Projet cofinancé par le Fonds Européen de Développement Régional (FEDER)

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MedStrategy Project - Integrated Strategy for Sustainable Development of Mediterranean Rural Areas

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C5 Strategic Planning in Med Rural Areas

Phase 3: Identification of Key Interventions

"Creation of Soil Map for Decision Support in Agricultural Management "

CIHEAM MAI CHANIA

CHANIA, 2012

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1. Introduction

The area enclosed within the administrative borders of the municipality of Archanon-Asterousion has a long tradition in cultivating vineyards, both for grapes and wine production. However, in the recent past, the size of production has been gradually diminishing and failing to meet the demands of the market. The main causes for this decline has been the lack of long term planning for the development of competitive viniculture in the region, the lack of information provided to the farmers and the presence of subsidies, which secured the producers income in the short term but removed the incentive for long-term planning of the cultivation. Viniculture now requires sustainable long-term planning in terms of choice of vineyard varieties to be cultivated and identification of optimum locations where each of those varieties can be established. In order to achieve such an endeavour, three types of factors need to be taken into account, the climate, the soil characteristics, relief and aspect and the requirements of each variety in terms of incident solar radiation, temperature and water availability.

This study has three main objectives: 1) The development of an up-to-date soil map of the region in a digital vector form, along with data layers containing information on the elevation, slope and aspect, geology and the average temperature at critical points of vineyard cultivation, 2) the combination of the above data, in order to assess the current situation regarding the capacity of the region to host early and late production of grapes and 3) the suggestion of which of the available vineyard varieties are suited in the regions of the municipality of Archanon-Asterousion.

2. Provision of up to date digital data for the municipality

1.12.1 Existing datasets

A number of existing datasets were used in order to generate the final data layers:

- The Register of Vineyards for the municipality was provided by the Payment and Control Agency for Guidance and Guarantee Community Aid (OPEKEPE) to the municipality. The dataset consisted of vector polygons representing the agricultural fields, with each polygon being associated with the type of cultivation used in that field.
- A Digital Elevation Model derived by SPOT satellite data was used in this study in order to derive the elevation, slope and aspect for the municipality, with a spatial resolution of 20 meters.
- Google Earth data was used to derive the land cover of the municipality.
- The geological map for the area was already available in digital vector form for the entire island of Crete, at a scale of 1:500,000.
- Archives of meteorological data from stations around the area were provided by the municipality, particularly regarding the temperature for the last 3 years.

1.22.2 Elevation, slope and aspect layers

Information on elevation, slope and aspect were generated from a Digital Elevation Model (DEM), which is owned by the Mediterranean Agronomic Institute of Chania (MAICh). The DEM was derived from SPOT satellite data and it consists of a raster

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file, with each pixel representing a 20 by 20 meter area. Each pixel is associated with an elevation value and this was treated as the average elevation within the 20 by 20 meter area.
The aspect and slope layers were generated through the use of the ArcMap software. For the calculation of aspect, the software compares the elevation of each pixel to that of the neighboring pixels and assigns an azimuth value to that pixel. A similar process is followed for the calculation of slope, with the relative difference between the elevation of each pixels and the immediate neighboring pixels defining the slope inclination in that particular pixel. Both the aspect and slope layers were delivered in raster format (Figure 1).

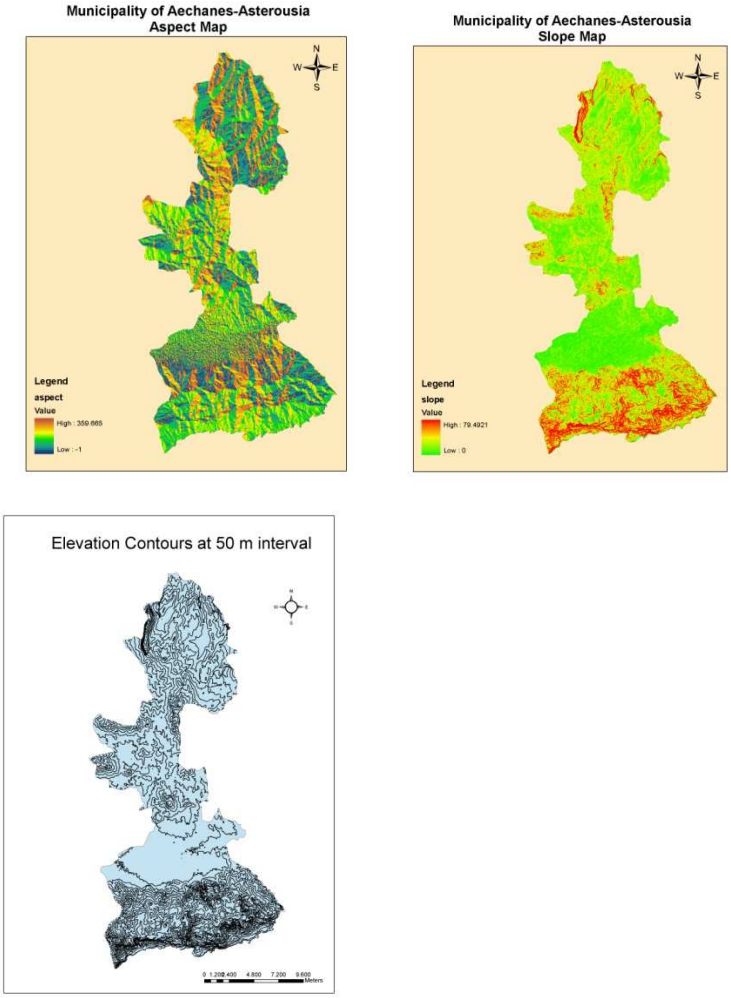

Figure 1. Aspect, slope and 50-metre interval elevation contours for the municipality of Archanon-Asterousion.

1.32.3 Soil data layer

In order to generate the soil map, a set of soil samples needed to be collected from representative locations within the municipality. In order to ensure that the samples would be representative, the municipality was divided in cartographic soil units, based on the underlying geology. This information was obtained from the existing geology map for the area (Figure 2).

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A total of 30 measurement locations were identified and soil samples were collected from the vineyards found in these locations. For each of the samples, four to eight sub-samples were collected from different locations in the field consisting of a soil core from the surface and up to a depth of 30 cm. These sub-samples were mixed together and then separated in four parts of equal weight. Two of these parts were then mixed together and split again in four parts, repeating the process and until a sample of approximately two kilograms was left. The sample was then placed in a plastic bag, which was labeled to identify its location and transferred to the soil lab of MAICh. The samples were analyzed to determine the following information:

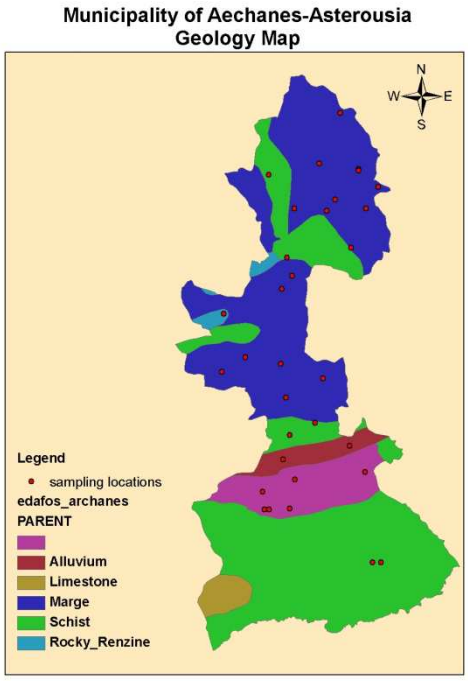

Figure 2. Geology map of the municipality of Archanon-Asterousion, with the 30 soil sample locations

1) Soil texture
2) pH
3) Electric conductivity
4) NO3 – N
5) Exchangeable K, Mg, Ca and Na
6) Micronutrients (Fe, Cu, Zn, Mn)
7) Phosphorus
8) Organic matter
9) Total calcium carbonate (CaCO3)
10) Boron
11) SAR (Sodium Absorption Rate)
12) CEC (Cation Exchange Capacity)
13) Active calcium carbonate

The locations of each sample collection were represented as points in a vector layer and each point was associated with the respective measurements for the above characteristics. Using the Inverse Distance Weight method a map was generated for

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each of those characteristics, for the entire extent of the municipality. The relevant figures are found in the Annex of this report.

1.42.4 Meteorological data

The meteorological data concerned with the vineyard cultivation is primarily temperature, rainfall and relative humidity. Four meteorological stations (in the locations of Archanes, Asimi, Viannos and Vonni) were used to provide hourly measurements of these parameters for the 2008-2012 period. The temperature data were used in order to identify the areas where the temperature promoted early and late grape production, for the periods of April-May, June-August and September-October.

3. Depiction of current capacity of the area for early and late production of grapes

The soil structure and morphology of the area of the municipality of Archanon-Asterousion is quite variable. The whole area is strongly influenced by variable wind direction and intensity, temperature and humidity, depending on the landscape, creating microclimatic zones that are quite important for the cultivation of grapes. The aim of this action is to draw the cultivation zones based on the soil – thermal indexes for several varieties of grapes at the Municipality of Archanon- Asterousion. Vineyard cultivation is still very significant in the municipality, employing mostly the Soultanina variety for direct or raisin consumption. According to the viniculture registry the number of fields and total hectares used for raisin and wine production are:

Variety	**Number of fields**	**Hectares**
Soultanina/Raisins	11042	3651.5
Wine	6925	1195.2
Total	17967	4846.7

The main two points considered in order to determine the several viticulture zones were:

- Day temperature of 25^{o}C and high relative humidity is ideal for the photosynthetic procedure and the production of sugars on leaves.
- Low night temperature is expanding maturity stage. In such case the needs of sugars per time unit is lower, maturing is more gradual and the quality characteristics of the final product are increasing. After several experiments that took place in France, scientists came to the conclusion that the ideal temperature for the development of grape is 25^{o}C during the day and 20^{o}C during the night (Carboneau). The municipality of Archanon-Asterousion contains areas that are suitable for very early or late production of grapes and relevant varieties, as they approximate the ideal temperatures that the optimum photosynthetic procedure requires.
- Special attention is needed on early production varieties. Due to the lack of soil water, vines may get stressed and dormancy hormones may be produced on the leaves. This usually causes over maturation phenomena like neutralization of the acids, dehydration of the fruits and oxidation of the pigments and taint of flavors.
- The direct sunlight may cause burnings on grape skin. High temperature may cause structure problems on grape skin so to become penetrated on oxygen that oxidized the skin pigments and downgrade the final product quality.

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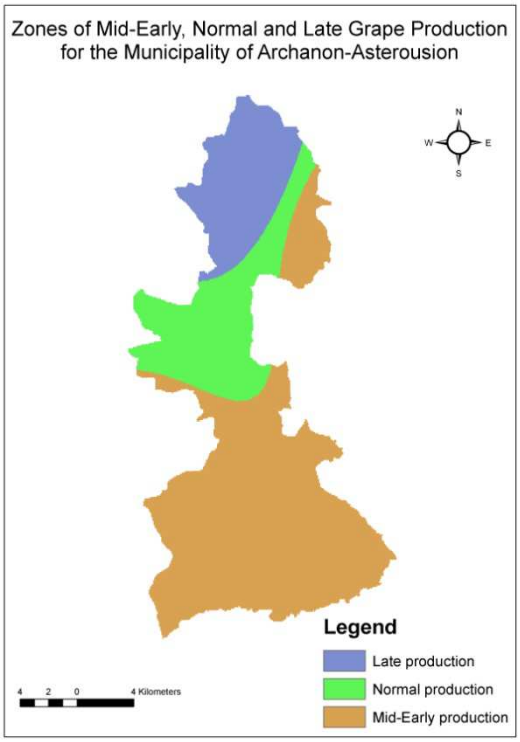

Figure 3. Zone of Mid-Early, Normal and Late grape production for the municipality of Archanon-Asterousion

Based on the average temperatures in three periods (April-May, June-August and September-October) a map of the municipality was produced, indicating the areas where mid-early, normal and late production is achieved (Figure 3).

4. Proposal of vineyard varieties for each area in the municipality of Archanon-Asterousion

Based on early and late production climatic zones several varieties for each cultivation zone can be suggested. The **Superior** and **Flame** varieties are very early varieties and they are suggested to be installed in the early zones, in order to achieve production as early as possible. **Attiki** and **Victoria** are two mid-early varieties and are suggested to be installed at the mid-early zone, in order to get the highest quality characteristics. **Soultanina** can be installed anywhere in the municipality and can yield early or late production, with the appropriate technique (i.e. coverage with plastic in August to delay production). **Crimson** is a late, red seedless variety, which was introduced very recently to the market and it is suggested to be installed at the very late zone in order to have very late production as there is no other variety with such characteristics.

Cultivation techniques may also be adapted in each area in order to have the optimum production quality and quantity. Very important factor on the quality of the final product is the ratio leaves to fruits. Vigorous plants in general have a nice ratio of leaves/fruits but are apt to produce high loads, so there is a need of determining the pruning system in order to keep this ratio in good level throughout the production season.

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The use of vigorous rootstocks like 140R, 1103P, R110 is recommended. 41B is suitable at irrigated fields. SO4 in general is not suitable for the area. Balanced irrigation that is not leading to overloading of the vines enhances quality. Finally high propping systems are causing the same effects.
This was an initial study in the identification of areas where vineyards can achieve early and late production, in order for the producer to adapt to the demands of the market and achieve good prices and higher profits. However, in order to identify the optimum variety for each section of the municipality, it is imperative that experimentation takes places, assessing a range of varieties in different areas and employing different cultivating techniques. Furthermore, this study provided information regarding soil and meteorological information through the area, employing a small number of soil samples and meteorological stations, respectively. A more holistic approach will require a larger number of soil samples and analyses and the collection of meteorological data from more locations over a longer period of time, in order to achieve finer spatial detail in the soil and meteorological parameters estimation.

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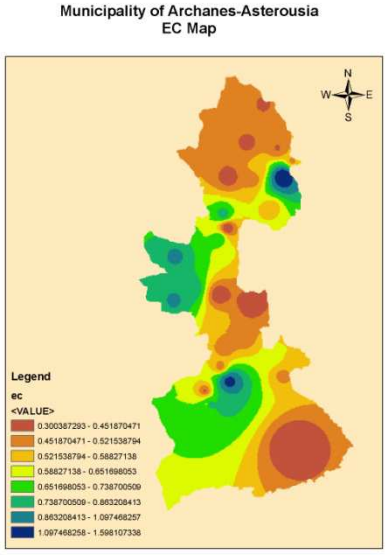
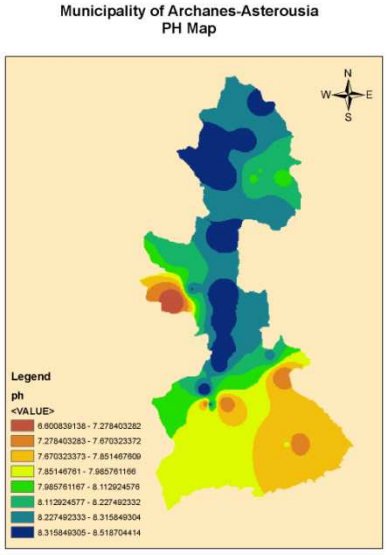
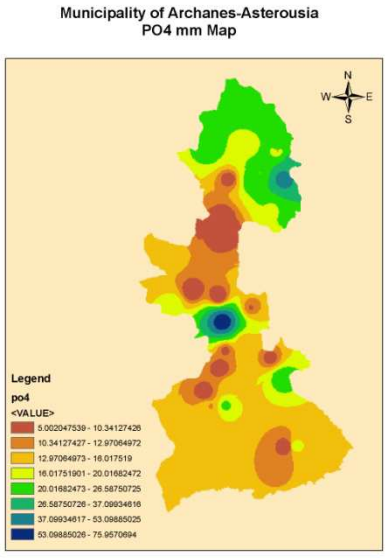
ANNEX



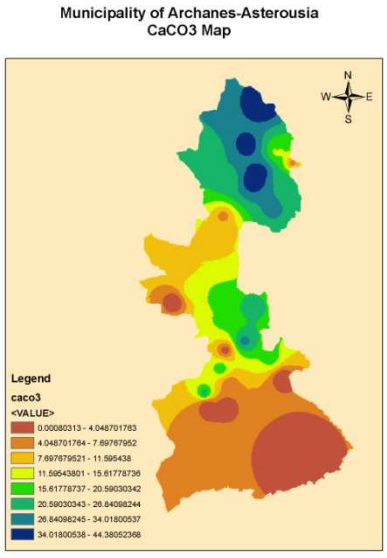
Electric Conductivity



pH



PO_4



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