

PERSPECTIVES ABOUT THE ANALYSIS OF ROMAN VITICULTURE IN GUADALQUIVIR ESTUARY.

PERSPECTIVAS SOBRE EL ANÁLISIS DE LA VITICULTURA ROMANA EN EL ESTUARIO DEL GUADALQUIVIR.

PEDRO TRAPERO FERNÁNDEZ

pedro.trapero@uca.es

UNIVERSIDAD DE CÁDIZ¹

ABSTRACT

The analysis of roman agriculture in the ancient estuary of Guadalquivir river, specially about viticulture, require a previous studies for determinate which could be the better places to plant vineyard. Using a Geographical Information System (GIS) and the literary information of Columella, it is possible to do an approach to this knowledge, in the territory of *Hasta Regia* colony.

KEY WORDS: GIS, viticulture, Columella, Roman agriculture, *Hasta Regia*.

RESUMEN

El análisis de la agricultura romana en el antiguo estuario del río Guadalquivir, especialmente la viticultura, requiere de unos planteamientos previos para poder determinar cuáles podrían ser los lugares idóneos para este cultivo. Mediante la utilización de un Sistema de Información Geográfica (SIG) y la información literaria contenida en Columela, es posible hacer una aproximación a este conocimiento en un territorio como el de la colonia de *Hasta Regia*.

PALABRAS CLAVE: GIS, viticultura, Columela, agricultura romana, *Hasta Regia*.

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1. Introduction

I want to express in this study a proposal about the location of potential places where vineyards used to be planted. The information needed for that is located in the ancient sources, especially Columella's books *de re Rustica*, by their origin in *Gades* and because he is the best latin agronomist who wrote about the vineyard and most of their quotes are specifically about the territory to study. Through the investigation of some of this references and the comparison with other latin agronomists or other sources, it is possible to know which are the most important natural conditions to place a vineyard. This hypothetical study placed in a specifically framework, where the conditions could be fulfil, allows us to locate this spaces, using a Geographical Information System.

The framework would be the lower Guadalquivir (south of Spain) especially focused on the territory of one important roman colony, *Hasta Regia*. The limits of the study are larger because it is unknown the real *territorium* of *Hasta* and for that the limits are big enough for cover the maximum extension possible. It is important to consider in the land the ancient estuary of Guadalquivir, a place called by the romans, *Lacus Ligustinus*². This navigable space allowed them to reach places which nowadays are not even near the coast. For the territory study I use some limits between the presumption of *lacus Ligustinus* the actual coast and on the East by the Guadalete River (Fig. 1)³.

² L. LAGÓSTENA BARRIOS, "La percepción de la ribera en la costa atlántica de la *provincia Hispania Ulterior Baetica*. El *lacus Ligustinus*", E. HERMON, A. WATELET (Eds.), *Riparia, un patrimoine culturel. La gestion intégrée des bords de l'eau*, 2014, 187-197.

³ H. GOODCHILD, "GIS models of roman agricultural production", A. BOWMAN, A. WILSON, (Eds), *The roman agricultural economy: organization, investment, and production*, 2013, 55-86.

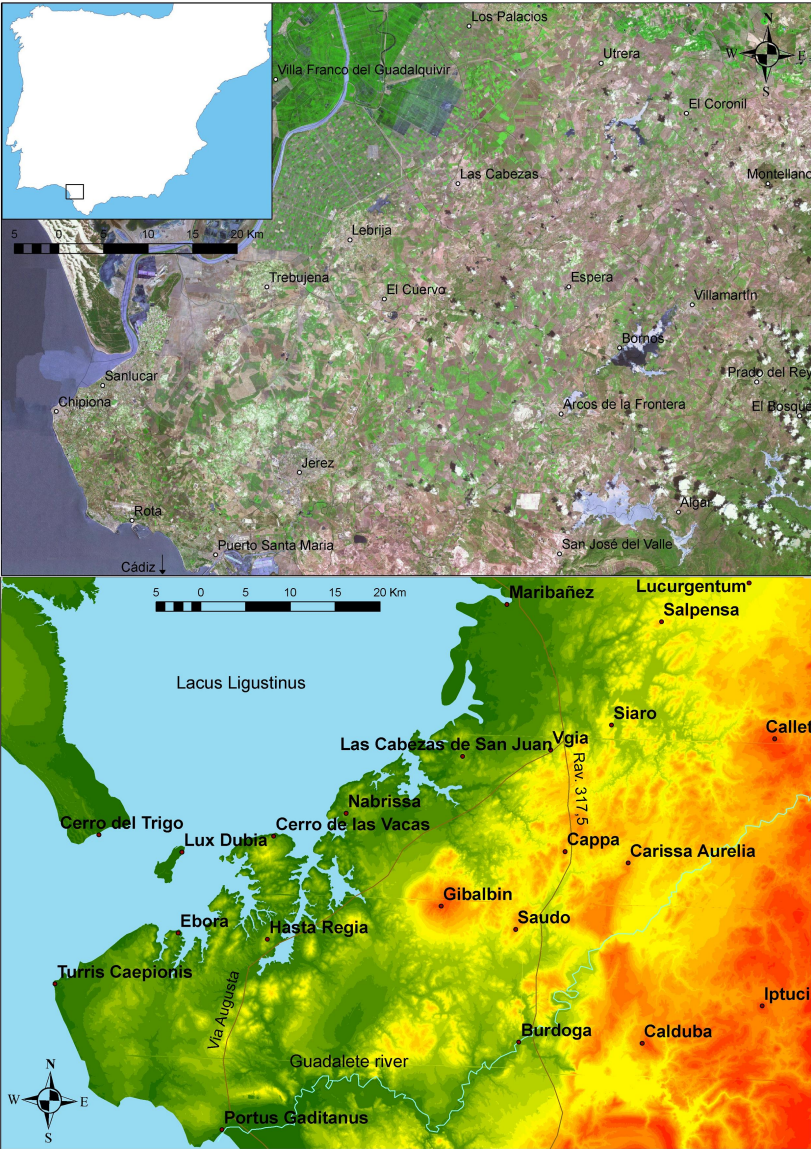


Fig. 1. *Actual Framework and ancient Guadalquivir's estuary, roads and settlements.*

The vineyard agriculture in the *Uterior Baetica* province is one of the most important activities, but it isn't well studied in contrast with other products like oil. The problems about vineyard and wine in the area are that we don't know the production emplacements and in the same way, the potteries *figlinae* where the betic wine amphoras were produced it is unknown⁴. The places where they produced vine or amphoras would be a priority in the future research of the colony of *Hasta*. For that issue we will develop which are the main conditions or criteria that agronomists named as most important in their books, analysing and considered it in contrast with the actual geographical information, using for that issue the tool ArcGIS in order to create cartographical information for future prospections, based on the technical realization⁵, to specifically analyze the correct interpretation of the sources.

2. Natural and Historical Conditions

2.1. Soil Types

The first criterion is the soil type. Cato didn't show great interest in this matter, further than choose a good soil⁶. Varro considered three different soils but not about the ground nature,

⁴ C. CARRERAS MONFORT, "Producción de Haltern 70 y Dressel 7-11 en las inmediaciones del Lacus Ligustinus (Las Marismas, Bajo Guadalquivir)", *Congreso Internacional Ex Baetica Amphorae. Conservas, aceite y vino de la Bética en el Imperio Romano*, Ecija 2001, 419-426; E. GARCÍA VARGAS, "Las ánforas del vino Bético altoimperial: formas, contenidos y alfares a la luz de algunas novedades arqueológicas", D. BERNAL CASASOLA, L. LAGÓSTENA BARRIOS (Eds.) *Figlinae Baeticae talleres alfareros y producciones cerámicas en la Bética romana* (ss. II a.C. – VII d.C.), 2004, 507-514.; T. SILVINO, M. POUX, "Où est passé le vin de bétique? Nouvelles données sur le contenu des amphores dites « à sauces de poisson et à saumures » de types Dressel 7/11, Pompéi VII, Beltrán II (Ier s. av. J.-C.-IIe s. apr.J.-C.)", *Sfecag*, 2005; about the potteries problematic: L. LAGÓSTENA BARRIOS, *La producción de salsas y conservas de pescado en la Hispania romana (II a.C.-VI d.C.)*, Barcelona 2001, esp. 261-270.

⁵ P. TRAPERO FERNÁNDEZ, "Roman Viticulture analysis based on latin agronomists and the application of a geographic information system in lower Guadalquivir", *Virtual Archaeology Review*, 7 (14), 2016, 53-60.

⁶ Cato *Agr.* 1.1.

instead about elevation, plains, slopes and mountains⁷. Columella did a reference connected with the zone, because he refers to his uncle, natural of the *Baetica* province, ...*to heap clay on gravelly ground, and gravel on ground that was clayey and too stiff, and in this way to grow not only luxuriant crops of grain but also very fine vineyards*⁸.

His uncle used these two types of soils, that need to exchange and mix each other, for get a good quality. We are going to define what exactly the latin text said. There are two soils types, *sabulum* and *cretam*, also two characteristics of the land *sabulosus* and *cretosus*. *Sabulum* is gross sand, because for sand there is other word, *saburra*. The adjective of *sabulosus* it is referred to a sandy land not clay or gravel like in the translation before. About this type it is known the vines in sand a variety of the roman vineyard, and also we have by the archaeology some ditches of vines that could be this type of plantation in one of the studies in the area⁹. The word *cretam* (*creta*) it is referred to loam not gravel, specifically because gravel is *glarea*¹⁰. Loam soil *cretosus* (*cretosus*) is a mix of sand, clay and silt. Also Varro wrote about *creta* in a passage based on his experience, when he had been in *Gallia* and had seen enriching the soil with quarry loam¹¹. It is in Virgil where we can see the difference between these two terms *glarea*

⁷ Varro. R.R. 1.6.

⁸ Col. 2.15.4. *Marcum Columellam patrum meum, doctissimum et diligentissimum agricolam, saepe numero usurpasse memoria repeto, ut sabulosus locis cretam ingereret, cretosis ac nimium densis sabulu, atque... ligone succident, vim optimaee stercorationis exhibebit. Succidi autem lupinum sabulosus locis oportet, cum secundum florem, lubricosis, eum tertium egerit.* The English translation about this text and the followers: COLUMELA, *De re rustica*, by H.B. ASH, Loeb Classical Library, vol. 1-3, 1977.

⁹ J.J. LÓPEZ AMADOR, J.A. RUIZ GIL, “Arqueología de la vid y el vino en El Puerto de Santa María”, *Revista de Historia de El Puerto*, 38, 2007, 11-36.

¹⁰ Gravel in Vitruvius and Columella: Vitr. 1.4.2; 8.1.2; Col. 2.2.10.

¹¹ Varro. R.R. 1.7.8: *In Gallia transalpina intus, ad Rhenum cum exercitum ducerem, aliquot regiones accessi, ubi nec vitis nec olea nec poma nascerentur, ubi agros stercorarent candida fossicia creta...*

for gravel and *creta* for loam both used in the same paragraph¹². Those two best soils seem to be like two of the common and better soils in the province¹³, “albarizas” (Regosoles) y (Luvisoles) “arenas”¹⁴.

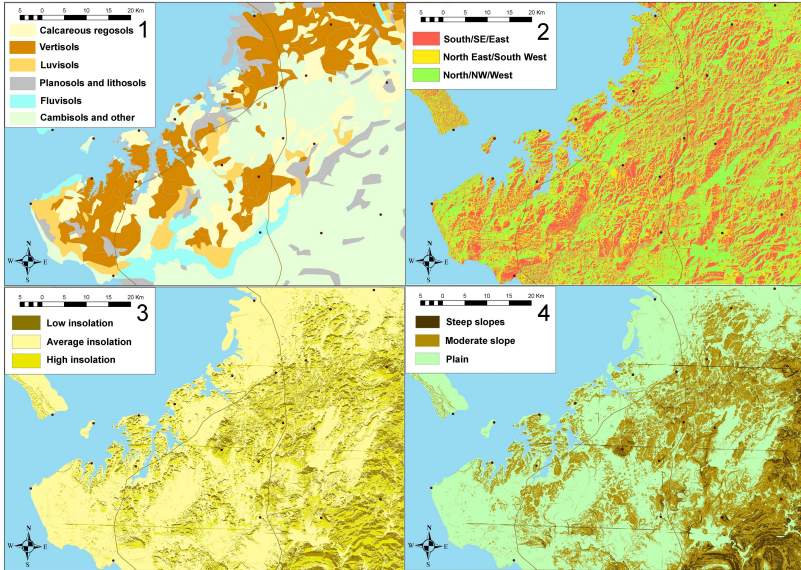


Fig. 2. Soils types (1); Orientation according to winds (2); Orientation according to insolation (3); Land slopes (4).

¹² Verg. G. 2.215: *nam ieiuna quidem cliuosi glarea ruris uix humilis apibus casias roremque ministrat; et tofus scaber et nigris exesa cheydris creta negant alios aequae serpentibus agros dulcem ferre cibum et curuas praeberere latebras.*

¹³ <http://www.eweb.unex.es/eweb/edafo/>

¹⁴ These relation was doing by P. SÁEZ FERNÁNDEZ, “Sobre algunos tipos de tierras víticolas de la Bética”, *Actas I Congreso Peninsular de Historia Antigua*, Santiago de Compostela 1986, 221-231; P. SÁEZ FERNÁNDEZ, *Agricultura romana de la Bética*, Sevilla 1987; P. SÁEZ FERNÁNDEZ, “El vino en la Bética romana”, J.J. IGLESIAS RODRÍGUEZ (Ed.), *Historia y cultura del vino en Andalucía*, Sevilla 1995.

“Perspectives about the analysis of Roman viticulture in Guadalquivir estuary”

The other criteria is Columella's reference to marshland vines, ...*used to employ this method of preservation on the farms where he had vineyards on marshy ground...*¹⁵ The adjective *palustres* (*paluster*) in ancient sources are associated with wetlands. Columella instead uses this word to design a place with plenty of water, not specifically marshland. The meaning is the opposite of dry soil and also he distinct between a marshland and a flooded area¹⁶. Vines not often want wet soils¹⁷ and for that this type would be refers to a soil characteristic, a type of ground that could be flooded in some months of the year, like the vertisols (bujeo). Columella in his fifth book spoke about the use of holes for plant vines and also said that it was not recommended in wet or rainy area, like Betic province could be, because it could damage the plant by the excessive water¹⁸.

There are other soils types in the area some could be bad for the vines like litosols, typically in mountains, or planosols commons in marshland soils both useful for cattle. The fluvisols are a soil that appears near a river formed by alluvial deposits, and can be used for vines and for other types of agriculture, specially in irrigated agriculture. The last one is cambisols good soils in general, useful for all cultivations due to for vines as well¹⁹. In fact the best soil types now in the region, seems to be the types

¹⁵ Col. 12.21.4. *Hac conditura Columella patruus meus, inlustris agricola, uti solitus est in his fundis, in quibus palustres vineas habebat...*

¹⁶ Col. 2.11.2. Opposes dry and sunny, to cold and marshy land. In that way the opposite of dry is marshy. *Nam in agris siccis et apricis... In locis autem frigidis et palustribus.* In Col. 1.5.3 *detrimenta palustris, quae pigro lapsu repit; et pestilens, quae in palude semper consistit.* In this fragment about the quality of water types, he contrasts the difference of a flooded area to stagnant water.

¹⁷ J.A. DE CARA GARCÍA, "Características agroclimáticas de la vid", *Agencia Estatal de Meteorología, Servicio de Aplicaciones Agrícolas e Hidrológicas*, 2010.

¹⁸ Col. 5.5.4. *Sic enim putat vitem cogi deorsum agere radices. Hoc ego siccis locis fieri utiliter non negaverim; sed ubi aut uliginosa regio est, aut caeli status imbrifer, minime faciundum censeo. Nam consistens in semiplenis scrobibus nimius humor, antequam convalescant, semina necat.*

¹⁹ E.M. VIITANEN, *Locus Bonus, the relationship of the roman villa to its environment in the vicinity of Rome*, Helsinki 2010, 55-82.

written by Columella. This land types could be analyses in a map to search and weigh this soils (Fig. 2.1)²⁰.

2.2. Land Orientation

Winds

The second criterion is land orientation, Columella told us about the bad winds in the area, a proof that he was known of the territory. That winds like east and south winds, both strong and hot, are nowadays the similar:

“To us it has seemed best to direct in general that vineyards have, in cold regions, a southern exposure, and that in warm ones they face harassed by the south and south-east winds, as are the maritime coasts of Baetica. If, however, your tracts are subjects to the aforementioned winds, it will be better to entrust them to the north or the west wind²¹”.

Cato about the land orientation advises to buy the new farm in a hill and expose to south²² and about the orientation of olives²³, Varro shows less interest in this problematic²⁴, but wrote about the exposure to winds and insolation in the case of farm animals²⁵. It is in Virgil where we could see the right orientation about vines, to south and east²⁶. Columella used the traditional advises, but for a specifically space, like the frame we are studying, he advises to plant in north and west direction to fight the winds back. Nowadays it is known that east winds in Cadiz province are hot and strong, a medium of 60-70 km/h that could

²⁰ <http://www.ideandalucia.es/portal/web/ideandalucia>

²¹ Col. 3.12.6. *Nobis in universum praecipere optimum visum est ut in locis frigidis meridiano vineta subiciantur, tepidis orienti advertantur; si tamen non infestabuntur Austris Eurisque, velut orae maritimae in Baetica. Sin autem regiones praedictis ventis fuerint obnoxiae, melius Aquiloni vel Favonio committentur...*

²² Cato. *Agri*. 1.1.

²³ Cato *Agri*. 8.2. *ager oleo conserundo, qui in uentum fauonium spectabit et soli ostentus erit.*

²⁴ Varro. *R.R.* 1.4.4.

²⁵ Varro. *R.R.* 2.2.6, 2.3.7.

²⁶ Verg. *G.* 2.185 y 2.295.

damage and dry off the vines. Also the wind of the south comes from Africa, winds that are extremely hot in summer. It is possible to study the susceptible zone of these winds, by a territorial study (Fig. 2.2)²⁷.

Insolation

The third criterion to consider is about the insolation the terrain-ground receives, *The bad qualities of a place which usually bring vineyards to destruction are meanness and barrenness of soil, salty or sour marshland, a steep and rugged situation, a valley that is too dark and not exposed to the sun...*²⁸, especially the places affected by shadow.

Both Cato and Varro wrote about the insolation, Varro quotes Cato in the use to plant elms and poplar to north in order not to overshadow²⁹.

About this quote it is not necessary to explain the importance of sun, but curiously it is bad for vines a place with a lot of water or salty, that we see before in the case of *palustre*, and a high steep, that will be the following criterion. It is important the insolation in contrast with the wind orientation, because there are in our frame diametrically opposed. A vineyard oriented to south, with good insolation, could be damage by the winds and in a north side of a hill, could not get enough insolation (Fig. 2.3)³⁰.

2.3. Land Slopes

The fourth criterion is based in land slope. The terrain slopes present in Varro *Owing to these three types of configuration*

²⁷ For this we used a terrain model MDT and the tool in Spatial Analysis Tools/Surface/aspect with a reclassification in three zones, the south east, the north-west, and northeast and southwest that are in the middle.

²⁸Col. 4.22.8. *Loci porro vitia sunt, quae fere ad internecionem vineta perducunt, macies et sterilitas terrae, salsa vel amara uligo, praeceps et praerupta positio, nimium opaca et soli aversa vallis...*

²⁹ Cato *Agri*. 6.3. Varro *R.R.* 1.24.3.

³⁰ Tool Surface/hillshade. In the reclassification there aren't bad many bad places because of the orography, mostly plain.

*different crops are planted, grain being considered best adapted to the plains, vines to the hills, and forests to the mountains*³¹, and with the same idea Columella *But if your own wishes are to be considered in the selection of site and climate for your vineyard, is the best soil... neither flat nor steep, but like plain-land with a rise...*³² The idea is that hills are preferably for grown vineyards in a medium slope, non in a plain and either in a high slope. The first one is better for plant wheat and the second one for cattle (Fig. 2.4)³³.

2.4. Proximity

Until now the criteria were historical but at the same time they had relationship with land characteristics. Now the fifth criteria is more historical based in nearness. Since Cato we could see that idea *si poteris, sub radice montis siet, in meridiem spectet, loco salubri; operariorum copia siet, bonumque aquarium, oppidum ualidum prope siet aut mare aut amnis, qua naues ambulant, aut uia bona celebrisque...*³⁴ As we can see in the text, there are in fact four characteristics of nearness, a city, a way out of a waterway, a road and nearness of water. All this conditions are common in all agronomists, because we know the model of *villae*, bigs agricultural holdings with a lot of slave workforce that allows them to export large market surpluses³⁵.

³¹Var. R.R. 1.6.5. *Propter haec tria fastigia formae discrimina quaedam fiunt sationum, quod segetes meliores existimantur esse campestris, vineae collinae, silvae montanae.* Text from <http://www.perseus.tufts.edu/>

³² Col. 3.1.8. *At si voto est eligendus vineis locus et status caeli, sicut censet verissime Celsus, optimum est solum nec densum nimis nec resolutum, soluto tamen propius; nec exile nec laetissimum, proximum tamen uberi; nec campestre nec praeceps, simile tamen edito campo; nec siccum nec uliginosum, modice tamen roscidum.*

³³ Tool surface/slopes and a reclassification of the results.

³⁴ Cato *Agri*. 1.3.

³⁵ E.M. VIITANEN, *Locus Bonus...* pp. 151-158.

Proximity: emplacements

The first one is staying near to a city or other important places³⁶. Columella advises us the importance of proximity not only for the market provided by a city, but also the good management of the owner, *I am of the opinion, therefore, that land should be purchased nearby, so that the owner may visit it often and announce that his visits will be more frequent than he really intends them to be...*³⁷

Columella wasn't spoken about cities, but in the quote he referred that the field must be near the owner, who lives in the city. This condition may not be fulfilled, because as when he writes his book, Columella precisely aims to teach how to be a good farmer and one of the conditions is to manage the properties directly. He was very critical about their contemporaries, because they didn't manage their land by them self and gave the control to an others, free or slave and for that, we could considered that this maybe wasn't fulfilled³⁸. Anyway the nearness of a city is an important criterion to place a plantation for the market, not specifically about vines, but maybe about fresh grapes and of course other products (Fig. 3.1)³⁹.

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Proximity: roads

About the terrestrial communication Columella advises not to be near an important roadway because of many people circulate there and between them criminals and passers. Neither Cato and Varro wrote about this question. Columella said not be too close to the road but enough for product's transportation, *The highway, moreover, impairs and estate through the depredations of passing*

³⁶ E. GARCÍA VARGAS, E. FERRER ALBELDA, F.J. GARCÍA FERNÁNDEZ, "La romanización del bajo Guadalquivir: ciudad, territorio y economía (Siglos II-I a.C.)", *Mainake* XXX, 2008, 247-270.

³⁷ Col. 1.2.1. *Censeo igitur in propinquo agrum mercari, quo et frequenter dominus veniat et frequentius venturum se...*

³⁸ Col. Praef.; R. MARTIN, *Recherches sur les agronomes latins et leurs conceptions économiques et sociales*, Société d'édition Les Belles Lettres, Paris 1971, 343.

³⁹ The map only considered the orography of the land using a Cost Distance tool.

*travellers... For these reasons my advice is to... place the villa neither on a highway nor far from a highway...*⁴⁰

In the spatial framework it is known two important roadway, the first one is the *via Augusta* and the second is mentioned by Ravenna Cosmography a road, that went from *Hispalis* to *Baessipo* (Fig. 3.2)⁴¹.

Proximity: sea and rivers

At the same way the nearness of a road or navigable waterways were important because the transportation was one of the activities that increased more the price of the final product⁴², *we shall have a farm in a healthful climate, with fertile soil... not far from the sea or a navigable stream, by witch its products may be carried off and supplies brought in*⁴³.

The navigable communication seems to be very important, particularly for sold these products to other provinces, but also for medium communications. Always would be prefer to use a navigable route, cheaper than others like terrestrial transportation more expensive. The fluvial and maritime communication could be effectuated by the *Lacus Ligustinus*, the actual coast and the Guadalete river. The method to do the map is the same as above and will be the same for the following one (Fig. 3.3).

⁴⁰ Col. 1.5.7. *Haec autem praetereuntem viatorum populationibus et adsiduis devertentium hospitium infestat rem familiarem. Propter quae censeo eius modi vitare incommoda villamque nec in via nec a via procul editiore situ condere, sic ut frons eius ad orientem aequinoctialem directa sit.*

⁴¹ Rav. 317.5; P. SILLIÈRES, "Prospections le long de la Via Augusta", *Habis* 8, 1977, 331-344.

⁴² P. SILLIÈRES, "Voies d'eau et essor économique de l'Hispanie, Vías marítimas, fluviales y desarrollo económico de Hispania", *Zephyrus* 53-54, 2001, 333-342; P. SOTO, C. CARRERAS, "Gis and network analysis applied to the study of transport in the roman Hispania", *CVIII CLAC: centro y periferia en el mundo clásico*, Mérida 2014, 733-738.

⁴³ Col. 1.2.3. *Quod si voto fortuna subscribit, agrum habebimus salubri caelo, uberi glæba, parte campestri, parte alia collibus vel ad orientem vel ad meridiem molliter devexis; terrenisque aliis atque aliis silvestribus et asperis, nec procul a mari vel navigabili flumine, quo deportari fructus et per quod merces invehiri possint.*

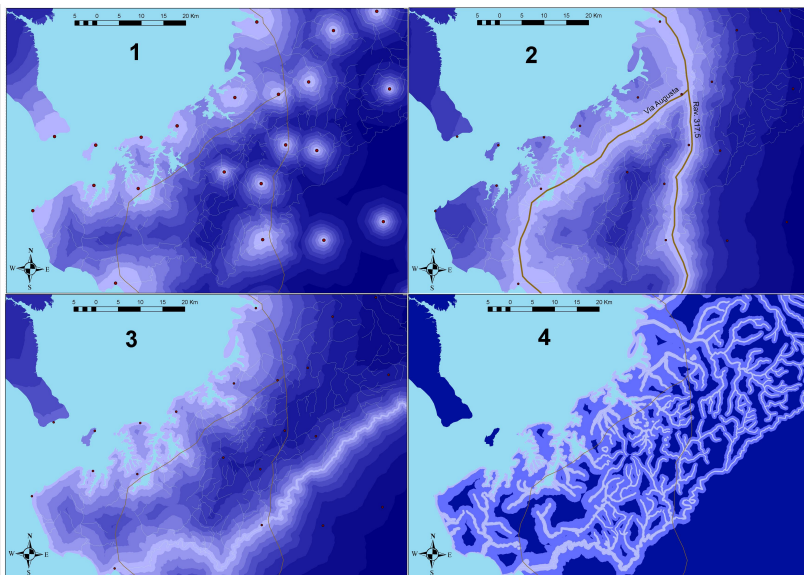


Fig. 3. *Costs distance: settlement (1); roads (2); sea and river (3); hydrography (4).*

Proximity: water supply

The last factor to consider is the nearness of water, but not specifically for consumption or cattle, also by the necessity of some kind of crops; plants like cane, osier and rushes that are related with the crop of vineyards⁴⁴.

“Inasmuch as we have discussed those matters which it seemed could be taught to advantage for the establishing and cultivating of vineyards, a method must be set down for the provision of props, frames, and withes. For these are prepared beforehand, as dowries, so to speak, for the vineyards. And if the farmer is destitute of these, he has no reason for making vineyards, since everything that is needed will have to be sought outside the farm; and, just as Atticus says, not only does the cost of purchase put a burden upon

⁴⁴ E.M. VIITANEN, *Locus Bonus...* pp. 105.

the accounts of the overseer, but also the procuring of them is a very great annoyance”⁴⁵.

They are necessary for a good production and could be a useful resource. These plants in general are associated with rivers, streams, lakes or coast depending if the plant need fresh or salt water⁴⁶. Also by the use of water in watering vineyard, like some of ancient sources told us about in all Hispania, *The courses of the rivers are not violent and rapid, so as to be hurtful, but gentle, watering the vineyards and the plains...*⁴⁷

This criterion is difficult to establish, because there were many places with water in the area and especially because it can be created artificially. For this we only considered the zones that are near to coast, rivers and streams, and consider only three values.

3. Unificating conditions

With this cartographical information, based in historical sources and environmental factors we could combine them to generate a unique map.

For create this cartography we use the tool overlay/weighted overlay. The punctuation used for weighted each map are reclassify from 0-10. The soil types good for vineyards are 10, in front of bad that have 0 and others that could

⁴⁵ Col. 4.30.1. *Quoniam constituendis colendisq[ue] vineis, quae videbantur utiliter praecipi posse, disseruimus, pedaminum iugorumque et viminum prospiciendorum tradenda ratio est. Haec enim quasi quaedam dotes vineis ante praeparantur. Quibus si deficitur agricola, causam faciendi vineta non habet, cum omnia, quae sunt necessaria, extra fundum quaerenda sint; nec emptionis tantum...*

⁴⁶A. ADAM, *Antigüedades Romanas*, Tomo III, 1834, 182-220; E. SÁNCHEZ LÓPEZ, E. GOZALBES CRAVIOTO, “Los usos del agua en la Hispania romana”, *Vínculos de Historia* 1, 2012, 14-19; D. MARTÍN-ARROYO SÁNCHEZ, P. TRAPERO FERNÁNDEZ, “La explotación romana de la vegetación *Riparia* y el análisis espacial de la ocupación rural”, L. LAGOSTENA BARRIOS (Ed.), *Qui lacus aquae stagna paludes sunt...*, Cádiz 2015, 243-260.

⁴⁷ Justin 44.1.7. *In hac cursus amnium non torrents rapidique, ut noceant, sed lenes et uineis campisque inrigui...*

be good but are not refers in Columella with 5. In winds, slope and insolation, the best results are 10 and the worst 0 using a medium category of 5 in case of: a south-west and north-east orientation, plain slopes and zones with medium insolation. For the proximity study, the values are pondered to 0-10 distributing the map in ten bands, using the nearness zone of rivers, cities and others with maximum punctuation. In case of the road, the first band nearness of roads are 9 in punctuation, in front the second band less near with 10, because Columella advise to stay near to a road but immediately in the road.

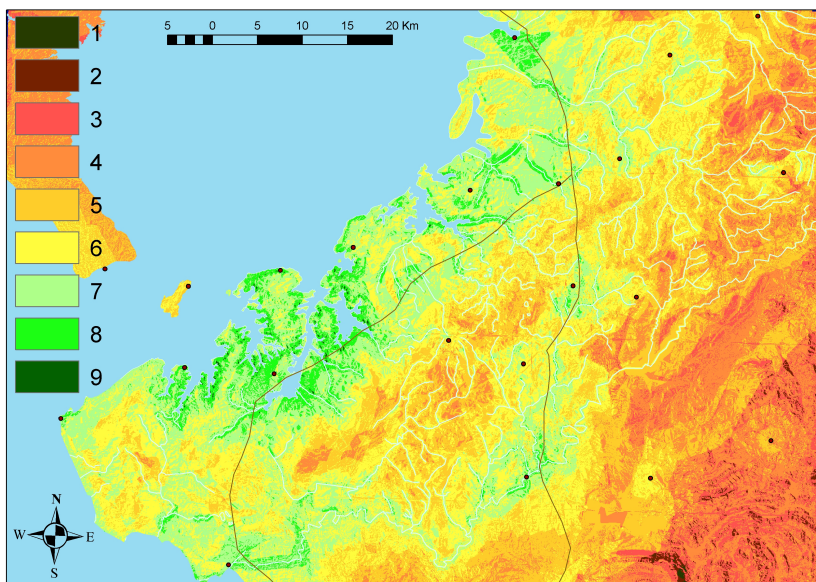


Fig. 4. *Best places for vineyards.*

All this criteria could be weighted from one to nine, in a single map, where we can see the more probability to have vineyards (Fig. 4). All conditions or criteria will be weighted in the new map according the same value, using the same tool. We give the same importance to each, because none of them are completely determinant in the study. For example, the quality of

soil was very important, but if they had a bad soil although near a big point of connection, like a city or important road, they could also cultivate a vineyard there and they could solve this problem, by enriching the soil⁴⁸. Other example could be the Columella quotes about the vines were covered with palm leaves supposedly in places affected by damaging winds⁴⁹. In this case the orientation could be the contrary or at least, a additional protection for the good orientation. The punctuation permit to identify the places where more criteria appeared, but not all of them are necessary, it is the total, the sumatory which Romans would have in consideration and due to that I conclude to use the same weighting for each.

It seems to be important the connexion with the water, not only for drink, especially by the advantage of a communication rout like the sea or a river, but also the exploitation of the riverside plants. This marshland and floodable places not necessarily bad and places to desiccate that could be useful by the resources, especially in the case of the vineyard, were it is necessary this type of plants⁵⁰.

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4. Conclusions

As we can see in the article which quotes of Columella are the most important⁵¹, not only because he refers to the frame studied as natural of *Gades*, also because he is the most complete agronomist about vineyard and in general. Cato and Varro are the

⁴⁸ Col. 2.15. Wrote several options to enriching the soil.

⁴⁹ Col. 5.5.15.

⁵⁰ Col. 4.30.2. *Quare salices viminales atque arundineta vulgaresque silvae, vel consulto sitae [e] castaneis, prius faciendi sunt.*

⁵¹ Other studies like out in similar things, L. LAGÓSTENA BARRIOS, "Columela, de re rustica VIII, 16-17: una fuente para el conocimiento de la piscicultura en Baetica", L. LAGÓSTENA BARRIOS, D. BERNAL CASASOLA, A. ARÉVALO GONZÁLEZ (Eds.) *Actas del Congreso Internacional Cetariae. Salsas y salazones de pescado en Occidente durante la Antigüedad*, Oxford 2007, 109-115.; L. LAGÓSTENA BARRIOS, "Columela: una visión provincial de la uillatica pastio", L. PONS PUJOL (Ed.), *Hispania et Gallia: dos provincias del occidente romano*, Barcelona 2010, 93-108.

bases for Columella, with other authors like Vergil or others we not conserve totally like Mago. Most of the references are based in the experience of Columella or maybe in other lose author that we do not know. In fact, most are notes for Columella's experiences, could be referred to *Baetica* where he grown up, are about the zone near of *Gades*.

The use of this historical information, combined with actual land information for created a map using a Geographical information system, allow us to estimate where are the potential human and natural factors that Romans should chose for place this kind of cultivation. The cartography, in conclusion have a logical answer, the better places are in the ancient coast and near the river side, where the product could be exported. The worst part is in the southeast but it is in the other riverside of Guadalete, and there the result is not real because I do not used the soils, cities, and hydrography, in this other part of the river. Most of the places good are the Jerez frame "Marco del Jerez" an important winegrowing region, and it seems to be that the cultivation of vineyards were also important there in roman age⁵².

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This study can help us to determinate the production places, and it would be a criterion when prospecting the land in future interventions. This works needed for their develop to actualize the current arqueological information in the land, to see if this criteria where good enough. This methodology could help either in other areas about agriculture uses, like oil production, also with potteries, we could know how to places for amphora's production. If we do it in a smaller place, the result should be the same, but with greater accuracy that will help us to choose places for prospecting or excavation.

⁵² The comparative between ancient maps could help to know this evolution, J. G. SUTER. M. PALACIOS Y GUILLEN, *Plano General de los terrenos vinícolas de jerez, Puerto de Santa Maria y Sanlucar de Barrameda*, 1867.

The last point is that this investigation could be exported to other places, the methodology is simple to use to other land, and the only condition is to adapt the criteria like the land orientation. In my study Columella knows perfectly the problem about the east and south winds in this area that will be different in other areas.

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