Towards a spatial analysis of antique viticultural areas: the case study of Amos (Turkey) and some other places

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ABSTRACT
Interpretation of ancient texts, such as the Amos epigraphic farming leases, questions both locations and spatial extents of the viticultural area, as well as soils, landscapes, cropping methods and the quality of grapes in the antique Greece. These issues may be partially answered undertaking spatial analysis of soils and landscape of the present day through digital morphometric and multispectral satellite data. This paper aims at discussing the possible locations of the Amos antique district and identifying the additional data and methodological developments that will be needed for a further zoning of its componing terroir units. It compares the viticultural and geographical details given in the leases prescriptions with a preliminary spatial analysis of the Amos region (Bozburun peninsula, southwest Turkey) using digital morphometric ASTER GDM data and Landsat ETM+ satellite data. The viticultural prescriptions in the Amos epigraphic farming leases discriminate between vineyards grown in "plain" and vineyards grown in "rocky terrain". Considering both distances to coast, distances to the Amos cape, regional morphology, geology, present land use together, we consider that the antique Amos vineyards were located along the coastline in the Kumlubük bay at the foot of the Amos cape. Some other antique places are also discussed with a spatial analysis perspective.

Keywords: antique vineyards, terroirs, spatial analysis, ancient texts, Aegean world.

1 INTRODUCTION

Interpretation of ancient texts, such as the Amos epigraphic farming leases, questions both locations and spatial extents of vineyards, as well as soils, landscapes, cropping methods and the quality of grapes in the antique Greece. These issues may be partially answered undertaking spatial analysis of soils and landscape of the present day through digital morphometric and multispectral satellite data. The potential of satellite imagery as a technique of archaeological site characterization or even prospection has long been undervalued (1). To our knowledge, remote sensing has never been used for the purpose of reconstructing archeological viticultural landscapes. Archeological prospections conducted in Southern France (2) excavated traces of pre-Roman vineyards. Archeobotanical remains can provide unequivocal evidence of ancient vine cultivation, as this was the case in the Roman site of Gasquinoy, Southern France (3). As it proved useful for the purpose of demarcating existing viticultural terroirs (4, 5), remote sensing could be used in combination to both conventional archeological prospection and archeobotanical approaches. Terroir can be defined as a spatial and temporal entity with homogeneous or outstanding grape and/or wine, soil landscape and climate characteristics, at a given spatial level and over a given duration, within a territory marked by social context and cultural technical choices (4). Terroir zoning requires a comprehensive set of spatial data about viticultural environments, including viticultural data or, at least, knowledge about distinct grape qualities according to positioning in geographical space.

This paper draws a first attempt to address the issue of antique viticultural terroir characterization. We propose to discuss the possible locations of the Amos antique vineyards (Kumlubük bay, Southern Turkey) and identify the additional data and methodological developments that will be needed for a further terroir zoning. Some other antique places are also discussed with a spatial analysis perspective.

2 MATERIALS AND METHODS

2.1 Study area

Amos (modern Kumlubük) is located in the Bozburun Peninsula in southwestern Turkey, about 40 km north to the city of Rhodes (Greece). The antique Amos, which pertained the Athenian alliance in the Vth century B.C., is well known from its steles describing farming leases, which were found near Hisarbunu in the Kumlubük bay by G.E. Bean in 1948. This epigraphic material has been published by Fraser and Bean (6), then interpreted by other authors (7, 8, 9, 10). The inscriptions attest to the granting of leases on land by the commonalty of the Amians to certain individuals.

2.2 Geographical and historical data

The available material to discuss locations of the Amos antique vineyards were epigraphic data, literary data from both the Roman Antiquity and the Byzantine Period, and a set of geographical data (geological maps, geological studies, satellite images, digital elevation data, ground landscape observations). The general methodology consisted in relating translated information from both Amos farming leases and the antique literature to the environmental characteristics

in the vicinity of Amos, through a spatial analysis of the available geographical data so as to propose possible locations for ancient vineyards and discuss antique terroir units.

Geological interpretation relied on available literature about the Lycian Taurus (11, 12) and particularly those mentioning the Bozburun Peninsula (13, 14). The soil data are lacking, so that edaphic characteristics were roughly inferred from general rules of soil genesis in Mediterranean regions, according to morphologic units and substrate lithology (4, 15, 16). The assessment of the viticultural area location and extent relied both on examining the Amos leases and the most probable edaphic constraints. Vine grows in a wide range of environments (4, 17, 18), except for soils with metal toxicity, constant hydromorphic conditions (water table) or the presence of salts. Both extreme low temperatures leading to frost risk and high temperatures giving rise to highly drought conditions are also unfavorable, though not impossible.

Present landuse was derived from the digital processing of an ETM+ Landsat image of 14 September 2006 with 30 m-resolution. The aim of such landuse mapping being to give a rough preliminary idea of the cropland extent vs other landuse categories, the classification performance was evaluated from visual interpretation of additional observation sites. Relief attributes such as elevation, slope and aspect were derived from a 30-m resolution DEM (ASTER GDM).

3 RESULTS AND DISCUSSION

From the farming leases recommendations about planting geometry and planting intervals, use of agroforestry association with fruit production (figs, olives) and intercalary crops, soil management and training systems and additional assumptions about the distinct characteristics of either flat or rocky environment were inferred (table 1). Vineyards were planted in the vicinity of woods or bush. The main actual landuse, covering 60% of the mapped area, is forest or bush, whereas the actual croplands cover less than 2.5% of it. Many fields located in steep slopes were abandoned in the last decades. The ancient viticultural area developed in situations where bush or forest can be found today.

Table 1. Leasing criteria according to viticultural environments and assumptions about their distinct characteristics.

Leasing criteria	Viticultural environment	
	"Plain"	**"Rocky terrain"**
Planting geometry	square	square
Crop association	vine/figs/intercalary crops	vine/figs/intercalary crops
Planting density	4100 vines/ha	7000 vines/ha
Soil management	organic manure	organic manure
"soil surface"	coarse fragment content null or low	high coarse fragment content
fertility	high	low
slope	null or low	high

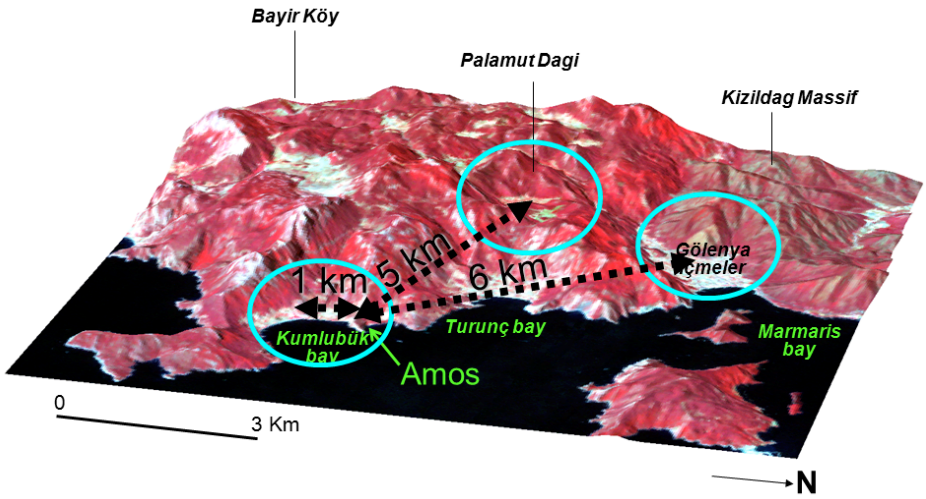

Figure 1. 3D-view of the Amos region with possible locations of antique vineyards (Landsat and DEM available from the U.S. Geological Survey).

The location of the ancient viticultural area has long been argued, some authors pointing out the plain of Gölenya (19), other the mountain back of the Turunç bay (20), other the alluvial plain alongside the coast of Kumlubük bay (21) for topographical grounds (figure 1). Rather than topography only, both the topographical and edaphic constraints shall be considered together with the transportation constraints

that may have occurred when carrying grapes or must from vineyard to cellar. “Flat areas”, that is to say with null or low slope between 0 and 4%, cover 4.9% of the studied lands only, whereas nearly 64% of these lands are very steep slopes higher than 24%. The remaining topography covering about 31% of the studied lands is likely to be managed into cultivation terraces, provided that elevation, aspect and soils are compatible with vine cultivation. It may be the case in surrounding bays, where some cultivation terraces are still visible in the present time. The highest mountain top reaches 836 m and 25% only of the total pixels are higher than 459 m. About 30% of the pixels are located in plateaus higher than 420 m. Although such elevations, which correspond to cooler temperatures, do not impede vine cultivation, the lower parts of the landscape are more likely to favor grape ripening, whereas the higher plateaus could, else, be occupied by sylvo-pastoral systems.

The Rhodian Perea pertains to the Lycian Taurus which is composed Mesozoic thrust sheets (14), including limestones which are likely to be parental substrates for shallow red “terra rossa”. Unless managed into terraces, steep slopes are more likely to result in shallow soils. North to the Turunç bay, the soils originating from the ophiolitic nappe are likely to develop high levels of potentially phytotoxic metal elements together with acid soil solutions (22). Therefore, the Kizildag Massif (figure 1) can be excluded from the possible locations for the Amos vineyards.

The vineyards were closely controlled by the authorities. Wines from Amos, although less famous than those from Thasos and Chios (23), were aimed at export. Both controls and export by sea should be easier at distances shorter to both the coast and the Amos cape. Whether the grapes were vinified near the field or carried to distant wineries, transportation should reasonably not exceed some kilometers. The Kumlubük bay, which is closest to the Amos cape (about 1 km from the promontory top to the center of the Kumlubük bay), comprises both rocky terrain and flat or low-sloping areasand is therefore the most probable location for the ancient Amos vineyards. Its possible extent can be assessed excluding zones with both slopes higher than 24% and forest landuse (bush not excluded), that is to say 200 ha.

If so, how to validate this presumed viticultural area of ancient Amos? Assuming that grape yields were lower than 30 hl/ha, such extent could correspond to a yearly wine production lower than 6000 hl. Both exported wine volumes and the ratio between exported and locally-consumed wines in ancient Amos are unknown. The ancient landscape was very different from that of the present time, as also observed in the Aegean Archipels (23, 24). However, the present landscape still contains evidence of past terrace cultivation inherited from long ago. Very high resolution images could enable to detect abandoned cultivation terraces. Field prospection should enable to locate dry stone terrace walls. Archeological prospection is of course expected and could enable to find remains of antique cellars and wineries, or even ancient vineyards.

The presently available data do not enable to characterize potential terroir units in a satisfactory and fully rationalized way. Soil information is needed in order to characterize those terroir units, particularly water storage capacity, soil depth, water regime, together with possible long-term erosional effects.

Amos prescriptions about planting geometry shall not be considered independently from the associated crops, whereas the present day viticulture is a monoculture. Each prescription begins with specifying the tenant’s name and the field localization, so that its genericity is debatable. Another unsolved question deals with the possible fluctuation of the sea shore due to neotectonic activity, through high magnitude earthquakes (13, 24). Both tectonic and agrarian changes over the last 10000 years need to be considered for the whole Cycladic region (24), some islands of which are renowned for their antique wines through ancient texts, such as Naxos, Thera, Chios and Lesbos (23).

4 CONCLUSIONS

This was an exploratory phase prior to a further prospection phase, for which the acquisition of soil information and remote sensing data of higher spatial resolution is needed. The spatial analysis of easily available morphometric and satellite data over an ancient site nevertheless contributed towards reasoning the possible location of the ancient viticultural area. Spatial analysis of current landscapes does both revive and enrich questioning about viticulture at the time of the antique Amos. Even without comprehensive soil and viticultural information, spatial data bring more detail than the prescriptions do, and raise the problem of further spatial validation of the antique viticultural area through either epigraphic, literary or archaeological data.

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L'histoire du « Vin des Abymes » sur les pentes reconquises du Mont Granier suite au glissement de 1248 (Savoie, France)

Historical reconquest of hillslopes by the "Vins des Abymes" after the collapse of Mont Granier in 1248 (Savoie, France)

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ABSTRACT
The vineyards extending between the hillslopes of 'Apremont' and 'Les Marches' that dominate the valley of Chambéry (Savoie, French Alps) define the terroir of the 'Vins des Abymes'. The particularity of this terroir is directly related to the chaotic morphology of the hillslopes formed by one of the largest landslides ever to occur in the Alps. In November 1248, the collapse of the Mont Granier cliff, which lost nearly 900 m in height, caused the displacement of more than 500 million m3 of mud and rocks extending downslope over about 30 km2. This landslide entirely 'reset' the soils of the original hillslopes, but also generated chaotic morphologies (locally called 'mollards'), over which vine stocks have been planted.
Even if vine-growing was attested before 1248, the terroir of the 'Vins des Abymes' is specific to the soils affected by the landslide which therefore only existed after 1248.
These hillslopes remained abandoned until the early fourteenth century, and were then gradually occupied by agricultural activities and by vine-growing. The study of the construction of this terroir is made possible by the first modern cadastral survey, 'La mappe sarde', an exceptional document drawn up in the then Kingdom of Savoy, in 1713. It shows the extension of the vineyards in the early eighteenth century and confirms that territorial organization is linked to wine-growing practices. It also highlights the presence of many temporary shelters scattered throughout the vineyard, called 'sartos' and shows that the geometry of the plots and the road network are adapted to the rugged slopes. The history of the construction of this landscape gives a strong identity to this terroir, from both geological and human perspectives.

Keywords: collapse, local wine, vineyard development, vineyard historical construction.
Mots-clés : écroulement, terroir viticole, aménagement viticole, construction historique des vignobles.

1 INTRODUCTION

Les appellations « Vin d'Apremont » et « Vin des Abymes » sont parmi les plus connues des Vins de Savoie. Ces terroirs viti-vinicoles dominent la vallée de Chambéry au pied du Mont Granier et s'étendent sur les communes d' « Apremont », « Les Marches », « Myans » et « Chapareillan » dans les Alpes françaises. La vigne s'impose en une quasi-