca PDO (Spain) the PS refers to “mountain groves situated on hillside terraces, the latter being constructions typical of Mallorca that enable the soil to be held in place and crops to be grown on rough terrain. Terracing allows rainwater to be used to maximum effect and helps contain erosion”. In the Sitia Lasithiou Kritis PDO (Greece) the Accompanying Document mentions that “the Union of Agricultural Co-operatives tries to conduct soil analyses to better deal with the fertilisation needs. In this way the environment is better preserved and the water resources are not polluted”.

*Table 8 – Environmental awareness emerging from PDOs-PGIs official documents*

#### **4.2. Analysis according to overall environmental care**

Analysis based upon overall environmental care identifies the olive-oil PDOs-PGIs that appear to be more sensitive with regard to environmental issues. In order to measure the environmental care of each protected GI, some key indicators are taken into consideration for each of the six thematic areas. The indicators are then normalised and totalled to build up a synthetic indicator.

The key indicators used are the following:

- Tree varieties: sub-indicators 3.2.1(V<sub>1</sub>) and 3.3.1(V<sub>2</sub>),
- Intensity of production: indicators 4.1.(I<sub>1</sub>) and 5.1(I<sub>2</sub>),
- Phytosanitary and fertilisation methods: indicators 6.1(Ph<sub>1</sub>), 7.1(Ph<sub>2</sub>), 8.1(Ph<sub>3</sub>),
- Soil management: indicators 9.1(S<sub>1</sub>) and 10.1(S<sub>2</sub>),
- Harvesting/post harvesting methods: indicators 11.1(H<sub>1</sub>), 11.2(H<sub>2</sub>), 12.1(H<sub>3</sub>),
- Environmental awareness: sub-indicators 13.1.1(E<sub>1</sub>), 13.1.2(E<sub>2</sub>), 13.1.3(E<sub>3</sub>), 13.1.4(E<sub>4</sub>) 13.1.5(E<sub>5</sub>).

Table 9 shows the protected GIs by number of thematic areas regulated, that is, thematic areas for which the PS contains at least one enforceable rule or – in the case of environmental awareness – expresses a care. No GI regulates all six thematic areas, and only one (the Italian PDO Vulture) regulates five (Table 9). 26 cases (seven from Italy, seven from Greece, six from Spain, six from Portugal) have no enforceable rules at all applying to any thematic area, and 63 cases (19 from Italy, 19 from Greece, 14 from Spain, ten from Portugal, one from Slovenia) regulate only one area. Only six GIs regulate four areas; the Italian PDOs Seggiano and Monte Etna, as well as the French PDOs Corse, Nice, Aix-en-Provence and Haute-Provence. All seven French GIs regulate at least one thematic area, followed by Italy with 73 cases (91.2% of the 80 Italian records). Portugal exhibits the lowest level of environmental care since only ten cases (of the 16 in total, 62.5%) regulate one of the thematic areas.

*Table 9: PDOs-PGIs by number of environmental thematic areas regulated by their PSs*

In order to define a synthetic indicator of environmental care, quantitative indicators are normalised on a 0-1 scale<sup>4</sup>, whereas qualitative indicators are expressed as dummy variables, “0” corresponding to the answer “No” and “1” to a “Yes”. All six thematic areas are assumed to have the same weight, 1/6 of the overall GI indicator. When one of the indicators is analysed in a number of sub-indicators, each sub-indicator has the same weight<sup>5</sup>. The synthetic indicator of environmental care is:

$$SI = \frac{1}{6} \left( \frac{1}{2} \sum_{i=1}^2 Vi \right) + \frac{1}{6} \left( \frac{1}{2} \sum_{i=1}^2 Ii \right) + \frac{1}{6} \left( \frac{1}{3} \sum_{i=1}^3 Phi \right) + \frac{1}{6} \left( \frac{1}{2} \sum_{i=1}^2 Si \right) + \frac{1}{6} \left( \frac{1}{3} \sum_{i=1}^3 Hi \right) + \frac{1}{6} \left( \frac{1}{5} \sum_{i=1}^5 Ei \right)$$

The Italian Seggiano PDO is the product showing the highest synthetic indicator (0.402 on the 0-1 scale), followed by the French Huile d’olive de Nice PDO (0.394), the Italian Vulture PDO (0.381) and Collina di Brindisi PDO (0.361), while the French Huile d’olive de Corse obtains the fifth highest score (0.336). The highest-scoring Spanish product is the Antequera PDO

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<sup>4</sup> For indicator 4,1 densities below 100/ha trees take the value ‘1’ (good environmental performance), while densities above 400 trees/ha take the value ‘0’ (bad environmental performance). For densities between 100 and 400 trees/ha, the value of the indicator is calculated proportionally. The selected densities are based on the typology proposed by Beaufoy (2001) and Therios (2009). The same applies to indicator 5.1. For indicators 3.2 and 3.3 (native and rare varieties), in the absence of clear evidence from the literature, the classification is based on data collected (min. observation = 0 and maximum = 1, then by division into four equal intervals).

<sup>5</sup> Most composite indicators rely on equal weighting, which essentially implies that all variables have the same value (OECD and JRC, 2008). For the aggregation, we use the arithmetic average, although the synthetic indicator values were also calculated with the geometric average: no significant differences were reported.

(0.186), while the highest scoring Greek one is Selino Kritis PDO and Krokees Lakonias PDO (both with a score of 0.133).

Year of registration appears to constitute an important variable, as four of the five highest-scoring products were registered after 2006, the only exception being the Huile d'olive de Corse PDO (registered in 1996). This is also true for all the PDOs-PGIs. On calculating the average values of the synthetic indicator for each year, the trend becomes evident: the newly registered GIs were seen to be exercising “greening” over time” (Figure 2).

*Figure 2: Average values of the synthetic indicator of environmental care of PDOs-PGIs registered in each year*

On calculating the synthetic indicator at national level (Table 10) and analysing the average values of each country in the six thematic areas, France is the country presenting the highest average score (0.288, related to seven records) followed by Italy (0.120, related to 80 records), while the lowest average score is that of Portugal (0.032, related to 16 records), where rules only refer to tree varieties. Therefore, big differences exist among countries in the way the PSs of olive-oil GIs are structured and perceived as tools for obtaining greater environmental benefits. France and Italy show the highest environmental performances, while Greece, Portugal and Slovenia perform rather poorly. Spain would appear to be in somewhere in the middle.

*Table 10: Synthetic indicators at the national level*

Another two relevant issues refer to the comparison of the two forms of GI protection in the European Union, PDO and PGI, as well as their territorial size. The synthetic indicator calculated for the 143 olive-oil PDOs is more than three times higher than that calculated for the 17 olive-oil PGIs (0.103 versus 0.031). This difference is statistically significant (p-value: 0.008). The stronger links between PDOs and the area of production (both from the point of view of the link between origin and product quality, and of the location of all the production process within the PDO area) seem to favour a greater degree of care for the environment. As



far as PDO-PGI size is concerned, there is great variability in the areas encompassed within the boundaries delimited by the PSs (see above), but there is no correlation between size and the environmental synthetic indicator (-0.120).

## **5. Discussion**

In the present study we systematically analyse for the first time the relationship between protected GIs and the environment, highlighting the presence of rules potentially favourable to the environment within a number of PDOs-PGIs in the EU olive-oil sector. Only approximately one fifth of the PSs are lacking enforceable rules relevant for the environment, even if in some cases they express some degree of awareness of environmental problems. In the remaining 80%, at least one enforceable rule favours the environment, either imposing restrictions (for example on the intensity of cultivation) or prescribing good practises (for example, the use of rare olive-tree varieties). Thus, the general assumption expressed by Barham (2003), Bérard and Marchenay (2006) and Riccheri (2007) regarding the “responsibility to place” by producers involved in protected GIs is confirmed.

However, relevant differences emerge, both with regard to the thematic areas affected by the rules, and between different protected GIs and countries.

With regard to thematic areas, enforceable rules are virtually inexistent for soil management and irrigation, whilst approximately 20% of PSs contains rules on phytosanitary and fertilisation methods and just under half of PSs prescribe specific olive-tree varieties and fix maximum production limits. These results are coherent with the scope of GI protection, which is conceived as a market tool as opposed to an implement for environmental policy. Specific olive-tree varieties are normally regulated, as they are directly linked to the quality and identity of the olive oil, while soil management and irrigation do not appear to be quite so relevant; instead, maximum production limits are fixed mainly because they provide a reference for traceability and control systems (maximum quantity of certifiable olives/olive oil). Case-by-case analysis

shows that even when PDOs-PGIs refer to areas where traditional olive farming systems are predominant (such as the Lucca and Chianti PDOs in Tuscany, the Lesvos PGI on the Greek island of Lesvos, the Sierra de Cazorla PDO and the Sierra de Cádiz PDO in Andalusia), they do not usually incorporate environmental rules into PSs, in order to leave room for cost-saving innovations and to avoid increases in production and certification costs.

The attention paid to the environment in the PSs is therefore induced by short-term market motivations and addresses specific aspects. Few PDOs-PGIs (14.3% of the 160 records) regulate at least three thematic areas. This result partially contradicts what is asserted in the literature on ecological embeddedness (Morris and Kirwan, 2011) regarding the propensity of territorialized production systems to preserve the local environment, as perceived as a fundamental prerequisite for long-term economic and social sustainability. The issue for producers is to strive to be competitive on the market, and they therefore avoid the additional burdens of any rules perceived as being unnecessary.

The opportunity provided by the protection of GIs to adapt production rules to local environmental specificities (Marie-Vivien et al., 2014) does not appear to have been fully exploited in the olive-oil sector. Indeed, one might expect – *ceteris paribus* – the PSs of PDOs-PGIs with a small territory to contain more, and more specific, enforceable rules than the big PDOs-PGIs, due to greater homogeneity in agro-ecological and soil profile conditions. Empirical evidence from the olive-oil sector shows that surprisingly, the correlation between size and environmental rules is negative (albeit slightly).

Empirical results indicate some relevant differences among countries. In France, Italy and, to a lesser extent, Spain, PSs are characterised by the highest level of environmental care; Greece, Portugal and Slovenia exhibit a much lower level of environmental sensitivity. What drives this result? In principle, country contexts can be relevant in relation to three main aspects: formal GI institutions, national GI culture, and olive-growing characteristics. With regard to institutions, GI general rules are the same in all EU countries as a result of the 1992 EU regulation and – unlike the wine sector – no long-standing national rules had previously existed. However, some

national and regional GI authorities in charge of the national phase of the GI application ask for more detailed rules in the PSs in order to better justify the link between product and territory; this is probably the case of France, where INAO, the public body managing the GI process, follows very strict procedures. The second and third reasons are less relevant, because on one hand, EU Mediterranean countries share a similar vision of GIs and “production cultures”, and on the other, in all countries great variability exists in olive-growing characteristics, a fact that makes it impossible to define, at least in the three biggest-producing countries, homogeneous “national models” of olive production that could affect PDO-PGI interpretation. For these reasons, it can be argued that, at least in the case of olive oils, national contexts are not necessarily relevant with regard to explaining differences between countries in the environmental care of PSs. Rather, what seems to influence country performances is time of registration, due to the increase in environmental sensitivity over time<sup>6</sup>: Portugal and Greece registered a high share of their GIs prior to 1999 (94% and 81% of their respective GIs; EU average 54%), while in France six out of seven GIs have been registered after 1999.

The different level of attention paid by the PSs to the environment would appear to be better explained by contextual factors related to single products. The content of PSs depends on how the complex process of GI rule-setting and registration is managed (Belletti et al, 2012). Indeed, different actors intervene – private (belonging to different stages of the chain), collective (professional associations but also citizens’ associations), and public (such as municipalities and universities). Each stakeholder is characterised by different interests, visions of the product and aims assigned to the GI, making the final outcome of the negotiations on PSs uncertain. Short

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<sup>6</sup> Additionally, until 1998, many GIs were registered under a simplified procedure (art 17 Reg 2081/92) that, although based on the same general principles, in fact provided a less critical analysis of PSs by the EU Commission services. This procedure was applied - within six months of coming into force of the Reg. 2081/92 - only to products already protected in each Member State or whose names were already established by usage. Eighty-seven PDOs-PGIs were registered according to this procedure in the olive-oil sector.

term goals may take precedence over the search for environmental sustainability. Some GI marketing strategies care only for quality characteristics and not so much for territorial specificities (e.g. acidity), while other strategies do recognise these specificities (including landscapes and environmental quality) as being highly important in shaping the identity of the product.

This strategy can be seen in the number of PDOs-PGIs positioned in high-price market segments (like some olive oils from Northern and Central Italy and from Southern France) and presenting a good value of environmental care.

Considering the relevance of olive groves in the total utilised agricultural land of the EU and the wide-ranging geographical coverage of olive-oil PDOs-PGIs boundaries, environmental rules in PSs could exert a strong impact. But the environmental effects of GI protection do not only depend upon the rules written in the PSs, but also on the extent to which the protected GIs are used by firms (and consequently appreciated by consumers), and therefore on the degree to which these rules are complied with. Indeed, some protected GIs are used at very low levels by firms, as shown by Kizos and Vakoufaris (2011a, 2011b) for Greece and for many Italian GIs ([www.qualivita.it](http://www.qualivita.it)). Furthermore, PS rules may not be fully enforced by national authorities (London Economics, 2008).

Another relevant point is that the effects of PS rules on the environment depend on the characteristics of the local olive-farming systems in the PDO-PGI territorial boundaries. Nevertheless, PDOs-PGIs can have positive effects on the environment even when the PSs do not impose strict rules, depending upon the local characteristics of the olive-farming systems. The framework presented in Table 11 highlights the different roles of protected GIs, which should be considered in the context of the current local “standard” of olive-growing and in relation to the possibility of evolution of the local olive-growing towards the ‘input-intensive’ model.

Case A (upper left cell in Table 11), containing 20% of PDO-PGI records lacking environmental rules, does not exert any environmental effects. Cases C and D (right-hand side

of the matrix) are not consistent with the role assigned to the GI protection by the EU Regulations. In cases B and E, where 80% of the 160 olive-oil PDO-PGI records are found, PS rules more or less describe the current farming practices (e.g. in terms of low tree densities, limits to production, use of specific olive-tree varieties), but can serve as a barrier against future intensification or abandonment of rare varieties, particularly when the current practices are extensive (case E). Even in case F, where no specific environmental rules exist in the PSs, protecting the GIs can play a relevant (albeit unintentional) role in maintaining traditional farming systems by means of the expected increase in prices paid for the olive oil on the market: in this case, 20% of the records have no environmental rules.

*Table 11: Mapping the potential environmental effects of GIs*

Following the stream of literature on multifunctionality in the olive-oil sector (Fleskens et al., 2009) the present study confirms the relevant role played by GI protection in preserving the environment, particularly in sectors such as olive-oil production, largely characterised by traditional and semi-traditional farming systems and by being particularly concentrated in marginal areas.

## **6. Concluding remarks**

In the present paper we investigate the environmental care exercised by protected GIs in the EU olive-oil sector according to the rules set out in PSs. Indeed, a relevant number of PSs include some rules with a potential environmental impact, and environmental sensitivity improves over time, as the PDOs-PGIs more recently registered become ‘greener’. Analysis of PSs constitutes an initial significant step in the investigation of the environmental effects of GI protection due to the fact that it highlights potentialities. Whatever the case may be, further research is needed at individual GI level, in order to take into account not only the real use of the GI by producers, or the environmental local specificities, but also the dynamics of territorial governance. A key success factor for environmentally responsible protected GIs involves the ability of local actors

to strengthen the links between the environmental and physical/organoleptic attributes of the product, and/or to incorporate territorial and environmental specificities into the product and to communicate these to consumers.

The role of National and Regional Authorities involved in GI protection processes is highly relevant, as they can require producers to provide further ‘justification’ of the link between product quality and the territory of production, including environmentally relevant issues. These Authorities, however, should regulate with great caution, mediating between the different interests expressed by firms belonging to the local supply chain and by other territorial stakeholders. Indeed, moving towards ‘environmentally friendly GIs’ can also be a source of conflict, the main risk being that firms may not use the GI label to market their products, due to the excessive amount of rules and administrative hindrances, which can lead to a loss of profitability.

The link between protected GIs and the environment should be strengthened on a voluntary basis, within the perspective of an increase in the value of the protected GI product on the market as a result of the internalisation of the environmental externalities. Moreover, including environmentally friendly attributes in the PSs can prove to be a tool for encouraging stakeholders to develop environmental governance processes based on collective action. In short, the development of a protected GI enhances a multi-attribute approach for marketing strategies, which favours incorporation of environmental attributes into its differentiation strategy.

Public policies can also play a significant role in supporting producers’ initiatives in several ways: i) rewarding the environmental externalities that cannot easily be internalised by the label, at least in the short term; ii) aiding research and innovation activities; iii) giving advice to help to better understand the links between the different features of the production process, which are relevant both for the environment and for the quality of the GI product (e.g. the effects of using a rare olive-tree variety, or irrigation techniques), in order to incorporate this knowledge into the design of the PS. From the macro level of the EU to the micro level of Municipalities, public

policies can support GIs specifically involved in the preservation of the local environment, thus strengthening their communication with consumers.

The “greening” of olive-oil GIs reveals a trend towards a more comprehensive and sustainable conception of typical products and GIs, related not only to organoleptic and hedonistic characteristics, but also to environmental and social ones. This process can be viewed positively from the point of view of agri-environmental policies, because GIs provide the opportunity for territorialisation of environmentally friendly production rules, taking into account the multiplicity of local specific resources.

### **Acknowledgements**

This study was supported by the research project of the Spanish RDI National Plan (AGL2012-36537, PI: Sanz-Cañada, J): *Local Agro-food Systems and public goods. Analysis and valuation models of territorial externalities in designations of origin of olive oil* (EXTERSIAL II).

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## **TABLES**

Table 1 – Olive-oil sector and PDOs-PGIs in the EU: main features

	Total olive tree area 2010 (ha)	Relevance of olive tree area in total UAA Year 2010 (%)	Registered PDOs-PGIs (30.06.2011)	PDOs-PGIs in %	Year of 1 <sup>st</sup> registration of an olive-oil PDO- PGI
France	17,690	0.1	7	6.5	2000
Greece	705,960	13.6	27	25.2	1996
Italy	1,123,330	8.7	43	40.2	1996
Portugal	335,840	9.2	6	5.6	1996
Slovenia	890	0.2	1	0.9	2007
Spain	2,153,730	9.1	23	21.5	1996
Others	29,180	1.8	0	0.0	...
TOTAL	4,366,620	5.8	107	100.0	...
	Extent of the GI area * (Km <sup>2</sup> )	GI area on total olive tree area	Average GI area per PDO-PGI (Km2)	% PDOs-PGIs on total sales volumes (2010)	% of PDOs-PGIs on national production (2010)
France	19,805	112,0	2,829.29	2.0	19.1
Greece	19,315	2,7	715.37	27.0	3.8
Italy	115,066	10,2	2,675.95	23.0	2.4
Portugal	35,005	10,4	5,834.17	4.0	2.6
Slovenia	419	47,1	419.00	0.0	> 5
Spain	72,021	3,3	3,131.35	44.0	1.4
Others	-	-	-	-	-
TOTAL	261,631	6,0	2,445.15	100.0	2.0

(\*) GI area: total area encompassed in the GI administrative boundaries

Source: elaboration on Eurostat and DOOR data

Table 2: Olive-oil PDOs-PGIs and sub-PDOs-PGIs in the European Union, per country

	GIs	Sub-GIs	Total	%
France	7	0	7	4.4%
Italy	38	42	80	50.0%
Greece	27	0	27	16.9%
Portugal	6	10	16	10.0%
Spain	23	6	29	18.1%
Slovenia	1	0	1	0.6%
TOTAL	102	58	160	100.0%

Source: DOOR database

Table 3: The two levels of analysis of the database

Topic	1 <sup>st</sup> level of analysis	Response	2 <sup>nd</sup> level of analysis	Response
1 Product information	1.1 Country			
	1.2 Name			
	1.3 Status (Registered – Published - Applied)			
	1.4 Type	PDO/PGI		
	1.5 Dates of registration / amendment			
2 Data source	2.1 Summary of PS	Y/N		
	2.2 Single document	Y/N		
	2.3 National authority document	Y/N		
	2.4 Accompanying document	Y/N		
3 Variety	3.1 Are there specific varieties mentioned in the PS?	Y/N	3.1.1 How many varieties are mentioned in the PS?	N <sup>o</sup>
			3.1.2 Are there specific rules on specific varieties defined in a quantitative manner?	Y/N
	3.2 Is there at least one variety that originates in the area?	Y/N	3.2.1 Is there an effective rule on the role of this/these variety/varieties?	Y/N
			3.2.2 Less than 25%	Y/N + %
			3.2.3 $\geq 25\%$ and $< 50\%$	Y/N + %
			3.2.4 $\geq 50\%$ and $< 75\%$	Y/N + %
			3.2.5 $\geq 75\%$	Y/N + %
	3.3 Is there at least one variety that is not dispersed throughout more than 2 other NUTS-2 regions?	Y/N	3.3.1 Is there an effective rule on their role?	Y/N
			3.3.2 Less than 25%	Y/N + %
			3.3.3 $\geq 25\%$ and $< 50\%$	Y/N + %
			3.3.4 $\geq 50\%$ and $< 75\%$	Y/N + %
			3.3.5 $\geq 75\%$	Y/N + %
	3.4 Is there a super-intensive variety among those specified in the PS?	Y/N		
	3.5 'Other varieties' can be $> 15\%$	Y/N		
4 Density	4.1 Are there specific rules limiting the density of plantations?	Y/N	4.1.1 $> 100$ trees/ha	Y/N + N <sup>o</sup>
			4.1.2 101-250 trees/ha	Y/N + N <sup>o</sup>
			4.1.3 251-400 trees/ha	Y/N + N <sup>o</sup>
			4.1.4 $> 400$ trees/ha	Y/N + N <sup>o</sup>
5 Maximum production	5.1 Are there specific rules limiting production?	Y/N	5.1.1 $> 2,000$ kg of olives/ha or 400 kg of oil/ha	Y/N + N <sup>o</sup>
			5.1.2 2,001-5,000 kg olives/ha or 401-1,000 kg oil/ha	Y/N + N <sup>o</sup>
			5.1.3 5,001-10,000 kg olives/ha or 1,001-2,000 kg oil/ha	Y/N + N <sup>o</sup>
			5.1.4 $> 10,001$ kg olives/ha or $> 2,001$ kg oil/ha	Y/N + N <sup>o</sup>
6 Pest management	6.1 Are there specific rules?	Y/N	6.1.1 Are specific chemicals prohibited?	Y/N
			6.1.2 Is organic production mandatory?	Y/N
			6.1.3 Is integrated production mandatory?	Y/N
7 Weed control	7.1 Are there specific rules?	Y/N	7.1.1 Are specific products prohibited?	Y/N
			7.1.2 Is organic production mandatory?	Y/N
			7.1.3 Is integrated production mandatory?	Y/N
8 Fertiliser practices	8.1 Are there specific rules?	Y/N	8.1.1 Are specific products prohibited?	Y/N
			8.1.2 Is organic production mandatory?	Y/N
			8.1.3 Is integrated production mandatory?	Y/N
9 Soil management	9.1 Are there specific rules?	Y/N		
	9.2 Is grass cover mandatory?	Y/N		
	9.3 Is management of terraces mandatory?	Y/N		
10 Irrigation	10.1 Are there rules limiting irrigation practices?	Y/N		
11 Picking	11.1 Is picking by hand mandatory?	Y/N		
	11.2 Are adjuvant chemicals prohibited?	Y/N		
12 Milling	12.1 Are there rules on water polluted by the oil mill?	Y/N		
13 Environmental awareness	13.1 The official documents mention specific issues of olive cultivation:	Y/N	13.1.1 related to environmental effects in the area	Y/N
			13.1.2 regarding biodiversity conservation	
			13.1.3 regarding landscape preservation	Y/N
			13.1.4 regarding hydro-geological preservation	Y/N
			13.1.5 Other (specify)	[ ]

Table 4: PSs and native olive-tree varieties

	Total GI Records	PSs specifying native varieties	PSs with effective rules	Share of native varieties			
				<25%	25-50%	50-75%	> 75%
<b>Italy</b>	80	56 (70.0%)	32 (40.0%)	2 (2.5%)	1 (1.3%)	20 (25.0%)	9 (11.3%)
<b>Spain</b>	29	28 (96.6%)	16 (55.2%)	0 (0.0%)	2 (6.9%)	6 (20.7%)	8 (27.6%)
<b>Greece</b>	27	15 (55.6%)	13 (48.1%)	4 (14.8%)	0 (0.0%)	2 (7.4%)	7 (25.9%)
<b>Portugal</b>	16	9 (56.2%)	8 (50.0%)	3 (18.7%)	3 (18.7%)	1 (6.2%)	1 (6.2%)
<b>France</b>	7	7 (100%)	6 (85.7%)	0 (0.0%)	1 (14.3%)	3 (42.8%)	2 (28.6%)
<b>Slovenia</b>	1	1 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	160	116 (72.5%)	75 (46.9%)	9 (5.6%)	7 (4.4%)	32 (20.0%)	27 (16.9%)

Note: percentages refer to total number of GI records per row.

Source: own primary data

Table 5: PSs and rare olive-tree varieties

	Total GI Records	PSs specifying rare varieties	PSs with effective rules	Share of rare varieties			
				<25%	25-50%	50-75%	> 75%
<b>Italy</b>	80	54 (64.4%)	35 (43.8%)	1 (1.3%)	2 (2.5%)	23 (28.8%)	9 (11.3%)
<b>Spain</b>	29	18 (62.1%)	7 (24.1%)	5 (17.2%)	0 (0.0%)	1 (3.4%)	1 (3.4%)
<b>Greece</b>	27	13 (48.1%)	10 (37.0%)	7 (25.9%)	0 (0.0%)	1 (3.7%)	2 (7.4%)
<b>Portugal</b>	16	11 (68.8%)	11 (68.8%)	5 (31.2%)	3 (18.7%)	2 (12.5%)	1 (6.2%)
<b>France</b>	7	7 (100%)	5 (71.4%)	0 (0.0%)	1 (14.3%)	2 (28.6%)	2 (28.6%)
<b>Slovenia</b>	1	1 (100%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	160	104 (65.0%)	68 (42.5%)	18 (11.3%)	6 (3.8%)	29 (18.1%)	15 (9.4%)

Note: percentages refer to the total number of GI records per row.

Source: own primary data

Table 6: PSs, density of plantations and maximum production

	PSs specifying density	PSs with effective rules	<i>Traditional plantations</i>	<i>Intensified traditional plantations</i>	<i>Intensive plantations</i>	<i>Super-intensive plantations</i>
			≤ 100 trees/ha	101-250 trees/ha	251-400 trees/ha	>400 trees/ha
<b>Italy</b>	16 (20.0%)	16 (20.0%)	0 (0.0%)	3 (3.7%)	10 (12.5%)	3 (3.7%)
<b>Spain</b>	5 (17.3%)	5 (17.3%)	1 (3.4%)	4 (13.8%)	0 (0.0%)	0 (0.0%)
<b>Greece</b>	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Portugal</b>	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>France</b>	6 (85.7%)	6 (85.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6 (85.7%)
<b>Slovenia</b>	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	<b>27 (16.8%)</b>	<b>27 (16.8%)</b>	<b>1 (0.6%)</b>	<b>7 (4.4%)</b>	<b>10 (6.2%)</b>	<b>9 (5.6%)</b>
	PSs specifying production	PSs with effective rules	≤ 2000 kilos/ha*	2001-5000 kilos/ha*	5001-10000 kilos/ha*	> 10000 kilos/ha*
			kilos/ha*	kilos/ha*	kilos/ha*	kilos/ha*
<b>Italy</b>	71 (88.8%)	71 (88.8%)	0 (0.0%)	8 (10.0%)	50 (62.5%)	13 (16.2%)
<b>Spain</b>	1 (3.4%)	1 (3.4%)	0 (0.0%)	0 (0.0%)	1 (3.4%)	0 (0.0%)
<b>Greece</b>	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Portugal</b>	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>France</b>	6 (85.7%)	6 (85.7%)	0 (0.0%)	0 (0.0%)	5 (71.4%)	1 (14.3%)
<b>Slovenia</b>	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
<b>Total</b>	<b>78 (48.7%)</b>	<b>78 (48.7%)</b>	<b>0 (0.0%)</b>	<b>8 (5.0%)</b>	<b>56 (35.0%)</b>	<b>14 (8.7%)</b>

Note: percentages refer to the total number of GI records per Country.

\*These figures refer to olive fruits. On the basis of an average yield of 1 Kg of olive oil for 5 Kg of olives, the four categories expressed in olive-oil quantities are as follows: ≤ 400 kilos/ha, 401-1000 kilos/ha, 1001-2000 kilos/ha, > 2000 kilos/ha.

Source: own primary data

Table 7 – PSs establishing rules on phytosanitary and fertilization methods

	EU	in %	Italy	in %	Greece	in %	Spain	in %	Other	in %
Without any kind of rules	126	78.8	49	61.3	27	100.0	26	89.7	24	100.0
Rules on pest management	26	16.3	25	31.3	0	0.0	1	3.4	0	0.0
Rules on weed control	14	8.8	14	17.5	0	0.0	0	0.0	0	0.0
Rules on fertilization	7	4.4	5	6.3	0	0.0	2	6.9	0	0.0
With 1 category of rules	21	13.1	18	22.5	0	0.0	3	10.3	0	0.0
With 2 categories of rules	13	8.1	13	16.3	0	0.0	0	0.0	0	0.0
With 3 categories of rules	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
These rules refer to:										
- Prohibitions	4	2.5	4	5.0	0	0.0	0	0.0	0	0.0
- organic methods	3	1.9	3	3.8	0	0.0	0	0.0	0	0.0
- integrated method	31	19.4	30	37.5	0	0.0	1	3.4	0	0.0
Total GI records	160	100.0	80	100.0	27	100.0	29	100.0	24	100.0

Source: own primary data

Table 8 – Environmental awareness emerging from PDOs-PGIs official documents

	Total	in %	Italy	in %	Greece	in %	Spain	in %	Other	in %
Control of negative env. effects	17	10.6	12	15.0	4	14.8	1	3.4	0	0.0
Biodiversity preservation	19	11.9	15	18.8	1	3.7	3	10.3	0	0.0
Landscape/soil preservation	23	14.4	19	23.8	2	7.4	1	3.4	1	4.2
Preservation of water resources	8	5.0	6	7.5	1	3.7	1	3.4	0	0.0
Other (specified) issues	2	1.3	0	0.0	0	0.0	1	3.4	1	4.2
At least one of the above	38	23.8	24	30.0	6	22.2	6	20.7	2	8.3
Total GI records	160	100.0	80	100.0	27	100.0	29	100.0	24	100.0

Source: own primary data

Table 9: PDOs-PGIs by number of environmental thematic areas regulated by PSs

	Total	%	Italy	%	Greece	%	Spain	%	Portugal	%	Other	%
None	26	16.2	7	8.7	7	25.9	6	20.6	6	37.5	0	0.0
1 area	63	39.3	19	23.7	19	70.3	14	48.2	10	62.5	1	12.5
2 areas	48	30.0	39	48.7	1	3.7	8	27.5	0	0.0	0	0.0
3 areas	16	10.0	12	15.0	0	0.0	1	3.4	0	0.0	3	37.5
4 areas	6	3.7	2	2.5	0	0.0	0	0.0	0	0.0	4	50.0
5 areas	1	0.6	1	1.2	0	0.0	0	0.0	0	0.0	0	0.0
6 areas	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	160	100.0	80	100.0	27	100.0	29	100.0	16	100.0	8	100.0

Source: own primary data



Table 10: Synthetic indicators at the national level

	Tree varieties	Intensity of production	Phytosanitary and fertilization	Soil management	Harvesting and post Harvesting	Environmental awareness	Synthetic Indicator
Italy	0.256	0.092	0.179	0.006	0.054	0.130	0.120
Spain	0.230	0.056	0.011	0.000	0.046	0.048	0.065
Greece	0.203	0.000	0.000	0.000	0.000	0.059	0.044
Portugal	0.189	0.000	0.000	0.000	0.000	0.000	0.032
France	0.571	0.089	0.000	0.536	0.476	0.057	0.288
Slovenia	0.000	0.000	0.000	0.000	0.333	0.000	0.056

Source: own primary data

Table 11: Mapping the potential environmental effects of GIs

PS rules with regard to the current “standard” local olive growing				
Possibility of evolution of the local olive growing towards the ‘input-intensive’ model*	No rules in the PS			
	Same rules as for current, dominant local olive growing			
	Stricter rules than the current ones, dominant local olive growing			
	High	(A) No effect	(B) PS as a ‘good standard’	(C) PS as a ‘good standard’
	Low	(F) Unaware economic barrier (automatic environmental effects)	(E) Aware economic barrier (conscious preservation)	(D) High value environmental olive growing

\*Local specificities (e.g. terrain, climate) can affect the potential evolution of local olive growing.

## FIGURES

Figure 1: Different environmental reference levels for the environmental impacts of PSs

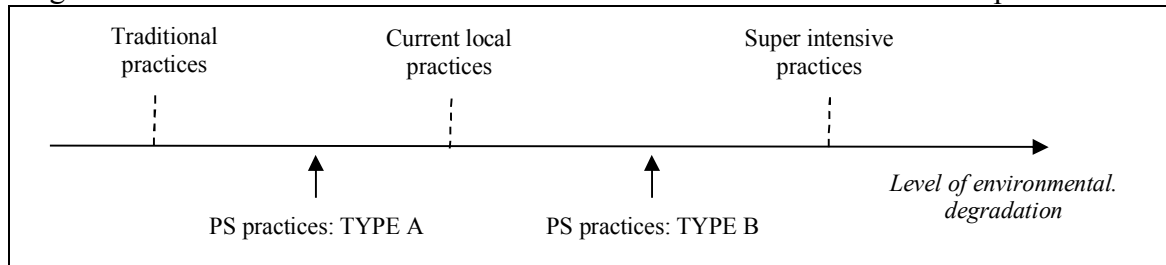
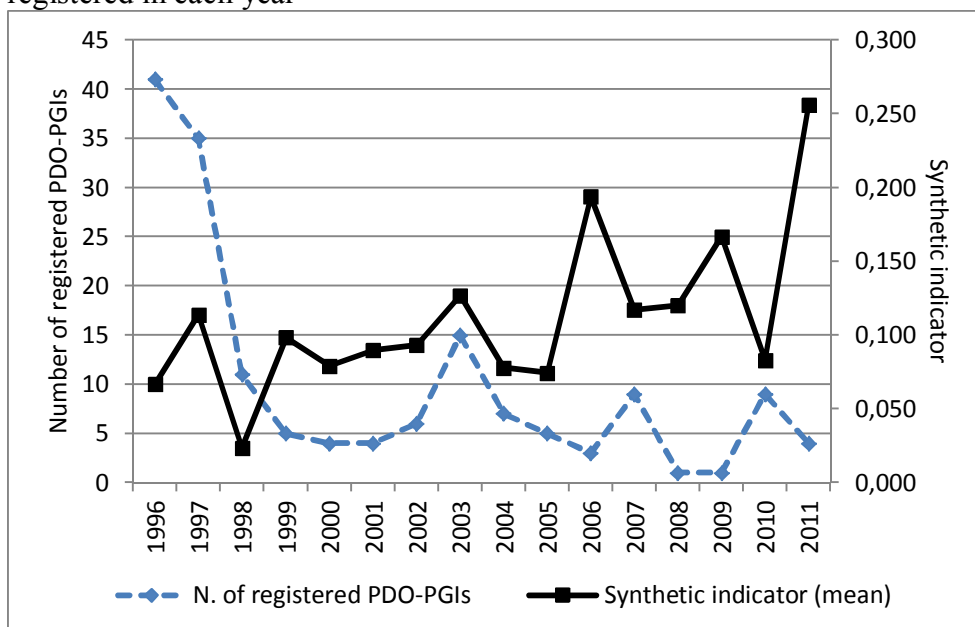


Figure 2: Average values of the synthetic indicator of environmental care of PDOs-PGIs registered in each year



Source: own primary data