

# THE USE OF GIS FOR THE STUDY OF THE LOCAL VARIATION OF THE ECOLOGICAL FACTORS IN THE AVEREȘTI VINE-GROWING CENTRE – HUȘI VINEYARD

## UTILIZAREA GIS PENTRU STUDIUL VARIAȚIEI LOCALE A FACTORILOR ECOLOGICI DIN CENTRUL VITICOL AVEREȘTI – PODGORIA HUȘI

IRIMIA L.<sup>1</sup>, PATRICHE C.V.<sup>2</sup>, ȚÂRDEA C.<sup>1</sup>

<sup>1</sup>University of Agricultural Sciences and Veterinary Medicine Iasi, Romania

<sup>2</sup>Iasi Branch of the Romanian Academy, Romania

**Abstract.** *The paper present the preliminary results of a research regarding the use of the Geographic Information Systems to evaluate the ecological suitability of the vineyards. To analyze the ecological factors variation, we used the satellite images of Averești vine-growing centre – Huși vineyard. The images were processed with the digitalelevation model SRTM – USGS (2004). Using this we obtained the maps with the local variation of the topographic and climatic factors. The maps reveal and explain the different ecological favorability of the terroirs composing Averești wine-growing area.*

**Key words:** vine, viticultural area, Geographic Information System, climatic maps, ecologic favorability.

**Rezumat.** *În lucrare sunt prezentate rezultatele preliminare ale unei cercetări privind evaluarea potențialului ecological al arealelor viticole, prin folosirea Sistemelor de Informații Geografice. Pentru analiza variației locale a factorilor ecologici s-au folosit imagini din satelit ale arealului viticol Averești din podgoria Huși. Imaginile au fost procesate folosind modelul numeric al terenului SRTM - USGS (2004). Pe baza modelului numeric al terenului s-au elaborat hărțile cu variația locală a factorilor ecologici. Acestea evidențiază și explică potențialul diferit al unităților de terroir care intră în alcătuirea centrului viticol Averești.*

**Cuvinte cheie:** vița de vie, areal viticol, Sistem de Informații Geografice, hărți climatic, favorabilitate ecologică.

### INTRODUCTION

The establishment and the exploitation of wine plantations needs data, concerning the environment and the factors that compose it (*climate, topography, soil etc.*). The quality of the information determine the quality of the decisions, the yield and ultimately, the profitability of the vineyard. The climatic studies based on data provided by far weather stations, presents certain incertitude, because the station always gives the data for its own particular location. The use of these data leads to wrong decisions in the settlement of the appropriate grapevine varieties, in the establishment of the trellising systems, and in the settlement of the optimum winegrowing technologies. Therefore, in the viticulture were introduced, in the last years, some modern methods of research, that allows an exhaustive analyze of the

environment and procurement of the necessary data for implementing the precision viticulture principles.

Such a modern method is the use of *Geographic Information Systems* (GIS), tools of informational technologies created to “*captures, stores, edits, analyzes, shares, and displays geographic information*”. GIS offer the possibility to determine the local variation of the ecological factors from a vine area and to establish, accurately, the grapevine varieties, the trellising systems and the appropriate technologies.

## MATERIALS AND METHODS

For the study of the ecological factors' variation was used the digital elevation model (DEM) (SRTM – USGS, 2004) for the Averești vine area and the adjacent sloping coasts, where is located the vineyard. The marked area represent the plantations in 2007. The surface of the vine area is approximate 600 ha. It include seven *sites (terroirs)* with distinctive characteristics. These sites are: *Bunești, Armășeni, Roșiori, Averești, Arsura, Pribeasca and Pâhnești* (fig. 1). For a detailed analyze of the vine area, the Averești *site* was divided in two distinctive subunits: *Averești Deal și Averești Plopi*. The digital elevation model (DEM) was resampled from the original 90 m resolution at 10 m, through bilinear interpolation, for an accurate reproduction of the land surface. Then, this was used to derive the slopes and their exposure. The spatial distribution of the air temperature (the *annual average temperature, the average temperature in the hottest month - July*) and of *the annual average precipitations*, were obtained using DEM, through statistical regression analyze. The characteristics of the radiation (*global radiation, the duration of the solar shining*) where, also, obtained using DEM, in two stages: derivation of the irradiative parameters, ignoring the nebulosity and second, correcting them using the solar shining.

## RESULTS AND DISCUSSIONS

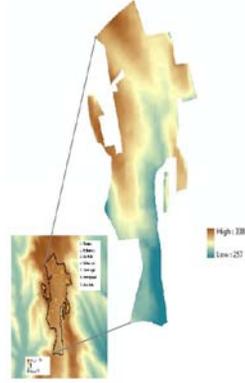
**Topographic suitability.** The vineyard is located in a hilly area, characteristic for the central part of the Moldavian Plate. The Averești hilltop is the element that dominates the entire relief of the region and is situated at the separation point of Crasna and Lohan hills from the Bunești hill.

The altitude. The vine plantations are located on the highest sector of the entire region. The planted area covers two distinctive subunits: a taller one, in the northern part, and a lower one in the southern part (fig. 2). At the northern limit of the planted area (*Bunești site*) the maximum elevation is by 338 m, while at the southern limit (*Averești site*) is 257 m. The relief amplitude in the planted area is not very significant (81 m), but it exerts a certain influence on the climate, knowing that the thermic gradient is 0.65°C for 100 m.

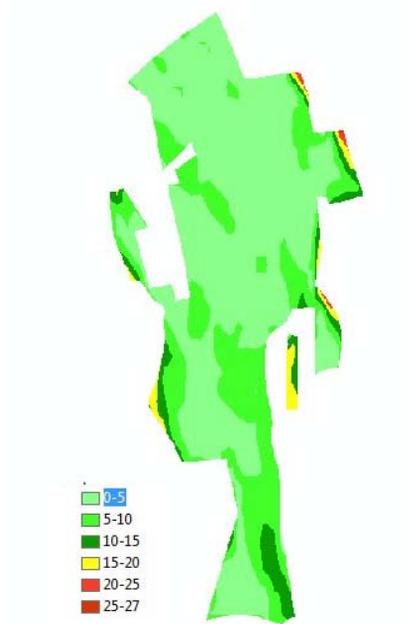
The slopes in the planted area are roughly uniform: 65% of the plantations are located on the flat terrain (0 – 5 % inclination), and 32.1% on the moderate slopes (5–15% inclination), the most favorable for the vine culture. These are located at the western (*Armășeni and Roșiori sites*) and eastern (*Arsura and Pâhnești sites*) limits of the planted area (fig. 3). The uniformity of the slopes assures a facile circulation of the cold air currents and prevents the freezing of the



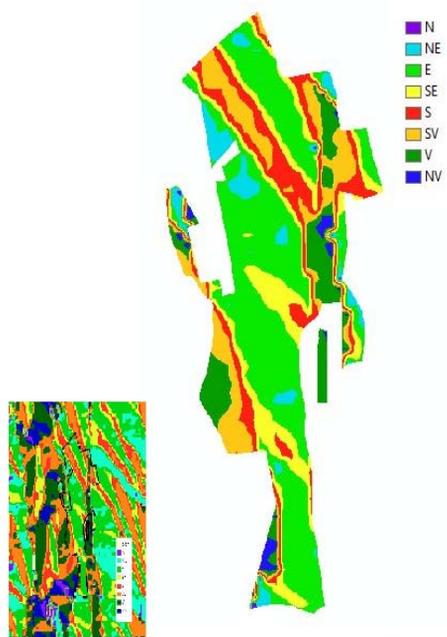
**Fig.1.** The *terroirs* of Averești vine-growing area (satellite image): 1. Bunești; 2. Pribeasca; 3. Arsura; 4. Pâhnești; 5. Averești Plopi; 6. Averești Deal; 7. Roșiori; 8. Armășeni.



**Fig. 2.** The elevation map, Averești vinegrowing centre –Huși vineyard



**Fig. 3.** The slopes map, Averești vinegrowing centre –Huși vineyard



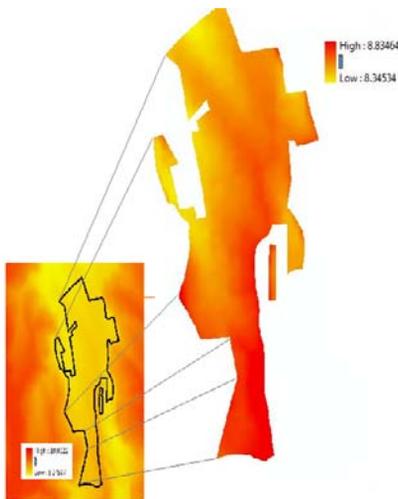
**Fig. 4.** The slopes direction map, Averești vinegrowing centre –Huși vineyard

vines in the cold seasons. An exception is the valley from the middle of the highland, which seems to be a collector of the cold air currents from de eastern and western slopes.

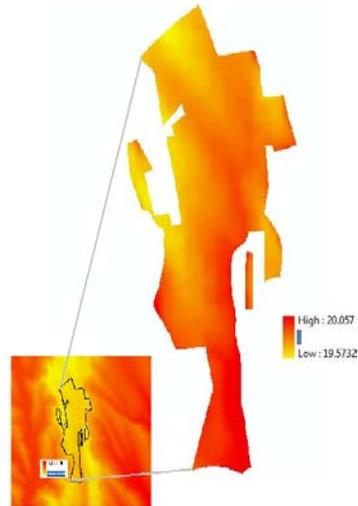
**The slopes directions.** Analytical study reveal that 9.9% of the slopes from the planted area has south exposure, and 25.3% has south-east to south-west exposure. These are located on the Lohan valley, on the lower part of the slopes that demarcate it (*Bunești* and *Pribeasca sites*) and in the *Averesti Deal* site. More than 53.2% from the planted area has east and west exposure, passable for the vine culture, but not enough to balance the lack of thermal resources that characterize this region.

**Climate suitability.** The study is based on the data provided by the Husi weather station, that make de recordings for this area. To illustrate the spatial variation in climatic factors, the analyses used a digital elevation model and a combination of point data sets to create estimates of annual climate variables.

**Annual average temperature.** The temperatures map reveal that the Averesti vine growing centre is situated in the coldest part of the region (fig. 5). The annual average temperature, by +8,34...+8,83°C is, according to the grapevine zoning specifications (Oșlobeanu et al., 1991), under the minimum



**Fig. 5.** The map of the annual temperature variation, Averesti vine growing centre

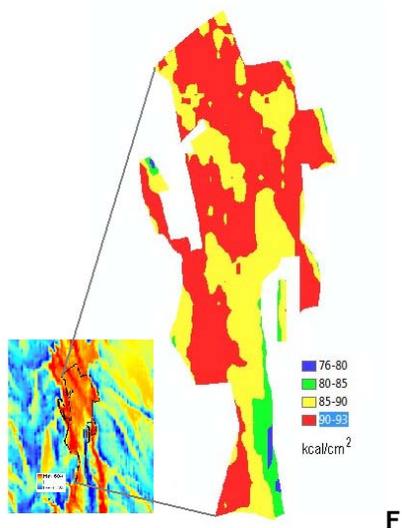


**Fig. 6.** The map of the hottest month temperature variation, Averesti vine growing centre

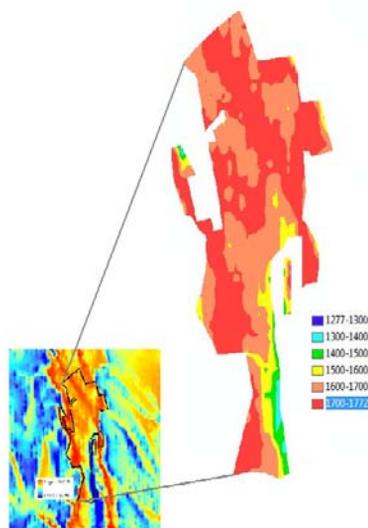
level (+ 9.0°C) for the economic efficiency of the grapevine culture. The northern part of the area (*Bunești*, *Armășeni* and *Roșiori sites*) is colder that the southern one. The lower values of the annual temperature, explain the 10 – 14 days delay of the beginning of the growing season, comparatively with the neighbored vine growing centers *Bohotin* and *Huși*.

*The average temperature of the hottest month (July)*, an important indicator for the potential of a *terroir* to produce qualitative wines, vary between 19.5°C in the northern part of the plateau (*Bunești*, *Armășeni*, *Roșiori* and *Arsura*

sites) and 20.05°C at the southern limit (*Averești Plopi site*) (fig. 6). These values indicate the presence of the necessary thermal resources for producing white qualitative wines (Oșlobeanu et al., 1991). Thermal differences between the northern and the southern part of the area, own to the elevation factor.



**fig. 7.** Solar radiation map (1.IV – 30.IX), Averești vine-growing centre



**Fig. 8.** Insolation map (1.IV – 30.IX), Averești vine growing centre

*Solar radiation.* The quantity of the solar energy received by the vine during the growing season (1.IV-30.IX) is presented in *fig. 7*. The vine plantations are located in the zone with the higher values of the solar radiation from the entire region, fact that compensates the lack of thermal favorability of the local climate. For 55.6% from the planted area, the solar radiation vary between 90 and 93 kcal/cm<sup>2</sup>/year, while the minimum value for vine culture is 80 kcal/cm<sup>2</sup>/year; for 39% of the surface, the solar radiation is 85 - 90 kcal/cm<sup>2</sup>/year. The solar radiation has an important seasonal variation, due to the incidence angle of the solar rays with earth surface; in the spring, the slopes are advantaged by the reduced angle of the rays, while in the summer, the flat surfaces benefit by bigger solar energy quantities.

The comparative analyze of the exposure and solar radiation maps, reveal that the abundant solar radiation is registered on the slopes with southern exposition, from the northern part of the area (*Bunești, Armășeni, Roșiori, Arsura and Pâhnești sites*) and at the southern limit (*Averești- Plopi site*). *Insolation.* For more than 89% from the planted area, the useful insolation (01 April - 30 September) vary between 1600 and 1773 hours/year, while the minimum requirements for the vine culture is 1200 hours/year. The major values of the useful insolation (1700-1773 hours/year) are registered on the slopes with

southern and eastern exposure from the Bunesti, *Armășeni*, *Roșiori*, *Arsura* and *Averești Plopi sites* (fig. 8).

*Annual precipitations* vary between 558.1 and 574.9 mm/year and they have a rather homogeneous distribution in the studied area (fig.9). The maximum values are registered on the northern limit of the area (*Bunesti*, *Armășeni*, *Roșiori*, *Arsura sites*), and the minimum ones at the southern limit (*Averești – Plopi site*). In the years with lack of precipitations, droughty stress could appear in the sloping areas from the southern part of the area (*Averești-Plopi site*).



**Fig. 9.** Precipitations map, Averești vine growing centre

## CONCLUSIONS

1. Geographic Information System (GIS) allow an accurate analyze of the ecological factors from the vine planted areas.

2. Knowledge of the spatial variation of the ecological factors offer the possibility to evaluate the suitability of different areas (vineyards, wine-growing centers) for wine production, even of the little surfaces (*farms, parcels*).

3. The data regarding the values and spatial variation of the thermal and solar factors (*temperature, solar radiation, insolation*) are useful to select the suitable grapevine varieties and locate them in the most suiting locations.

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*The research reported in this paper was financed by the U.E.F.I.S.C.S.U., through the research contract CNCSIS 1141, PCE Program.*