

THE CONCEPT OF VINEYARD PARCEL FOR THE DOURO DELIMITED REGION

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ABSTRACT

The work presented here is an approach to standardize the concept of vineyard parcel for the Douro Delimited Region, supported in the geographical representation of the vineyard parcel. This enables a more effective management of the wine production, supported by Geographic Information System, and facilitates the activities of the competent institution, in this case, the *Instituto dos Vinhos do Douro e Porto*. To accomplish this, the definition of concepts and models has been conducted in order to automate the management of the assignment of the denominations of origin and the potential of production in the Douro Delimited Region (DDR). The compatibility of the vineyard parcels representation, among the several entities involved in the regulation in the Douro Delimited Region, was also ensured according to the procedures and rules of the *Sistema de Informação da Vinha e do Vinho*, responsibility of *Instituto da Vinha e do Vinho*, thus avoiding information redundancy between the regional and national actors involved.

RESUMO

O trabalho aqui apresentado consiste na normalização do conceito de parcela de vinha na Região Demarcada do Douro (RDD) a partir da sua representação geográfica. Este processo permite uma gestão eficaz da respectiva produção vitícola, suportada num Sistema de Informação Geográfica, e facilita as actividades a desenvolver pela Instituição competente, o Instituto do Vinhos do Douro e do Porto. Para tal, definiram-se conceitos e modelos para a automatização da gestão do potencial vitícola e das denominações de origem controlada na RDD. A compatibilização da representação das parcelas pelas várias entidades intervenientes na regulação da Região Demarcada do Douro foi assegurada de acordo com os procedimentos e as normas do sistema de registo do cadastro de parcelas, da responsabilidade do Instituto da Vinha e do Vinho, evitando assim redundância de informação entre os vários actores regionais e nacionais envolvidos.

INTRODUCTION

The management of the wine production and heritage in Portugal, particularly regarding the assignment of the denominations of origin in specific regions, is regulated by legislation and controlled by several Institutions. The exchange of information between these Institutions becomes imperative and needs to be synchronized. Therefore, resulting in the need to standardize the concept of "vineyard parcel" in order to match the wine business with the most modern management techniques, based on process automation through modern information systems, including Geographic Information Systems (GIS).

Beginning with several definitions of a vineyard parcel, we were able to establish a single definition that all Institutions adopt and implement. The basic vineyard parcel concept is their geographic representation, allowing the entire process of classification and management to

be supported by GIS. The model associates a set of coefficients to the geographical representation, allowing the geographical area of the vineyard parcel (projected on plane) to be affected with different soil and climatic factors (factors related to the characteristics of physical and chemical structure of soil and climate), which are defined by law, and determines different classification. This new approach also implied the adjustment of the survey protocol criteria to this new concept, allowing its application on the field.

THE DOURO DELIMITED REGION

The Douro Delimited Region (DDR), listed by UNESCO as World Heritage, was the first vineyard delimited region to be regulated (demarcation of the areas of production and regulation of its marketing), and produces one of the world's most famous wines: the Port Wine. It is the Portuguese viticulture product with further expansion at the international wine market, being one of the most famous Portuguese wines. This fame has been promoted by the quality control policies and markets regulation that have been implemented since the XVIII century. Historically, there was always a concern to systematize the process selection of vineyard parcels with the right to produce Port Wine, through scoring methods. This process is based on specific rules defining the scoring method to be used for the allocation of their classification of each vineyard parcel [Portaria n.º 413, 2000], as well the denomination of origin (DO) "Porto" and "Douro", which can be used for wine and wine products produced in the DDR, taking into account their individual delimitation and definition, given the possibility of producing more than one type of wine in the same vineyard. Also a mechanism was created to encourage the conversion and restructuring of vineyards in order to improve the quality, without prejudice on the part of farmers, the forfeiture of the DO "Porto" . [Decreto-Lei n.º 173, 2009], approving the new status of protected designations of origin (DO) and geographical indications (GIS) in the Douro Delimited Region (RDD). The management of the entire heritage of the Douro wine production is ensured by IVDP, an organization whose mission is to promote quality control and quantity of Port Wine, regulating the production process, as well as the protection and defense of DO "Douro" and "Port" as well as GI of Douro. Counting with the IVV support, which as has its core competencies coordination, regulation and development of the national vineyard, whose main purpose is to strengthen the competitiveness of Portuguese wines.

RELATED WORK

The specification of the concept "vineyard parcel" in GIS technology has been the subject of study and practical application, particularly with the implementation of a GIS system for recording the information of the vineyard parcels in Portugal, *Sistema de Informação da Vinha e do Vinho* (SIVV). It was developed to support IVV mission to ensure ongoing management and viticultural heritage, providing the tools to support decision making in the enhancement of national viticultural heritage.

The DDR has very specific regulations that makes it different from the remaining regions, namely the classification method used to rank the vine parcels [Portaria n.º 413, 2000]. However some works have already been done in order to define techniques to automate this process by using GIS systems [Luz, 2003].

STANDARDIZATION OF THE VINEYARD PARCEL CONCEPT

The standardization of the vineyard parcel took into consideration some legal and technical aspects associated to the survey of parcels. The aim is to guarantee that the representation of the parcels is compatible with the Geographic Information System (GIS) for the Vineyards – *Instituto da Vinha e do Vinho* (SIVV), with the processes of the *Instituto do Vinho do Douro*

e *Porto* (IVDP), and taking into consideration the records that describe the vineyard parcels of the Douro Delimited Region (RDD).

The specified conceptual data model was not limited to the definition of the concept of vineyard parcel in itself. In fact, it also contemplated all the entities associated to a parcel that are relevant to the correct contextualization of the vineyard parcel concept within wine production and heritage management processes, namely in terms production right attributed to wine-growers.

As far as the representation of the standardized concept of vineyard parcel is concerned, we chose to analyze the problem using the object-oriented paradigm with the UML notation [OMG, 2011]. The Unified Modeling Language (UML), which is used to specify, document, visualize and develop systems, is one of the most expressive languages in system modeling processes because it presents a vocabulary that is easy to understand, thus enabling an easier communication among all people involved in the process of developing a system - managers, analysts or programmers).

Conceptual data model for the Vineyard Parcel

The data model for the standardized Vineyard Parcel concept is presented in figure 1. The Vineyard Parcel concept was defined according to two components: a generic component, designated by *Vineyard Parcel*, which represents the concept as it is seen under the law, at a national level, according to the Community Vineyard Register (FVC); the second component, designated as *DDR Vineyard Parcel*, is a specific component of the concept and its aim is to represent the features and particularities of the vineyard parcel in the DDR. In other words, a '*DDR Vineyard Parcel*' is a *Vineyard Parcel*, and thus it inherits all its attributes. Nevertheless, it also has the extra set of attributes specific to the DDR.

An *Explorer* is a subtype of *Wine-Grower* who explores one or more *Vineyard Parcels*. A *Vineyard Parcel* can be designated as a *Farm*, belonging to one or more *Land Properties and having one or several Confrontations*. A *Vineyard Parcel* is associated to *Tree Culture* and a *Legal Context*. A *Vineyard Parcel* can be a *DDR Vineyard Parcel*. A *DDR Vineyard Parcel* is associated to a *DDR Legal Context*, which is a subtype of *Legal Context*. The *DDR Legal Context* is set up by several *DDR Plantation Rights*, which in their turn are associated to several *Legalization Types*. A *DDR Vineyard Parcel* is associated to several *Coefficients*, to a certain *Capability* (to produce wine capable of receiving the "Porto" Designation of Origin), and a *Parcel Classification* letter, with the respective score. A *Vineyard Parcel* is explored within the *DDR Exploration*, which includes a *DO Porto Production Area*. A *DDR Exploration* is associated to one or none *Restructuring Record*. A *DDR Vineyard Parcel undergoing Restructuring* is a subtype of *DDR Vineyard Parcel*. *DDR Vineyard Parcels*, classified as *A, B, C, D, E or F*, are entitled to a maximum yield (*DO Porto Production*), for the benefit of the respective *Explorers*. Below, the constant concepts of this data model (according to *classes*) are described.

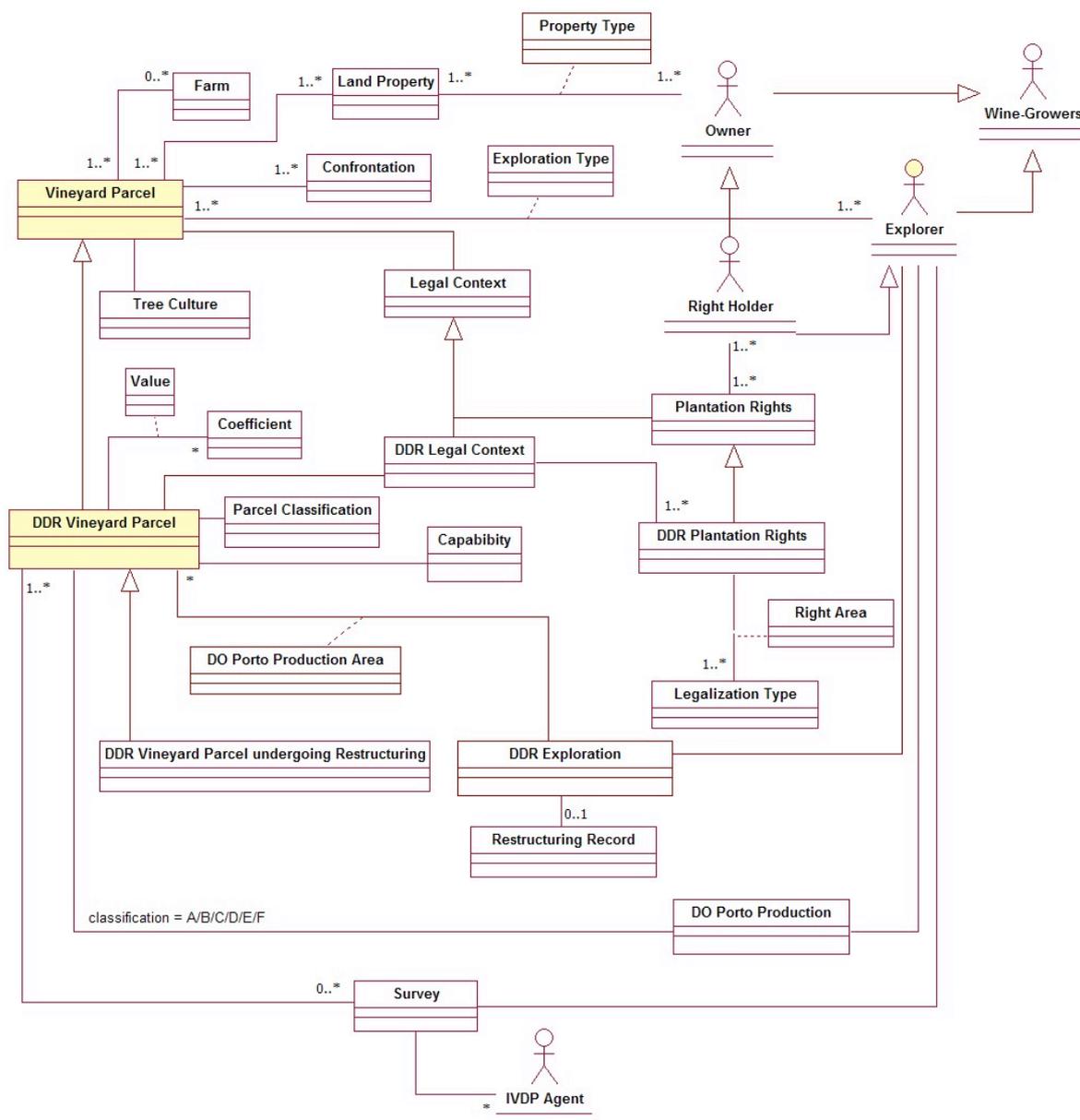


Fig. 1: "Vineyard Parcel and Associated Entities" - *Class Diagram*

Short description of the Model's Classes

In this section we describe each class briefly. The *classes* are described in alphabetical order.

Capability: The *Capability* concerns a *DDR Vineyard Parcel*. It means that the vineyard is capable of producing quality wine, susceptible of being attributed with the "Porto" Designation of Origin (DO Porto). For that, several factors are taken into consideration, including its category of use, method of training (trellising), type of culture, wine typology (with or without benefits) and the density of the plantation. In that sense, the *DDR Vineyard Parcel* will have an area capable of producing DO Porto wine (corrected by the "Capability Factor").

Coefficient: A *Coefficient* is used to correct the *DDR Vineyard Parcel's* potential to produce wine. The coefficients that were considered are the "Slope Coefficient" and the "Density Coefficient". Others may be identified and used in the future as needed.

Confrontation: *Confrontation* means that the existing *Vineyard Parcels* are confronting. When that happens, the names of the owner and the parcel should be registered, in accordance with the most important compass points (North, South, East and West). Every time the *Vineyard Parcel* is confronted by any watercourse (rivers, streams,...), their designation should be registered. In that case, the name of the parcel attribute will not be recorded.

DDR Exploration: *DDR Exploration* is the total set of *DDR Vineyard Parcels* owned by a certain *Explorer*. This is the total area of quality wine capable of obtaining the "Porto" Designation of Origin.

DDR Legal Context: *DDR Legal Context* means that an *Explorer* has the right to produce quality wine in *DDR Vineyard Parcels*. It defines the wine production typology and the wine products, particularly the type of right that is suitable to wine production with the Controlled Designation of Origin "Porto" and "Douro", as well as the geographical indication of the DDR. Every time a *DDR Legal Context*, applied in a *DDR Vineyard Parcel*, is the result of *DDR Plantation Rights*, with *Right Areas* from different *Legalization Types* ("Porto" and "Douro" areas), it is necessary to correct the production potential (right) in the *DDR Vineyard Parcel*. For that, a factor that translates the different plantation rights attributed to the *DDR Vineyard Parcels* ("DO Porto Factor") should be applied.

DDR Plantation Rights: The *DDR Plantation Rights* are subtypes of *Plantation Rights*. Every time it is applied in a *DDR Vineyard Parcel*, through its *DDR Legal Context*, and according to the *Legalization Types* associated to the *DDR Plantation Right*, the potential to produce quality wine varies (wine capable of obtaining the Designation of Origin "Porto" (DO Porto) or "Douro" (DO Douro)).

DDR Vineyard Parcel: According to what is provided in [Decreto-Lei nº 254, 1998], article 1, a *DDR Vineyard Parcel* is a subtype of *Vineyard Parcel* within the DDR. Therefore, it is possible to produce wine and wine products with Controlled Designations of Origin "Douro" and/or "Porto". A *DDR Vineyard Parcel* can be subjected to the parcel quantitative assessment method, developed by Moreira da Fonseca in 1948 and included in [Decreto-Lei nº 413, 2000]. In order to acknowledge the Designation of Origin (DO) "Porto" and "Douro", the Geographical Location of the DDR, and the adequate distribution of benefits by all wine producers, parcels are classified according to different conditions, including climate, soil and culture. Characterization of *DDR Vineyard Parcels* is carried out according to the specifications provided in [Decreto-Lei nº 254, 1998] (including changes made in [Decreto-Lei nº 173, 2009], where the new status for the designations of origin (DO) and the Geographical Indication of the DDR are approved. These specifications include: designation of land, plantation density and must yielding per hectare.

DDR Vineyard Parcel undergoing Restructuring: A *DDR Vineyard Parcel undergoing Restructuring* is a subtype of *DDR Vineyard Parcel* that is being restructured (replanting and reconstructed). Since a parcel undergoing restructuring does not produce any wine, the explorer, under certain circumstances, may use the unused capacity in other parcels.

DO Porto Production: *DO Porto Production* entails that the Wine-Grower is entitled to benefits (Authorized Must in liters/ha). The file where the *DDR Vineyard Parcels* are described is at the foundation of the benefit distribution. This is where the values of the parcels' attributes are registered. In their turn, these attributes are necessary to apply the scoring method [Decreto-Lei nº 413, 2000]. To provide the benefits, each *DDR Vineyard Parcel* will have a score, which is the result of the evaluation of parameters. The score will be identified by the letters A, B, C, D, E or F. However, this situation is decided on an annual basis and so the classification that is necessary for the must can vary. Every year, coefficients are established for the different vineyard classes, and according to the conditions of the campaigns carried out over the last years for the Port wine sector (commerce and

production). These coefficients will be applied for the fit area of the *DDR Vineyard Parcel*, taking each specific situation into consideration. As a result, each *DDR Vineyard Parcel* will have an Authorized Must production value per liter, for each year.

DO Porto Production Area: Area of the *DDR Vineyard Parcel*, explored within a certain *Exploration Area*, capable of producing wine that can obtain the “Porto” (DO Porto) Designation of Origin.

Exploration Type: *Exploration Type* is the type parcel explored, as well as the percentage of wine-growing owned by a certain *Explorer*, every time the exploration is run by more than one *Explorer*.

Explorer: An *Explorer* is a subtype of *Wine-Grower* that explores *Vineyard Parcels*. Every person (individual or collective) or groups of people exploring *Vineyard Parcels* are *Explorers* (Legislation number 649/87 of the European Commission, 3 March 1987). The description of the *Vineyard Parcels* of the *Exploration* is summarized in the Exploration Sheet, for each *Explorer*, which includes information on the *Vineyard Parcels* and the respective Right Holders.

Farm: A *Farm* corresponds to a set of *Vineyard Parcels*. A *Vineyard Parcel* can be owned by one or more *Farms*, in the same Parish or in surrounding Parishes.

IVDP Agent: The IVDP Agent is responsible for the field inspection/survey of the vineyard parcels in the DDR.

Land Property: A *Land Property* can have more than one *Vineyard Parcel* and a *Vineyard Parcel* can belong to more than one *Land Property*.

Legal Context: The *Legal Context* is associated to a *Vineyard Parcel* and it means that that plantation is legal. For that, the SIVV (owned by IVV) assigns a unique identifier to the parcel.

Legalization Type: *Legalization Type* is the legal typology associated to a *DDR Plantation Right*, which can be of the “Porto” type: general law, “*Casal Agrícola*”, PDRITM (*Project for the Integrated Rural Development of the Trás-os-Montes Region*), law 43/80, several; or the “Douro” type: DL 504-I/85 or DL 83/97, Regulation 393-C/2000, Regulation 1056/2000 (TDR – Replanting Rights Transfer outside the DDR), Regulation 461/2001 (1 ha) or several.

Owner: An *Owner* is a subtype of *Wine-Grower* that owns *Vineyard Parcels*. An *Owner* can have several *Vineyard Parcels*, belonging to several *Land Properties*, holding a share of the property (1/total number of parcel owners). The set of *Vineyard Parcels* belonging to the same *Owner* are summarized in the Wine-growing Areas Identification Sheet (FIPV) [Decreto-Lei nº 83, 97].

Parcel Classification: *Parcel Classification* means that the *DDR Vineyard Parcels* are evaluated and given a score (according to the sum of scores resulting from the evaluation of the climatic, soil and cultural conditions of the parcel, which are geographical location, altitude, sun exposure, slope, protection, nature of the terrain, stoniness, wine varieties, age of the vine, productivity, “*compasso*” (distribution of the vines per line and between lines) and trellising). These conditions differentiate them when it comes to producing quality wine capable of obtaining the Designation of Origin “Douro” and “Porto” [Decreto-Lei nº 413, 2000].

Plantation Rights: *Plantation Rights* are the rights to plant vineyards and are held by the *Right Holder*. These rights can be: right to new plantation (right to plant a new vineyard without using a pre-existing right); replanting right (right to plant a new vineyard in an equivalent area, in pure crop, which means that a pre-existing right is used). A *Plantation Right* is a subtype of *Legal Context* that takes the features of the *DDR Legal Context* when applied to a *DDR Vineyard Parcel*.

Property Type: *Property Type* is the share of property for the *Land property* and consequently for the *Vineyard Parcel*.

Restructuring Record: A *Restructuring Record* is associated to a *DDR Exploration* and it is the record of *DDR Vineyard Parcels undergoing Restructuring*, replanting and reconstructed, and that, according to the legislation, are authorized to produce DO Porto wine without losing

the right to the DOC (regarding the maximum yield for the DOC in the remaining area), as long as the total restructuring process is effectively carried out up to a maximum of 40% of the *DO Porto Production Area* of the *DDR Vineyard Parcel* in the *DDR Exploration* (with a *Total Area* in *DO Porto Production*). Therefore, the *Wine-Grower* manages the wine area globally, per *DDR Exploration*, and not at the level of the *DDR Vineyard Parcel*. Nevertheless, the parcel evaluation is maintained as the basis to classify the exploration. In that sense, every time the total restructured area of the *DDR Exploration* surpasses 40%, the *DO Porto* production potential of the *Vineyard Parcels undergoing Restructuring* should be corrected. For that, a “Restructuring Factor” should be applied when calculating the total value of the must production associated to the *DDR Exploration*.

Right Area: *Right Area* applied in a *DDR Vineyard Parcel* (right to produce wine capable of obtaining the "Douro" or "Porto" Designation of Origin) according to the *Legalization Type*. The *Right Area* applies the *DDR Plantation Right* in the *DDR Vineyard Parcel*, through the associated *DDR Legal Context*.

Right holder: A *Right Holder* is a subtype of *Wine-Grower*. Any individual or collective person, or group of people assigned with a *Plantation Right* are *Right Holders*.

Survey: Survey is the process of updating the descriptive record of the *DDR Vineyard Parcels* (new parcel and changed parcel survey), according to the method of collecting field information that characterizes *DDR Vineyard Parcels* (filed survey protocol). The Survey process is associated to one or several *DDR Vineyard Parcels* and it involves *IVDP Agents*, accompanied by the respective *Explorers*. In their turn, a *DDR Vineyard Parcel* can be subjected to several processes and the valid information will be the one corresponding to the date of the last Survey (date on the field bulletin).

Tree Culture: *Tree Culture* applies to one *Vineyard Parcel* and it means that part of the *Vineyard Parcel* is used to plant trees. If that occurs, the area of the *Vineyard Parcel* (area projected orthographically) should be corrected with a “Tree Culture Factor”.

Value: The *Value* is the result of the calculation made for each of the two coefficients (“Slope Coefficient” and “Density Coefficient”) to correct the production potential applied in a *DDR Vineyard Parcel*.

Vineyard Parcel: A *Vineyard Parcel* is a continuous portion of land used to plant vine located inside an exploration, submitted to single management. It is a distinct entity in terms of exploration, use category (purpose of the production), type of culture, method of training (trellising), irrigation and age of the plantation. As mentioned in the legislation, other than these criteria, the following also constitute geographical borders: administrative boundaries, topographical limits, rivers, roads or pathways or surfaces that are as wide or wider than four meters. According to the legislation, the concept of orthographically projected area is used in order to calculate the *Vineyard Parcel* regardless of the type of vineyard systematization in the field. The borders of the parcel are measured in horizontal projection, in hectares (ha). The characterization of a *Vineyard Parcel* thus includes the information used by the IVV to manage the national wine heritage.

Wine-Growers: Individual or collective person that produces wine. The *Wine-Grower* can represent all the entities that own and /or explore *Vineyard Parcels*. A *Wine-Grower* can be: *Owner*, *Right Holder* or *Explorer*. Usually the *Right Holder* of a certain *Vineyard Parcel* is also its *Owner*.

CONCLUSIONS AND FUTURE WORK

Plantation rights issued by the IVV and the maximum yield allowed by the IVDP are defined according to the parcel areas. Until now, the different regional and national institutions of the sector have been using several systems and criteria to measure the *Vineyard Parcels*, thus resulting in the definition of different areas for the same parcels. This, of course, generated “permanent conflicts” with the wine-growers. The work presented here brings a significant improvement to the sector because the record of the *Vineyard Parcels* in the Douro Region is

no longer simply descriptive. In fact, it now includes a well-defined geometrical representation, which brings the DDR to the forefront in the use of GIS to manage wine Designations of Origin.

Following the definition of the concept of vineyard parcel for the DDR, a new set of opportunities arise that promote the automation of the management of the vine parcels registration and wine production. Using the standardized concept of Vineyard Parcel as starting point, a field protocol shall be proposed, adjusting the parceling criteria to that definition. Therefore, the field information survey on the Vineyard Parcels should be methodologically defined, using the geographical borders (georeferenced geometry) of the Parcel and a field form that includes the elements necessary to characterize the parcel (alphanumerical elements) organized systematically. Furthermore, including both the concept of vineyard parcel based on its geometric representation and a survey protocol, a GIS will be developed to manage the entire process, from the data gathered in the field survey, that may be automated on mobile devices, to the automatic classification of the parcels.

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