The wine economy in Roman Hispania. Archaeological data and modellization

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«…Hispaniae coccolobim vocant, rarior uva, aestus austrousque tolerat, capiti inimica, copia larga»¹

Gaius Plinius Secundus, Naturalis Historia XIV, IV, 29

The establishment of a “wine economy” in Hispaniae between the end of the Republican period and the early centuries of the Empire is an essential area of study for various reasons.

Firstly, because of its place in the economy of various territories and its impact on social structures as a particular form of personal enrichment that could lead to the advancement of certain social groups². This impact is determined by the coming together of a set of agricultural, artisan and commercial activities that were organized and coordinated with the aim of producing a surplus for export. These activities, which used complex forms of work, technology and management, influenced the organization of other areas of the economy and the configuration of the territory. In this respect, studying the evolution of the wine economy is a central element when analysing the

¹ “The coccolobis vine in Hispaniae has its bunches less tight. It tolerates heat and southerly winds. Its wine produces headache but the output is very abundant” (commentary on Pliny the Elder’s Book XIV by M. L. Arríbas Hernández, 2010).
social and economic structures of certain regions of the Iberian Peninsula. In particular it may help us to understand their unequal urban development and the wealth of the Hispanian elites, some of whom established strong connections with the central power in the 1st and 2nd centuries AD³.

Secondly, the wine economy is a historical-cultural “indicator”. In most of the publications on *Hispania* that have appeared in recent decades, it is possible to find an image of the cultural change that uses, as one of its arguments, the spread of certain strategies and certain forms of work and technology in agriculture and other spheres. This has enabled the change, sparked by the Roman conquest and encouraged by Roman power, to be defined as a form of historical progress. This is clearly just another (although somewhat more sophisticated) way of presenting Romanization as a one-way process⁴. Certain agricultural products like wine and oil, which occupied a special place in the cultural mindset and in Roman life, thus take on the function of a catalyst, but also the value of a symbol. Their production and consumption, which reached all social groups, would apparently show the *romanitas* of a territory and its communities. In this perspective, hispanic viticulture also provides an interesting historiographic exercise in that studying it helps us to reconstruct some of the ways in which scholarly research has analysed the formation of a provincial society.

The aim of this study is to analyse some aspects of viticulture in *Hispaniae*, in particular those relating to the organization of the winemaking process and artisan production (especially the manufacture of amphorae). The analysis focuses on production technology and transport, the organization of the rural habitats and forms of work and management. We also plan to outline the difficulties of interpreting the evidence in economic and social terms in order to understand viticulture’s place in the global context of the Iberian Peninsula economy.

In this context, the wine economy is understood as a situation that includes all the aspects of production needed to produce wines of various qualities, along with a group of complementary activities related to product distribution. The bibliography is very extensive⁵. The spatial and

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1 It is the case of cities such as *Barcino, Tarraco, Saguntum, Valentia, Hispalis, Corduba*, or *Gades*.


chronological framework proposed covers the Eastern area of Hispania Citerior Tarraconensis and the province Ulterior Baetica between the 2nd-1st centuries BC and the 2nd-3rd centuries AD. In these centuries certain areas of the Peninsula developed a productive economy that was included in the great Mediterranean circuits of exchange, exporting a wide range of resources, agricultural products and manufactured goods. This evidence, rigorously analysed in recent years, enables us to place this provincial viticulture in a wider context. The frame of reference for the analysis is the epistemological and methodological renewal that has taken place in studies of the economy of Rome in recent years.

A HISTORIOGRAPHICAL OUTLINE

Contributions from archaeology over the last few decades have made it possible to gain a deeper knowledge of the history of viticulture in various areas of the Iberian Peninsula. This progress has followed a series of phases, defined by the incorporation of successive categories of documentation. For much of the 20th century the analysis centred on cataloguing literary sources that included references to wine. Not only the various histories of Hispaniae, both general and regional, but also specific studies of its economy have used these sources as the main basis for constructing a geography of production or assessing in purely qualitative terms the importance of Hispanic viticulture. The sparse archaeological evidence in the shape of excavations of villae or pottery workshops was relegated to illustrating the spread of Roman agricultural technology.


9 Revilla, Agrarian Systems, p.121; the root problem is the role given by the traditional economic history to Archeology and their ability to construct general hypotheses; cf. Revilla, Agricultura, pp. 2-3 y 6.
Developments in archaeology from the 1960s made it possible to introduce a new type of evidence: amphorae and their epigraphy. This was soon bolstered by the finding of many pottery workshops, enabling a number of aspects involving technology and work organization to be explored. The advances made have been more visible in some territories than in others: the coastal and pre-coastal areas of Catalonia and the Valencian Community, the lower and middle courses of the Ebro river, the coastal area of Murcia Region, the Andalusian coast and the Guadalquivir valley and so on. However, this progress has brought its own problems. Possibly influenced by the picture given by the literary sources, research initially limited the analysis of each region’s economy to the vicissitudes of a single export product: wine, in the case of the eastern coast of Citerior; and oil in the case of the Guadalquivir. This led at the same time to a generalization of the simplified image of an agricultural economy based on a single crop, an image which is having to be qualified due to the increasingly precise archaeological evidence.

At first, the importance given to easily-identifiable documentation in the archaeological record led researchers to study the circulation and dating of amphorae. This made it possible to draw up the first maps of wine consumption, which were simplistically interpreted as expressing the production capacity of this provincial viticulture. At the same time, identifying the centres of production allowed the first hypotheses to be made regarding the expansion of vineyards. Initially these hypotheses were still based on an analysis of the literary sources, while the archaeological evidence was assessed to complement the written texts. This dependence of archaeology on literature can be seen, for example, in the over-simplifying nature of hypotheses aimed at reconstructing the evolution of viticulture in Citerior between the 1st century BC and the 3rd century AD10.

In recent years the progress on field research has shown itself to be an essential resource for defining the geography of vineyards, since the technological evidence relating to the production and storage of wine or the manufacture of amphorae can, in many cases, be located and dated with great accuracy. However, in this area, also, there is a number of problems with its interpretation. The manufacture of amphorae was part of a wider artisan production process, given that the making of amphorae cannot be taken in isolation from the making of other ceramic products. Artisan topography therefore does not exactly match the location of vineyard areas. Neither does the simple presence of winemaking technology make it possible to systematically specify the exact strategies and forms of production associated with the spread of vineyards over a territory. Not to mention the so-called “local vineyards”, which were used to produce wine for personal consumption or for sale in strictly local markets and which have left little archaeological traces11.

Archaeology’s contribution has been just as essential as regards increasing our knowledge of the rural habitat and of how the territory was occupied and exploited12. Advances in this sphere, helped by renewed methodology and an increase in rigorous excavations, have enabled types of settlement to be identified, distribution patterns to be reconstructed and specific ways of using technology to

be defined\textsuperscript{13}. The new data make it possible to relate how the territory was occupied to specific management and production strategies. In the same context, the analysis of rural artisan centres has been fundamental for understanding the relationships between agriculture and other activities and, ultimately, for perceiving the economic importance of viticulture\textsuperscript{14}.

Nevertheless, it needs to be pointed out that there are a number of problems of an epistemological nature within the general framework of the research. First, no attempt has been made to carry out an in-depth analysis of the impact that the development of a wine economy had on the evolution of Hispanic provinces in the High Empire and, in particular, the consequences this economy may have had for the configuration of the social structure, assuming that it did actually offer real possibilities for personal enrichment and involved transfer of wealth and the concentration of property and resources. Neither was it our aim to carry out a mesoscale or microscale study of the impact that the wine economy may have had on the evolution of certain urban communities\textsuperscript{15}, a situation so out of balance that, a priori, it could deter us from attempting a global analysis of the economic structures of a region or province.

Analysis is also made difficult by the scant development of research into certain areas involving other crops, vegetation and landscape, and by the thoroughly heterogeneous character of this wine economy, which included a range of very different “qualities” and vineyards, from great wines to common wines for domestic consumption. The objectives, the resources invested, the forms of production and management and the possibilities associated with the making of each type of wine were very different. In this context the economic importance of other crops such as cereals should also be assessed\textsuperscript{16}.

Finally, there is no complete study on the importance of exports. The few attempts made so far, including the seminal work of Jordi Miró, are incomplete. The most recent literature concentrates on analysing shipwrecks or specific places where the proportion of amphorae from Citerior as opposed to those from elsewhere can be established. Many of these studies are undeniably important, as in the case of Rome and other western cities, military settlements, etc., but the choice of these places was determined by the research subject and the quality of the information available, which makes it impossible to reconstruct a systematic global picture.

\textsuperscript{13} Revilla, Agricultura, Y. Peña, Torcularia. La producción de vino y aceite en Hispania, Tarragona, Institut Català d’Arqueologia Clàssica; 2010.

\textsuperscript{14} On modern Catalonia: Revilla, Producción Cerámica; Tremoleda, Industria y artesanado cerámico; J. Tremoleda, ‘Les instal·lacions productives d’àmfores tarraconenses’, in La producció i el comerç de les àmfores de la província Hispania Tarraconensis. Homenatge a Ricard Pascual i Guasch (Barcelona, 17 i 18 de novembre de 2005), Barcelona, Museu d’Arqueologia de Catalunya. 2008, pp. 113-150.


Hispanic wines are occasionally mentioned in the literature between the end of the 1st century BC and the mid-2nd century AD. The corpus includes writers from a wide range of social and cultural backgrounds: Greeks and Romans; members of the elite and individuals of more humble origins, some with connections to the same elite as in the case of Martial; people from Italy and people from the provinces. The same can be found in the genres used. It is interesting to see how the information provided by the literature is organized in different ways and presents different features in each period. The earliest passages are similar in their geographical vagueness and the frequently negative comments made about the wine. Ovid is a good example of this, since he only mentions Hispanic wine in order to criticize it (Ars Amatoria III, 645). Only Strabo relates wine production to a geographic location, namely Turdetania (III, 2, 6), but it is a generic mention, referring only to its abundance in the context of a routine inventory of the region’s riches that are exported and therefore subject to taxation. This lack of precision paradoxically coincides with the regular presence of Hispanic wines in the Western Empire and Rome during the Augustan period and the first half of the 1st century AD, which has been well established through archaeology.

The situation at the end of the 1st century AD and the beginning of the 2nd is different. A number of writers from the Flavian and Trajan periods mention specific qualities and geographic areas of origin. In some cases the distinction between what are considered to be high “quality” wines and others is explicit. Pliny the Elder, in particular, establishes a clear distinction between vineyards and grape varieties with limited production, which give us great wines of the first and second rank, and other vineyards and grape varieties that give us common wines of the third and fourth rank. These latter wines can be termed as “high consumption” due to their mass production, and this group would include some of the wines produced on the central Catalan coast: “Hispaniarum Laetana copia nobiliantur” (H.N. 14.71). Other authors, such as Martial (1.26.9-10; 7.53.6; 13.118), Juvenal (5.29-30), Silius Italicus (3.369-370 and 15.176-177) and Fronto (Ép. De eloquentia, 1.1), give both positive and negative subjective assessments. A special case is Florus (Vergilius orator an poeta 2.8), who uses a generic reference to vineyards to construct an ideal picture of Tarraco.

The high number of quotations involving Hispanic wine in this period stands in contrast to the panorama provided by the archaeological record, since wine amphorae from both Citerior Tarraconensis and Baetica appear in very small quantities in the stratigraphies of Ostia and Rome. This highlights another apparent contradiction between literature and archaeology, although this could be overcome if we see the literary testimonies as being part of a cultural discourse rather than a direct “reflection” of an economic phenomenon. The repeated mentions of quality of the wines from Hispania coincide, and this seems significant, with the social and political presence of Spanish elites in Rome in the second half of the 1st century AD. This would explain some of the attention given in the literary sources to certain Hispanic products that were consumed by Rome City’s elite and it cannot

18 Miro, Producción de ánforas.
19 These differences have been spelled out by Tchernia, Vin, pp. 28-29.
20 Dressel 2-4 from Citerior and Haltern 70 from Baetica seem residual finds in 2nd century AD archaeological levels from Ostia and Rome. Other amphora types such as Pascual 1 and Oberaden 74 are not longer being used for trade by mid-1st century AD or even before: Miro, Producción de ánforas; G. Rizzo, ‘Ostia VI. Le Terme del Nuotatore. Le anfore, Ostia e i commerci mediterranei’, in C. Panella & G. Rizzo, Ostia VI. Le Terme del Nuotatore, Studi Miscellanei, vol. 38, 2014, pp. 198-199 y 205-206.
be ruled out that these same elites may have introduced some of their consumption habits and that they themselves may have produced some of the wines. In this historical context a geography of production could be compiled, defined by placing certain wines into an urban framework that could function as a specific “designation of origin” (Tarraco, Lauro, Saguntum, etc.). This geography could also be linked to territories corresponding to a regional origin (Laetanian wine) or geographic provenance (the Balearic Islands wine) reality. In any event, no writer mentions technological, productive, legal or financial aspects relating to the production and commercialization of Hispanic wine. Neither do they provide data on the making of different quality wines. The closest we get is the distinction made by Pliny the Elder mentioned earlier, but always from the subjective point of view of the consumer.

The quotations also present problems of accuracy and context. In some cases the data collected may be contemporary with the writing of the text, but in others they could be anachronisms.

In short, the case of wine shows how any attempt to reconstruct a production phenomenon comes up against the limits imposed by Roman society’s value system, which denies the economy’s autonomy with regard to the social and political order. References to viticulture therefore always appear as part of a discourse that brings together wine quality, forms of consumption, situations, ritualized spaces of use and status. The mechanisms used to make the product’s material and cultural value explicit are the interplay of comparisons and the description of the context in which the product is consumed. This explains the description of a hierarchy of wines in Pliny, the diversity of particular consumption situations and the references to the consumers’ condition that appear in other authors such as Ovid, Martial and Juvenal.

**Viticulture in Hispania Citerior Tarracoensis**

Over the last few decades the contributions of archaeological research have resulted in a deeper knowledge of the history of viticulture on the Mediterranean coast of Hispania Citerior. This is especially obvious in specific areas, such as the typology of the amphorae used to transport the region’s wines and their system of epigraphic representation. A great many artisan centres

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have also been located, and this has made it possible to define certain aspects of technology and work organization. In addition to this, archaeology has provided reliable information regarding the organization of the rural habitat, technology and how the territory was occupied.

The establishment of viticulture in the province is related to the thorough transformations brought about by the Roman conquest. Especially interesting in this respect is the existence of early wine production in the territory of Tarraco and close to the indigenous oppida of the central Catalan coast, which survived until the mid-1st century BC. This phenomenon is already confirmed in the final third of the 2nd century BC, in connection with the global transformation of the settlement and production structures. This development brought with it a need to manufacture specific containers for transport, in the form of imitations of the Dressel 1 and Lamboglia 2 Italic amphorae. However, the spread of vineyards geared towards commercialization in overseas markets did not come about until the second half of the 1st century BC, specifically in the final third of that century. This is confirmed by the foundation chronologies of many pottery workshops and numerous villa-type settlements and other rural centres, equipped with facilities for pressing and storing wine production. This incipient viticulture can be found in certain territories of the central Catalan coastline (see Maps 1&2).

A series of regional situations can be identified within Citerior, partly as a result of developing the research differently. In the north-east of the Peninsula, in what is today Catalonia, the geography of vineyards can be reconstructed with a fair degree of certainty. An especially dense concentration of evidence can be seen on the central coastline to the north of Barcelona, which seems to have been the preferred area for planting vineyards geared for export from the beginning of the Augustan period, while various vineyard areas have also been identified at some points of the Girona coastline, the coast of Garraf-Penedès, the Camp de Tarragona and the lower course of the Ebro river.

Viticulture spread rapidly after the change of era and throughout the first half of the 1st century AD, covering new territories or exploiting more intensively those spaces that were already occupied. This expansion appears to have been detected to the west of the ager Tarraconensis, especially in the area closest to Tarraco. It also affected the area situated between the rivers...
Rubricatum (Llobregat) and Besós, reorganized with the founding of the colony of Barcino. These rivers connected the colony with the interior of the territory, ensuring access to other agricultural spaces and their resources. This makes it possible to understand the economic development of Barcino in the 1st and 2nd centuries AD (see Map 1)\(^{29}\).

A similar process seems to have developed in the coastal area north of the Besós. In this geographic space, originally organized around two municipia founded in the late Republican period - Baetulo and Iluro - and the small oppidum of Blandae or Blandae situated at the mouth of the river Arnun (Tordera), where the villa system had been strongly established since the Augustan period. From a time well into the 1st century AD, the economic interests of important families from the colony of Barcino would become a consolidated presence in this area\(^{30}\).

The spread of viticulture from the beginning of the 1st century AD was accompanied by changes in the organization of artisan activities. It was at this time, in areas such as the river Llobregat, where large-scale pottery workshops with a complex internal organization appeared, whose purpose was to meet the varied demand generated by the villa’s economical system nearby Barcino\(^{31}\). This new production situation would also coincide with changes in how exchanges were organized (see below). Other areas of inland Barcelona, Girona and Lleida appear to have been occupied by vineyards that were aimed at satisfying a more local and regional demand, and which were developed later in association with specific artisan processes\(^{32}\).

On the coast of the Valencia Community and the Region of Murcia, viticulture became strongly established between the mid-1st century AD and well into the 3rd century AD. This seems to be related to a gradual change in the way the territory was occupied between the end of the Republican period and the beginning of the Augustan period, driven by colonial settlements\(^{33}\). In some cases (the territories of Saguntum and Dianium), the importance of agricultural and artisan activity suggests the existence of an intense viticulture aimed at commercialization in overseas markets\(^{34}\).

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\(^{32}\) Revilla, Viticultura, pp. 83-84; Castanyer, Nolla & Tremoleda, Producció vinícola, p. 57.


\(^{34}\) Production of amphoras of Iberian tradition in the surrounding area of Saguntum is stated in: C. Aranegui, ‘La producción y el comercio de ánforas tarracoenses en el País Valenciano’, in La producció i el comerç de les àmfores de la província Hispania Tarracoensis. Homenatge a Ricard Pascual i Guasch, Actes de les Jornades d’Estudi, 171 i 18 de novembre de 2005.
between the 1st and 2nd centuries AD that we see the development of a large-scale activity producing *garum* and fish preserves, also for export. In contrast, part of the region’s agricultural production, especially oil, seems mainly to be destined for meeting internal demand.

Evidence of vitivinicultural production, exported to the Peninsula and elsewhere, has also been found on the island of Ebusus (Ibiza). Research has enabled the identification of a number of rural centres with winemaking technology and evidence related to crop-growing systems that indicate intense production from the Late Punic period. Finally, there is important though scattered archaeological evidence of wine production in the Ebro valley and on the Meseta (high central plateau). These remains, in the shape of manufacturing and storage facilities, confirm the existence of surplus production destined for regional commercialization and possibly export. One example would be the *villa* of Arellano in Navarra.

The nature of the new forms of production can be seen in the use of specific technology for making wine. In Catalonia today, for example, over a hundred establishments have so far been identified as having traces of pressing facilities or spaces for storing liquids (mainly wine). These facilities vary greatly in importance, from modestly-built settlements with a single press to large buildings with four or more presses. This technology was accompanied by all the elements necessary for processing the grapes and must, which shows a desire to organize the whole winemaking process. The commercial orientation seems obvious when a place has a large number of *dolia* and there is a pottery workshop attached for making amphorae. At the same time there is evidence of the systematic use of technical principles applied to the pressing machinery to increase efficiency. These elements spread rapidly from the Augustan period onwards.

**Note:**


2. MURCIA, Poblamiento rural, p. 155.


5. In the absence of a synthesis study for presses in the whole province, see: PEÑA, *Torcularia*.


the use of the *arca lapidum* counterweights identified especially in the Catalonia area, is in turn related to the appearance of settlements characterized by a particular architecture and designed for intensive production, which are distributed with varying density across the rural space. This specific distribution is related to different ways of exploiting the territory\(^{41}\).

**Figure 1. Torcularium of Veral de Vallmora (Teià, Maresme, Barcelona) 3D restitution. Illustration: A. Martín i Oliveras & F. Bayés, 2008.**

The most important type of establishment is the *villa*, the management and exploitation centre, which is defined by spatial planning based on differentiating between one sector with all the services necessary for domestic life set aside to the private spaces for the owner, and another sector used for agricultural production. In general, the technology for winemaking, including several presses along with one or more tanks for collecting the must, is found in neighbouring buildings around the residential sector. But they could also be a little further away. Some *villae* had an artisan sector set apart from the residential area.

On a secondary level would be big establishments between 1,500 and 2,000 m\(^2\) in area, with a complex spatial organization and a basically productive function. These places would contain the complex infrastructure needed for making and storing wine on a certain scale: a *torcularia* or pressing room (with from 4 to 6 presses), *calcatoria*, *lacus* and *celiae vinariae* of between 100 and 200 *dolia*. Artisan pottery activities, a forge, etc., have also been identified in most of these places\(^{42}\).

Another category includes a wide range of buildings with a simpler spatial organization but also dedicated to agricultural production (from 400/500 to 1000/1200 m\(^2\) in area). Most were used for


producing wine and had one or two presses, a *lacus* and a space set aside for storing between 30 and 50 *dolia*. In some places, however, there is evidence of the simultaneous storage of a cereal production, either for personal use or for sale\(^43\). Some of these establishments had also a pottery workshop where amphorae were made. All this suggests that these were places given over to specialized; intensive work processes forming part of a production structure organized elsewhere, possibly a nearby *villa*. Indeed, some buildings were occupied only seasonally, during certain phases of the agricultural cycle\(^44\). This organization also points to a regular connection with commercialization structures.

This type of viticulture geared towards exporting to overseas markets would continue, depending on the area, until the mid- or late-2nd or even the early 3rd century AD, judging by the evidence provided by the catalogue of amphorae with specific variants of the Dressel 2-4 Tarracnonense form and the sequence of activity of certain pottery workshops and numerous agricultural settlements. In any event, there seem to be a great many local characteristics, as shown by the transformation of both agricultural and artisan centres. These agricultural centres would see the abandonment or reduction of big pressing facilities between the second half of the 2nd and the beginning of the 3rd century AD. In the case of the pottery workshops, some would disappear between the last third of the 1st and the start of the 2nd century AD, while others would convert and diversify their production. This ensured their continuity during the 2nd and 3rd centuries AD.

As mentioned above, a great many *villae* dedicated to winemaking had pottery workshops for making *amphorae* either attached or nearby. It is difficult to reconstruct the ways this artisan activity was organized, given the absence of written information. However, the archaeological documentation and amphora epigraphy supply highly important information in the form of onomastic, topographic and contractual practices.

So far over 90 pottery workshops that were involved in the manufacture of wine *amphorae* have been identified in the north-east of *Hispania Citerior* (see Map 2)\(^45\).

To these can be added around 20 more in what is today the Valencian Community, concentrated especially in the *ager* of *Dianium* and neighbouring towns (see Maps 3 and 4)\(^46\).

Most pottery workshops were located in territories with a high density of rural habitat and close to towns. The reasons for this are obvious: to ensure access to raw materials and the communications network in order to simultaneously meet rural, urban and overseas demand. Nevertheless, the way this artisan activity spread and the special characteristics it took on need to be understood in the wider context of the historical transformation of the provinces in the Western Mediterranean. Not only do we have the development of a sociocultural situation with associated forms of consumption generated by the urban lifestyle disseminated by Rome, we also have the establishment of economic structures that included specific ways of managing and organizing production and involved a complementary structural relationship between agriculture, the artisan sector and circuits of exchange in a free-market context.

\(^{43}\) *Revilla*, Viticultura, p. 87.

\(^{44}\) Some examples: *J. Bosch et al.* El fundus de Turissa entre el segle I aC i l’I dC. Arqueologia de dos establiments rurals. *Mas Carbotí i Ses Alzines*, Girona, Universitat de Girona, 2005; *Revilla*, Habitat rústic i territori, pp. 36-37.


The vast majority of the pottery workshops seem to be integrated into the organization of a fundus. Specifically, the production of amphorae should be understood as a complementary activity that met the needs of a semi-specialized agricultural sector that was geared to commercializing a surplus. In this context the pottery workshop first and foremost answered the instrumentum needs of an estate. It would therefore be a subordinate activity. But this is only a partial explanation. Not only roman treatises on agriculture but also legislation show that a fundus could be involved in a number of very different economic activities and that these activities were organized on various scales and with varying degrees of autonomy in relation to agriculture. An extreme case would be activities involving the mining and exploitation of natural resources and the artisan sector dedicated to satisfying nearby urban demand. The options chosen in each case were the result of a combination of the owner’s interests and the natural resources locally available. Thus in the case of the manufacture of ceramics, the intention was probably to achieve the dual objective of estate self-sufficiency and sale to meet local or regional demand47.

The pottery workshops on the coast of Citerior were making a wide range of amphorae for over three centuries, although most of them were in the form of the Pascual 1 and the Dressel 2-448. The two forms are intermixed for a number of decades around the change of era, until the Dressel 2-4 became the preferred container for exporting wine from Citerior in the first third of the 1st century AD49. The choice, coexistence and substitution of one amphora type by another, along with the production of less popular forms, seems to be the result of various factors acting together.

The transformation of the markets and the circuits of commercialization (with the appearance of new producers in the vicinity, in turn associated with a change in demand and tastes), no doubt brought about changes in the production structures of each territory in quantitative terms and the appearance of new qualities of wine. Although local peculiarities are difficult to appreciate in the area of production, the reorientation of the markets seems clear. While Gaul and the Limes Germanicus were the main consumers of wine from Citerior during the Augustan period, in the first half of the 1st century AD Italy, and especially the city of Rome, became the new priority destination50. Some indications suggest that, in this context, there was a change in the forms of artisan production in some territories such as Laetanian region. Specifically, factors such as the adoption of specific models in production capacity, the standardization of the Dressel 2-4 form and the complexity of

48 REVILLA, Producción cerámica, pp. 41-43; GIBBERT, Vi tarraconense, pp. 132-135; Pascual 1 and Dressel 2-4 amphora types were reproduced in Ibiza: RAMON, Ñofras altimperialis, pp. 257-266.
49 Other amphora types were produced during the 2nd and 3rd centuries AD, such as the Gauloise 4, but they seem to have been used for trade in low quantity; Dressel 2-4 form was still produced until the 3rd century AD: R. JARREGA & P. OTIÑA, ‘Un tipo de ánfora Tarraconense de época medioimperial (siglos II-III): la Dressel 2-4 evolucionada’, in SFECAG, Actes du Congrès de L’Escala-Empúries, 2008, Marseille, 2008, pp. 281-286; other amphora types were still produced during the 4th and 5th centuries AD in this region and Ibiza: J. A. REMOLA, Las ánforas tardo-antiguas en Tarraco (Hispania Tarraconensis), Barcelona, Publicaciones de la Universitat de Barcelona, 2000, p. 196; RAMON, Cerámica ebustiana, pp. 566 and 574, figs. 1 and 7.
50 MERO, Producción de Ñofras, pp.189-203; CORSI-SCHIALLANO & LIOU, Épaves, p. 172. New Italian markets and the technological improvements seem related to changes in the bottling and dispatch of wine during the central decades of the 1st century AD. Particularly, the introduction of ‘tankers ships’ with large dolia, allowing an increasing volume of wine being transported. This denotes a change in demand and a different method of production and commercialisation in bulk or perhaps similar to a maquila system; this would reduce the amount of transported amphorae considerably: CORSI-SCHIALLANO & LIOU, Épaves; P. DELL’AMICO & F. PALLARES, ‘Il relitto di Diana Marina e le navi a ‘dolia’: nuove considerazioni’, in A. CORTÉS & T. GABIN (ed.), De Triremibus. Festschrift in honour of Joseph Muscat, Malta, PEG Publications, 2005, pp. 67-114; P. DELL’AMICO & F. PALLARES, ‘Appunti sui relitti a ‘dolia’, Archaeologia Maritima Mediterranea, 8, 2011, pp. 47-135; see also “Dossier les épaves à dolia”, Archaeonautica, 15, 2008.
the onomastic representation used on the seal-stamps seem to indicate the existence of larger-scale, more systematized work processes within production structures of greater organizational complexity. Added to this is the possibility of other types of container (*dolia, cullei, cupae*) 51.

Amphorae accounted for most production in many pottery workshops in their initial phases (Augustan and Julio-Claudian periods), but common ceramics and building materials were also made52. Between the second half of the 1st and the beginning of the 2nd centuries AD, some of them seem to reorient their activity and concentrate on manufacturing common ceramics, cookware, building materials and other specific products such as imitation African ceramic cookware and *terra sigillata*, apparently in small quantities53. For now, the latest traces of activity for some pottery workshops reach only as far as the 3rd century AD 54. These changes in the range of products made and manufacturing methods, with slight variations depending on the territory, could be due to a restructuring of artisan activity, which in many cases would become an autonomous sector within the organization of a *fundus* to cover local or regional demand.

52 The amphoras were the 85% of the local ceramic produced in the *figlinae* from the territory of *Dianium*: GISBERT, Òmfores i vi, p. 389.
The limited corpus of amphora inscriptions and especially seal-stamps also make it possible to analyse the organization of the artisan pottery and winegrowing processes. However, this corpus presents some serious problems. First, the content is almost exclusively onomastic and difficult to interpret. These forms indicate different legal and social situations, and different relationships between the artisan sector and agricultural production. In only a few cases does the identification of certain people as members of the elites enable us to consider questions about ownership of the land, the pottery activity, the packaged product and the underlying interests and strategies. Second, generally speaking these are very simple epigraphs (often just capital letters), and this gives rise to problems of homonymy and identification. Finally, the corpus of seal-stamps collected is very small, comprising only a few hundred. Also, the habit of sealing amphorae seems to be very limited in both frequency (only a small proportion are sealed) and in terms of chronology and geography (most seal-stamps are essentially from the Julio-Claudian and Flavian periods and come from pottery workshops on the Barcelona coastline).

As a rule the seal-stamps are made up of capital letters identified as the possible initials of a name or groups of letters forming a cognomen. As regards what they mean, there are various interpretations. One suggestion is that these seal-stamps may be exclusively linked to the business of pottery production and would correspond to individuals of a modest social position carrying out specific roles within the artisanal amphora production process. Some could be identified as simple workers, while others would have greater responsibility as skilled workers or workgroup leaders. In any event, the presence of these seal-stamps and in particular the existence of 2 or 3 grouped together on the same amphora gives the impression of a well-defined rigorous organization of artisan work that would coincide with the standardized manufacture of the Dressel 2-4 Tarraco amphora. Other hypotheses link part of this epigraphy to the owners of the figlinae and to the contents, also representing the producer and/or the owner of the fundus.

A study of other forms of onomastic representation with duo nomina comprising praenomen-nomen or nomen-cognomen, or tria nomina, supplies an important piece of information: that the elites had direct interests in the region’s viticulture. It is difficult to define the exact value and organization of these interests, i.e. whether they were limited to land ownership or whether they stretched as far as artisan activity, the exploitation of natural resources and trade through representatives. Naturally it is also very difficult to establish what proportion of an elite family’s wealth these interests represented. At least it has been possible to identify very different people and social situations: senatorial families.

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55 Revilla, Producción cerámica, pp. 104-105; Revilla, ánforas y epigrafía, pp. 169-172 and 195.
56 Miro, Producción de ánforas, pp. 210-226; Pascual, Índex, 6-8.
57 Corsi-Scialiano & Liu, Épaves, p. 165; Revilla, Onomástica, pp. 1189-1191; Berni & Revilla, Sellos, pp. 95-111; P. Berni & R. Járrega, ‘Exportación e importación de ánforas en el ager Tarracoensis entre finales de la República y el Alto Imperio’, in V. Martínez Ferreras (ed.) La difusión Comercial de las Ánforas Vinarias de Hispania Citerior Tarracoensis (s.1 aC-I dC), Oxford, Archæopress, 2015, pp. 79 -90; C. Carreras, ‘Novedades en torno a la producción y distribución de las ánforas del ager Bacinonensis (El Baix Llobregat)’, in V. Martínez Ferreras (ed.) La difusión Comercial de las Ánforas Vinarias de Hispania Citerior Tarracoensis (s.1 aC-I dC), Oxford, Archæopress, 2015, pp. 67-78.
equites from the north of Italy\textsuperscript{60}, provincial aristocracy\textsuperscript{61} and families from Barcino and Tarraco\textsuperscript{62}. However, the origin and geographic location of these individuals’ properties pose another problem. In only a few cases do these people seem to be connected to the big wine-producing establishments on the coast between Barcino and Emporiae, always dated to the Julio-Claudian, Flavian and, to a lesser extent, Antonine periods. The development of this viticulture must also have contributed to a proliferation of small and medium-sized owners who would have sold their production to independent traders or big landowners’ commercial agents. For the present, however, we have insufficient data on the subject.

Some of the profits obtained from these activities may have enabled certain individuals and collectives to rise in legal and social terms. There is some evidence to suggest that a number of slaves responsible for management processes in agriculture and/or the artisan sector managed to obtain their freedom and rise socially. The significance of this phenomenon can be appreciated in the importance of freedmen in cities like Barcino and Dertosa\textsuperscript{63}. In short, therefore, the spread of viticulture and the wine trade may have contributed to the region’s socioeconomic development. However, there is not enough documentary evidence to allow an accurate assessment of viticulture’s position relative to other activities and its weight in the province’s economy as a whole.

**Viticulture in Hispania Ulterior Baetica**

The literary testimonies about Baetican wine are concentrated in the 1st century AD. Strabo (III, 2, 6), the first to mention it, describes the abundance of exports that may have benefited from the trade of other products such as grain and oil. His testimony summarizes the geography of consumption (cf. his reference to the ships from Turdetania that would arrive in *Puteoli* and *Ostia*) and the commercial traffic that “very nearly rivals that of the Libyan ships”. Columella (*De R. R.*, I, pref., 20), for his part, points out that products from the Cyclades and the regions of Baetica and Gaul were stored in Lazio. Testimonies like these show that exporting was a consolidated activity with Lazio and Campania as destinations, and that it was carried out in competition with other parts of the Empire. The perception of how important certain areas of Baetica were seems to be implied by the use of the term “regions”, e.g. “…ac regionibus Baeticis Gallicisque”, which suggests the existence of different production situations within the province. Because of Columella’s family connections with Gades, the news he provides forces us to question the appropriateness of his advice about agriculture as regards the real situation in Baetica\textsuperscript{64}. Other sources are markedly aesthetic in character and their references are difficult to evaluate as contemporary testimony\textsuperscript{65}. Silius Italicus (*Pun.*, III, 393), for
example, provides a literary image when he relates the name of Nabriissa - today Lebrija, on the coastline of the former lacus Ligustinus, today the Doñana Marshlands - with the cult of Bacchus.

The scarcity of sources has directed the research towards an exhaustive examination of texts and a search for complementary information. In this regard, scholars have explored the possibilities offered by civic coinages from the Republican and Augustan periods, with representations of vine tendrils and bunches of grapes or the god Bacchus. However, these representations must be understood primarily as images of prestige and identity used by certain cities. They are not direct evidence that viticulture was their main agricultural activity. More important are the contributions of archaeology, primarily as images of prestige and identity used by certain cities. They are not direct evidence that viticulture was their main agricultural activity. More important are the contributions of archaeology, which have made it possible to locate and date the introduction of technology and production processes. The evidence is scarce but significant, such as the torcularium from Loma de Ceres (Map 5, N° 35). Finally, the research has also resorted to comparing the philological-archaeological data with information from former regions of production and today’s designations of origin.

As with other regions, the study of Baetic viticulture is based on determining the types of amphorae used and analysing the figlinae. So far 8 types of amphorae have been identified in connection with the transporting of wine and grape-based products such as sapa and defrutum. In the case of two of these amphorae, the Haltern 70 and the Dressel 2-4, different areas of production have been identified: the coast of Baetica (C.B.) and the valley of the Guadalquivir (V.G.). The chronology and geographic distribution of Baetic products – although with serious problems as regards certain forms – have been summarized as far as possible in Table 1.

The table shows initial and final datings for the production and general distribution of each amphora and for its specific manufacture in Baetica. In the case of the Dressel 2-4, the chronological comparison falls within the wider framework of Ithic productions. In the case of the Haltern 70 and its later variant, the Verulamium 1908, the chronologies of these types of production from Lusitania and Gaul are also considered. Some forms, such as the Dressel 30 and the Gauloise 4, pose particular problems when it comes to dating the initial and final times of production. Some of the Baetic amphorae can also be considered bivalent, especially those produced on the coast. They would have been destined mainly for salted products and fish sauces, although that does not exclude the possibility that they may have occasionally been used for exporting a significant volume of grape-based products.

68 Peña, Torcularia, pp. 171-172.
69 Étienne & Mayet, Vin hispanique, pp. 71-72; Carreras, Geografía, p. 77, figs. 42-43; Peña, Torcularia, p. 172.
72 A similar consideration for Dressel 7-11 types from Citerior, particularly for Dressel 8 “emporitana” in: Miro, Producción de ánforas, p. 103; López Mullor & Martín Menéndez, Tipología, pp. 76-79.
Table 1. General and specific chronologies for the Baetican amphorae forms (INITIAL, FINAL) and geographical distribution of figlinae (Baetican coast: B.C and Guadalquivir Valley: G.V.) related with Baetican amphorae output for grape by-products. Data composition: D. Martín-Arroyo 2016.

When studying Baetican amphorae, the analysis of typological details also poses problems. For example, because of its similar shape it can be difficult to distinguish the coastal production of the Haltern 70, the most common container for these types of export, from the Dressel 7-11 group, very common in what is today the province of Cádiz. This problem does not arise in the Guadalquivir valley, since the difference in shape between the Haltern 70 amphorae and oil amphorae is more obvious.

One of the difficulties when studying amphorae from this area is the combination of a lack of excavations and the continued artisan activity in many places over various centuries. This continuity hinders identification of the production phases of the Haltern 70 that have been buried under the accumulated waste from the Dressel 20 amphorae corresponding to later phases of activity which, in addition, seem to correspond to production situations organized on a larger scale. Added to this is the fact that oil amphorae and their epigraphy have attracted more interest in recent years, relegating the identification of other types of amphora to a secondary plane. In both the coastal area and the Guadalquivir valley the manufacture of wine amphorae seems to occupy less space in pottery workshop activity, although the situation varies from area to area. Hence the limited presence of wine compared to oil amphorae seems obvious away from the sea. The difference is less disproportionate in the case of amphorae for salted products from the coast, although the subject needs to be examined in depth. This disparity makes it necessary to consider another problem: the assessment of the value of the wine economy in relation to other products exported on a large scale which have traditionally been considered the main resource and driving power of the Baetic economy, namely oil and salted products.

The initial point for Baetic exports depends on our identifying the exact contents of certain amphorae imitated in the region. It is known that there was local production of Greco-Italic with ancient chronologies (250–150/125 B.C.), manufactured exclusively on the coast, and Dressel 1 from the coast (140/130–30/25 B.C.) and inland (110/90–35/25 B.C.). One particular problem area

<table>
<thead>
<tr>
<th>FORM</th>
<th>INITIAL</th>
<th>INITIAL BAETICA</th>
<th>FINAL BAETICA</th>
<th>FINAL</th>
<th>FIGLINAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haltern 70 (B.C.)</td>
<td>80 BC</td>
<td>50 BC</td>
<td>75 AD</td>
<td>192 AD</td>
<td>24-29,31-32</td>
</tr>
<tr>
<td>Haltern 70 (G.V.)</td>
<td>80 BC</td>
<td>50 BC</td>
<td>90 AD</td>
<td>192 AD</td>
<td>1-23</td>
</tr>
<tr>
<td>Uliceus (G.V.)</td>
<td>25 BC</td>
<td>25 BC</td>
<td>125/150 AD</td>
<td></td>
<td>30-31, 34</td>
</tr>
<tr>
<td>Dressel 2-4 (B.C.)</td>
<td>70 BC (Dr. 2-4 Italian)</td>
<td>25 BC</td>
<td>125/150 AD</td>
<td>30-31, 34</td>
<td></td>
</tr>
<tr>
<td>Dressel 2-4 (G.V.)</td>
<td>70 BC (Dr. 2-4 Italian)</td>
<td>1 AD</td>
<td>100 AD</td>
<td>2-3</td>
<td></td>
</tr>
<tr>
<td>Dressel 28 (G.V.)</td>
<td>Late Augustan</td>
<td>1 AD</td>
<td>150 AD</td>
<td>6, 21-22</td>
<td></td>
</tr>
<tr>
<td>Verulamium 1908 (G.V.)</td>
<td>circa 30 AD</td>
<td>40 AD</td>
<td>160 AD</td>
<td>107</td>
<td></td>
</tr>
<tr>
<td>Dressel 30 (B.C.)</td>
<td>201 AD</td>
<td>150/175 AD</td>
<td>450 AD</td>
<td>33, 35-36</td>
<td></td>
</tr>
<tr>
<td>Gauloise 4 (B.C.)</td>
<td>50 AD</td>
<td>175 AD</td>
<td>350 AD</td>
<td>299 AD</td>
<td>27, 35-37</td>
</tr>
<tr>
<td>Matagallares (B.C.)</td>
<td>175 AD</td>
<td>350 AD</td>
<td>350 AD</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

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73 Torre de los Herberos (n. 23) and coast sites in the maps are taken from Carreras, Geografía, p. 76, fig. 42. It is likely that more Haltern 70 figlinae could be located along the ancient southern shore of the latus Ligustinus.

74 Inland sites in maps are taken from P. Berni, “Tipología de la Haltern 70 bética”, in C. Carreras, R. Morais & E. González Fernández (coords.), Anforas romanas de Lugo, Santiago de Compostela, Universidad de Santiago de Compostela, 2011, p. 105, fig. 12. On the Haltern 70 finds, see Berni, Tipología, pp. 98-99. We are grateful for the Juan Moros Díaz’s advice on the accurated location of these sites.
involves amphorae that still existed at the beginning of the Early Empire period, as in the case of the Ramon T. 7-7433 (Ca. 150 B.C./A.D. 140–1) shape, manufactured on the coast. Away from the coast the Ovoid 1, 4, 5 and 6 amphorae, with a chronology centred around 70 and 15 B.C., would be in a similar situation.

The export of grape by-products from the Guadalquivir valley would cease at the end of the 1st century AD, although it appears that shapes like the Dressel 28 continued to be made. Continuity in the manufacture of the Dressel 30, Gauloise 4 and Matagallares I shapes enables confirmation of the continued existence of a coastal viticulture with export capacity. And bearing in mind the hypothesis regarding their bivalence, the chronology of the Beltran IIA (ca. 15/25 ~ 150) and IIB (50 ~ 225) salted fish amphorae could let it be argued that a certain volume of exports was maintained. Other containers, such as barrels, could also have been used.

In marked contrast to the situation involving the Dressel 20, for example, the epigraphy of Baetic wine amphorae is scarce. The evidence is concentrated mainly on Haltern 70 amphorae from the Guadalquivir valley. No inscriptions have been found on Urceus, Dressel 30, Gauloise 4, Matagallares I or Haltern 70 type amphorae from the coast of Baetica. As regards Dressel 2-4 from the coast, two seal-stamps from the Villa Victoria figlina (Map 5, Nº 31) have been identified, consisting of a simple circle between the rim and the neck. However, the seal-stamp L-VALE[RI]-AMETHYSTI has been found at the Dehesa de Arriba (Map 5, Nº 2) site in the Guadalquivir valley. Epigraphy involving the Dressel 28 is also very scarce, with seal-stamps such as CASSIOR* and |CELTVS/ V'O'K'·FEC| being the main examples. The tituli picti on these amphorae include numerals and the names of traders. Outstanding among these is Aulus Atinius, which is also documented on amphorae for salted products. This coexistence is not surprising, since we know about the manufacture and commercialization of salted products from the lower course of the Betis, upstream from the lacus Ligustinus. As for the Verulamium 1908, the seal-stamps |LI·FO| and |L·I·F·O| have been found, the first of these being located on the handle.

In the case of the Haltern 70 amphora, the CEIPAC database includes a total of 77 objects which, in some cases, have a combination of stamps, tituli picti and graffiti. The corpus is listed as 13 seal-stamps, 27 tituli and 34 graffiti. The epigraphy of these amphorae has been catalogued and studied in great detail. These containers were produced and commercialized alongside the Dressel 20 oil amphora, as shown by stamped epigraphy and known graffiti. The written inscriptions show that the Haltern 70 were used to transport muria and olives, the latter occasionally ex defrutum. This preservative, also identified on the amphorae as sapa, consisted of a syrup made from must reduction.

75 ÉTIENNE & MAYET, Vin Hispanique, pp. 21-58.
81 A. AQUILERA, ‘El contenido de las Haltern 70 según los tituli picti’, in Culip VIII i les àmfores Haltern 70, pp. 119-120; AQUILERA, Defrutum, pp. 120-132.
A case study is a quantitative and/or qualitative method of research widely used in both the experimental sciences and the social sciences and humanities. It is also used in history and Archaeology to gain a detailed understanding of the transformation of a cultural landscape over time, or to understand the evolution of a social or economic phenomenon that took place in the past. The most typical feature of this method is an intensive, in-depth knowledge of one or more cases, faced with a situation or process of historical importance, this being understood as a system “restricted” by the limits dictated by the object of study itself, but framed within the global context in which this phenomenon comes about.

With the two studies chosen for this paper, the intention is to increase our knowledge of the origin, development and evolution of intensive vitivinicultural production during the Roman Late Republic and Early Empire in two very different territories: the regio Laeetana in Hispania Citerior Tarraconenensis and the confinium of Hasta Regia-Gades in Hispania Ulterior Baetica. In both cases the aim is to obtain greater knowledge by applying different study techniques and models to enable us to analyse the evolution of this historical phenomenon from a diachronic point of view in each territorial context. Afterwards we will apply all this knowledge in our study of the social space in which this ancient economic phenomenon occurred.

5.1. Regio Laeetana: economic, econometric and predictive/regressive/ reconstructive models.

Intensive viticulture during Roman times in the north-east of the Iberian Peninsula was a far-reaching phenomenon with important economic implications which constituted a true sociocultural revolution for this territory at all levels.

Figure 4. The regio Laeetana with its Latin toponymical items and main roads (1st. century BC to 3rd. century AD).
**Territorial scope**

Laetanian region is an ill-defined area in historical terms that includes, among other things, the oppidum of Blanda or Blandae, the municipia of Iluro and Baetulo and the colonia of Barcino. The extension and limits of these cities’ territories have not been precisely defined with the exception of the *ager Barcinonensis*, the constitution and legal status of which must have had an effect on the urban centres that were there before. The territory comprised the extensive plain situated between the course of the river Besós and the mouth of the *Rubricatum* (Llobregat), located on the other side of the Montjuïc promontory. The first foothills of the Garraf Massif would have risen from this point. Away from the coast the colony’s *ager* would have included the lower course of the Llobregat as far as *Ad fines* (Martorell) and the lower course of the Besós to where it joined the river Ripoll and the Congost-Mogent basin, spreading across the great Vallès plain as far as the Catalan Pre-Coastal Range.

**Work hypothesis**

The studies of amphorae carried out in recent decades and the suggestions put forward regarding how to interpret them make it possible to propose a chronocultural-evolutionary sequence of vitiviniculture in this territory, from both a production and a trade perspective. We start with the premise that there are five main chronocultural phases of development, which we consider correspond to the configuration of different agricultural and artisan production systems:\footnote{Martin i Oliveras, *Arqueología del vi*, pp. 197-207; cf. Miro, *Producción de ánforas*, pp. 210-226.}

- **Phase 1. Origins** (½ 2nd C-½ 1st C BC): First productions withItalic-imitation Greco-Italic and Dressel 1A, 1B and 1C Citerior types amphoric containers.

- **Phase 2. Expansion** (½ 1st C BC-middle decades of 1st C AD): Appearance of the first widely-manufactured amphorae forms: Tarraconense 1/Layetana 1 and Pascual 1, the latter being the first *Tarraconense* amphora intended for large scale trade. Appearance of first imitations of the Dressel 2-4 italic form.

- **Phase 3. Reorientation** (middle decades of 1st C AD-end of 1st C AD): Characterized by large-scale production of Dressel 2-4 *Tarraconense* amphorae form and *dolia* (big pottery jars) for the massive export of wine, both individually packaged and in bulk, mainly destined for the Italic Peninsula and the city of Rome itself.

- **Phase 4. Peak** (early 2nd C AD-mid 3rd C AD): Period when the production structures were transformed, probably connected to the export of wine in bulk in other types of containers such as *cupae* (barrels) and *culleti* (wineskins), and possibly as a consequence of having to reduce costs when supplying heavily-used, strongly competitive markets.

- **Phase 5. Decline** (½ 3rd C AD-early 5th V AD): Crisis and the end of viticulture for export? The phenomenon could be due to the appearance of new producers with much lower costs, which would imply a change in market orientation. The vitivinicultural centres of *Hispaniae* are restructured to carry out other agricultural activities or were gradually abandoned.
**Object of study**

Our object of study is focused on the knowledge of the origin, development and evolution of intensive vitivinicultural production in the ancient *regio Laetana* through the identification of different microeconomic, mesoeconomic and macroeconomic models. Using these as a starting point, our aim is to develop econometric models and specific predictive/regressive/reconstructive models to enable us to analyse the evolution of this historical phenomenon in the period from the mid-1st century BC to the mid-3rd century AD.

**Objectives**

- To inventory and catalogue all those archaeological sites within the territorial area of the object of study that have a presence of structures related to vitivinicultural production processes between the 1st century BC and the 3rd century AD.

- To identify possible settlement models and patterns to enable a diachronic reading of population fluctuations, the distribution and the ownership of the land and the agricultural use of the territory during the chronological period object of the study.

- To characterize a typology of paradigmatic settlements or “types”, studying their production structure and its evolution so as to establish possible economic models.

- To develop microeconomic studies of costs, margins and production prices in vitiviniculture so as to implement possible econometric models.

- To establish possible geospatial and geoeconomic study models to make it possible in the future to develop predictive/regressive economic and econometric models, capable of being applied diachronically to any agricultural or artisan activity in ancient times.

**Methodology**

From a methodological and conceptual point of view, we distinguish between three levels of knowledge:

a) In-depth study of the written sources (primary and secondary):

- Agronomists and other authors (Cato, Varro, Columella, Palladius and Pliny the Elder) who describe aspects related to production and commercialization, vitivinicultural techniques, processes and procedures. Writers who give information about symbolic aspects, tastes and preferences in wine consumption in Roman times (Martial, Ovid, Horace, Juvenal, Virgil).

b) Study of the archaeological evidence and ethnographic parallels:

- Analysis of archaeological sites and search for parallels in other sites, near and far, of similar characteristics and chronology.

- Analysis of ethnographic parallels in modern and contemporary times to provide study models and technofunctional solutions.
c) The third level of knowledge involves archaeological experimentation:

- Rigorous reproduction of the processes and the techniques concerning technological and functional procedures of vitivinicultural production in antiquity so as to prove or refute our work hypothesis.

On a territorial level we distinguish between five study types:

- **Palaeoenvironmental studies**: These correspond to the first work phase to be carried out. Sedimentological, carpological, palynological, anthracological, etc. analyses provide an important “data proxy” that enables us to make inferences about the transformation of the landscape, whether natural or anthropic, and its evolution over time.

- **Geospatial studies**: These correspond to the second work phase to be carried out and serve to identify and make known all the endogenous and exogenous variables and factors that from an archaeomorphological point of view play a part in the configuration of the system. A combination of tools will be used to implement them: geographic information systems (GIS), relational databases and statistical analysis programs. These will make it possible to model and calculate settlement patterns as regards the distribution and ownership of the land, *Ager divisus et adsignatus (catastro et centuriato)*, *ager per extremitatem mensura comprehensus* and *ager arcifinalis*, and to identify and typologically characterize the various centres of production/distribution and their evolution over time.

- **Geomorphological studies**: These enable us to model the agricultural use of the territory from a diachronic point of view as regards the analysis of the different types of terrain and soils and the configuration of the fields through the application of viticultural techniques including the different systems for propagating, training and pruning the vines.

- **Technofunctional studies**: These analyse both the production and storage structures and the technological innovations in pressing and winemaking identified for each settlement “type”.

- **Geoeconomic studies and models**: These are used to calculate the yield and productivity scales in absolute terms of maximum production capacity for both the properties as a whole (*crop simulation models, CRM*) and the production and storage facilities (*yields*).

**Modellization**

A model is any concept, relationship or object used to study and represent some part of the empirical reality simply and comprehensibly. Therefore, in order to obtain an objective, empirical

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83 Frontinus divides lands into three heads (qualitates): *Ager divisus et assignatus; ager mensura comprehensus* and *ager arcifinalis*. *Ager divisus et assignatus* was public land that was assigned or granted to private persons by *centuriato et catastro*. The *ager mensura comprehensus* appears to signify a tract, of which the limits were defined by measurement, which was given in the mass to some community: ‘*cujus modus universus civitati est assignatus*’. The *ager arcifinalis* appears to express the whole of a territory, which had only some natural or arbitrary boundary, and was not defined by measurement: ‘*qui nulla mensura continetur*’; in http://www.thelatinlibrary.com/frontinus.html; also see: W. SMITH D.C.L., LL.D., ‘A Dictionary of Greek and Roman Antiquities’, John Murray, London, 1875, *AGER, Lacus Curtius*: http://penelope.uchicago.edu/Thayer/E/Roman/Texts/secondary/SMIGRA*/Ager.html; and M. J. CASTILLO, Espacio en orden: El modelo gromático romano de ordenación del territorio, Universidad de la Rioja, 2011, pp. 83-110.

understanding of a past or present reality, study models need to be established to enable us to explain it and simulate it. On the basis of this definition and through the extensive use of mathematical and statistical models and online linear programming, we can analyse, interpret and make predictions, regressions or reconstructions about the evolution of ancient economic systems as regards the potential production of a region or territory, the production surplus that could be commercialized in foreign markets, and variables such as the selling price, market reactions, production and transport costs, business trends and the consequences of economic policy.

The following diagrams show the different stages and processes that define the cognitive process through the application of models:

![Diagram 1](image1.png)

They also show the different phases or stages of the research through the way these are developed and applied:

![Diagram 2](image2.png)

Any investigation that aims to obtain a more detailed knowledge must follow a methodology that includes developing its studies at different scales of analysis:

- **Geospatial**: At macro-spatial (regio), meso-spatial (territorium) and micro-spatial (torcularium atque figlina) levels.

- **Geoeconomic**: At macro-economic (regio), meso-economic (territorium) and micro-economic (torcularium atque figlina) levels.
As far as the origin, development and spread of vitiviniculture in the *regio Laetana* between the 1st century BC and 3rd century AD is concerned, an important catalyst seems to have been the territorial and demographic configurations themselves and the specific interaction between these two variables and the intra-regional and extra-regional economic networks. This interaction comes about due to a series of behaviours and decision-making processes that can be studied and modelled. There are three modelling categories:

- **Descriptive models**: These quantify the interrelations of the data in order to group them and classify them in sets, e.g. economic and econometric models developed through the adoption of geospatial and geoeconomic quantification processes, adapted to a past reality.\(^{85}\)

- **Decision-making models**: These describe decisions in connection with all the elements, variables and agents that play a part in the process. They serve to predict possible results depending on the decisions made, e.g. multi-agent models.

- **Predictive/regressive/reconstructive models**: These analyse situations and events in the past in order to make predictions. They can simulate human behaviour and the evolution of a socioeconomic system (production or market) when faced with different stimuli or specific situations.\(^{86}\) The predictive model is also an excellent tool for calculating, analysing and interpreting the balance between the intra-regional consumption and the extra-regional export of wine.

The following diagram shows three groups of predictive modelling that we consider essential for the development of our study, along with the different parameters that can be studied:

![Diagram of potential production, regional consumption, and market orientation models](image)

Other important questions that also need to be taken into account are as follows:

- **Technology**: In many cases the number and characteristics of the must processing, collection and storage systems are unknown and will therefore have to be estimated.

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- **Rural settlements:** With typologies, clearly-defined functions and unequal density depending on the territory. Such factors are determined by social, economic and social strategies.

- **Associated artisan sector:** Systematic presence of activities complementing the main agricultural activity in most settlements.

- **Land ownership and distribution:** Existence/coexistence of small producers and big landowners who each organize agricultural production in their own way.

- **Interpretation:** This documentation has been interpreted as part of a rationally organized production system, which means heavy investment in technology and labour, capable of generating surpluses, well connected to a market system\(^{87}\). This vitivinicultural production system would constitute an important sector in the provincial economy, and its dynamism could bring opportunities for personal enrichment for some social groups and help them to rise.

- **Demography:** Phenomena like indiscriminate increases or decreases in income per capita, migrations, epidemics, wars, etc. can create significant fluctuations in population and situations of imbalance that can have a decisive impact and influence the evolution of this socioeconomic system\(^{88}\).

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**Figure 5. Comparative study of Malthusian & Boserup’s demographic models with its carrying capacity & ecological overshoot**

\(^{87}\) Revilla, *Viticultura*, pp. 84-86.

\(^{88}\) Several demographical models must be considered on the analysis of relationships between population growth and optimization of food production (see figure 6).
5.2. The *confinium Hasta Regia-Gades*: GIS modelling in Roman agriculture and reflections on the *riparia-vinea* ratio

The difficulties involved in studying Baetican viticulture can be overcome by increasing the volume of the available, essentially archaeological data. However, there also needs to be a simultaneous renewal of the theoretical and methodological approaches. In this respect we present a brief reflection on the challenges and advantages of GIS modelling. This type of discourse runs the risk of becoming lost in the mass of possibilities provided by the methodology in question. We therefore propose to explain the subject by means of a case study. We will look at an investigation in progress to exemplify certain types of problem and probable solutions for other studies in the same area\(^99\). This research also returns with an alternative approach to the recurrent question of the weight of the Baetic references in Columella’s imagery.

First of all it would be a good idea to point out one of the basic principles of modelling: it is not a question of reproducing a past reality as it was, but of representing possible realities. These different scenarios are obtained by varying the status given to a series of parameters established as determinants of the historical phenomenon we want to model\(^90\). Secondly, it is important to limit this choice, bearing in mind the resources available for the research\(^91\). Indeed there is a risk of establishing over-complex models in which the variability of the solutions makes a decisive approach impossible. Thus the applications in the sphere of Roman agriculture can range from resource-capture analysis\(^92\) to agent-based modelling-ABM\(^93\). The case study we will describe had to cope with seriously limited means, hence the very specific nature of the research’s guiding question. Despite this, the points for analysis resulting from the study involve significant issues concerning Roman agriculture and economy.

The case study involved an exploration of the agronomic ratio between *riparia* vegetation and vines. Works by the Latin agronomist Columella (Col. IV, 30, 2) establish the proportion of land on which plants that provide the necessary material for training vines should be grown. These plants included reeds, willows and osiers, which were necessarily or preferably grown next to water. Seen from a modern-day perspective and bearing in mind the geographically unfavourable context, carrying out research into the historical application of this ratio would be considered unadvisable. However, just like the amphorae, these materials had a value as *instrumentum* within the *fundus* and physical characteristics that perfectly matched their function. The Roman agronomic mentality therefore gave them significant economic weight and stressed the need to apply the template mentioned above. It remained to be seen how applying this theoretical principle would fare in a specific practical case.


The choice of spatial framework took into account the information available and the researcher’s familiarity with the environment⁹⁴. The aim was also to keep the margin of error small and limit the ranges of the variables. Alternative solutions to the actual proposals of the model could be suggested as well. An example of this would be the use of plants other than those recommended for training vines by Columella but which proliferate in the region. An area was therefore chosen between two former territória of the colonia Hasta Regia and the municipium of Gades, in the Roman province of Baetica (Map 6). Here a collection of sites could be chosen, rural establishments that would have been active between 45 BC and 74 AD, coinciding with a particular phase of territorial planning and full implementation of the villa economic system. Most of this information comes from an archaeological record of the surface, detected in surveys. Excavations and palaeoenvironmental studies are few and far between. In short, this is a conventional context, with the usual determinants found in territorial studies of the Roman world. However, there are also definite advantages, mainly a clearly limited historical framework. The context is chronologically and politically defined and economically favourable for the development of viticulture, i.e. a fertile environment with good communications under the control of Romanized elites who would have been the driving force behind the investment.

The amphoric record needs to be inserted at this point in the debate, both as an argument and as an object of reflection in itself. The manufacture of wine amphorae in our area of study indicates the existence of production for export, but the bivalent character of known amphoric shapes poses problems of interpretation. Also, the possible existence of production for export does not necessarily presuppose the use of the vine-training technique because the vines could have been grown sine pedamentis. About 15 of the 73 sites studied (20.5%) produced amphorae, all within the chronological period stipulated⁹⁵. Some types were used exclusively as containers for salted products (Dressel 7 and 8).

The others would have had a bivalent use, also containing different types of wine. The Dressel 1 would follow the Italic tradition in this respect. The tituli picti occasionally indicate the contents: vin(um) d(ebrutum) (Mañá C2b), lump(hatum) vin(um) (Dressel 9 and Beltran IIA, and perhaps also the Dressel 11), vin(um) amin(eum) (Dressel 10) and vin(um) r(ubrum) (Beltran IIB)⁹⁶. The nearness in shape of the Dressel 7-11 typological group, the most abundant in the area, makes it difficult to taxatively distinguish between productions of these types of pottery. Another question to address is the location of the pottery workshops. Some are inland and others near the coast, but in environments in which vines have traditionally been grown. The availability of resources, communications and the seasonal complementarity of spaces and occupations thus come to be included in the debate. The production of the fish sauces and salted products could have contributed to the inclusion of local wine and grape by-products in the overseas trade.

Some pottery workshops, like certain wetlands, are very close to the edges of our study area. However, the space chosen is analysed as an isolated unit, distributed like a Voronoi diagram on the basis of site locations. Enclaves on the periphery are excluded, thereby avoiding an “edge-of-map” effect. This perspective goes back to the agronomic ideal of the fundus as a self-sufficient space. In this paper the cartographic resources used to document the environment across which the ratio was

⁹⁶ http://amphorae.icac.cat/, [27/10/2015].
estimated will not be specified, but it would be advisable to add an epistemological reflection. The general lack of palaeoenvironmental analysis calls for caution when dealing with anachronisms in landscape reconstructions. Indeed it is best to choose study areas where no big physical changes are expected to have taken place between the Roman period and today. Certain palliative measures may be useful for most studies of this type, e.g. estimating a particular height above sea level to imitate the former coastline. The historical cartography must be taken into account, although the distortion of the data represented often makes them difficult to incorporate into a GIS. Other interesting sources in this regard would be pre-industrialization notary and land registry documents. In the case of the study mentioned earlier, a German map from 1940-194497 fortunately provides a solution. This document indicates the presence of wetlands that have disappeared as a result of today’s technification of agriculture and even gives an idea of the area covered by vineyards.

Nevertheless, it could be argued that reconstruction is anachronistic, bearing in mind factors such as the vulnerability of certain wetlands to drainage works. In fact these infrastructures or the adaptation of river banks for landing stages would explain the location of certain enclaves in the area of study in spaces at risk of flooding. Then again, although the spread of crops depends to a large extent on cultural initiatives, the physical determinants would have had to have similar weight for all preindustrial technologies. However, while the true likeness of the phenomenon modelled in the area is important for weighing up the results, it must be taken into account that this concerns an idealized recreation with independent objectives, in this case a comparison between an agronomic ratio and a defined geographic space as laid out in the German map. This comparison could be extrapolated to other places which, in Roman times, satisfied the characteristics given for the GIS model. In short, this is a partial examination of the source in question and of Latin agronomy in general, as a theoretical discourse, in relation to the economic and geographic realities of Antiquity.

The preliminary results of applying the ratio indicate a highly unequal distribution of the riparia. This goes against the agronomic principle of the self-sufficiency of the fundus with its instrumentum. However, these results can be modelled because the vines could have been grown in varying proportions over the total available land. A different kind of consideration would give a grouping coefficient to the Voronoi sectors, which could create more sustainable theoretical fundi. There are plenty of strategies that can be used to reformulate the model. It is also a good idea to note down any reading of particular coherence. The total area analysed supplies a ratio of 8.9% riparia compared to the 9% indicated in the agronomic texts. This leads one to reflect on how unattached property could counteract the unequal distribution of the riparia. Although the transporting of materials from outside the property was not recommended, their nearness or favourable communications could weaken this rule. In this respect we could consider the information supplied in a notary protocol dated 1514 from a different historical context but close in conceptual and geographic terms98. It shows a sowing configuration similar to the one Cato (R. R., VI, 3-4) proposed for the riparia, reinforcing the idea of practices and patterns repeating themselves. The crop in this case was grown on an irrigated site separate from the vineyard which it would have had to supply. Thus using unattached property to produce riparia-type pedamenta is suggested as a probable solution in both the model and the historical parallel. Modelling therefore seems to be a useful tool for increasing historical knowledge in general and knowledge of Roman viticulture in particular.

97 Cartografía del Estado Mayor del Ejército Alemán, 1:50.000, 1940-1944 (MTA50R_1944). Instituto de Estadística y Cartografía de Andalucía.
98 Archivo Municipal de Jerez de la Frontera. Archivo Histórico de Protocolos Notariales. Escribano Luis de Llanos. Tomo 32 bis C. fols. 1161r-1163v. 9 de diciembre de 1514, Jerez de la Frontera
6. Discussion and Conclusions

This paper aims to provide a state of the art and suggest future lines of research about the importance of wine economy in Roman Hispaniae.

The nature of the information available and the various hypotheses put forward in recent decades enable us to pose a series of question which it seems possible to answer only via the creation of models of various types (economic, econometric, agent-based and/or predictive/regressive/reconstructive).

Some of these questions involve the nature of agricultural systems. Can the relationships between settlement patterns and agricultural exploitation systems be defined? Is it possible to identify a series of vitivinicultural production unit “types” and calculate their capacities and yields in absolute terms? Is it possible to “reconstruct” the interests, strategies and behaviours of rural landowners - defining certain categories - in relation to how an economic activity is organized or a particular property exploited? How might other factors such as forms of employment, the tax system, commissions and commercial margins have an influence? Other questions force one to look at the relationships between social structures and the economy, specifically the relationship between wealth generated by the wine economy and the social rise of individuals who took on the management of certain activities.

Yet more questions have to do with the possibilities of analysing the economy of the Hispanic provinces. Can the specific weight of viticulture be determined in relation to the weight of other known economic activities in the various regiones and territoria? Is it possible to establish a general study model to enable subsequent economic research into all these productive and commercial matters and their application to other territories?

In this context it is essential, first, to combine the analysis of archaeomorphological aspects and landscape archaeology with the study of the different variables that play a part in wine production. In this perspective it will be possible to draw inferences about agricultural productivity. More specifically, there are a number of issues that should be analysed in depth: technofunctional aspects relating to agricultural instruments, the machinery and structures used in the grape-treading and pressing process, winemaking techniques and processes and the various storage, packing and shipping systems, the product’s transport and distribution process, and the wholesale and retail trade process.

The intensive use of analysis tools, mathematical and statistical models and linear programming will make it possible to study, interpret and make predictions, regressions and reconstructions of ancient economic systems. We will therefore be able to calculate the production potential of a region or territory, regional consumption and how much of the surplus could be commercialized in foreign markets. Other variables such as the selling price, market reactions, production and transport costs, business trends and the consequences of economic policy will also need to be taken into account.

Our opinion is that, in order to be able to extract reliable macro-economic, meso-economic and micro-economic conclusions about the vitivinicultural production in a particular territory in Roman times, one of the first objectives should be an in-depth analysis of how the production chain functioned in that spatial and sociocultural context.

After that, efforts should be made to establish settlement patterns and exploitation typologies, define their evolution and develop what in classical economic theory would be called economic production models. These in turn are capable of being studied at micro-economic level. In this
area consideration is given to factors such as the calculation of yields, the production function, the appropriate use of production factors (land, workforce, capital, technology and knowledge), the structure of production and commercial costs and the system of prices and profits.

Subsequent efforts will be aimed at transforming these theoretical models into econometric models\(^9\). Econometrics provides the tools for the empirical analysis of economic theory, whether to verify it or to test the hypothesis of a model of relationships between variables. With econometrics the numerical values of the variables are analysed, not only their behaviour or general trend. It is also to test - in our case using historical and/or archaeological quantitative data - suggested or existing economic theories, to develop predictive/regressive economic models.

The ultimate aim of this study will therefore be to try and obtain absolute quantitative data on the subject, not only for the different stages of viticulture - growing, harvest, grape processing - but also for viniculture - pressing, storage, winemaking, packaging - in the different vitivinicultural facilities documented in the area of our object of study. From this point the meso-economic study of different scenarios will allow possible patterns to be drawn to enable us to study in greater detail the organization and evolution of the different agricultural concerns over time.

The use of econometric models along with the application and development of predictive/regressive/reconstructive models based on the identification of theoretical economic and productive vitivinicultural models of Roman times and their evolution over time in a specific territory thus becomes a new line of research that will no doubt make it possible to study in greater depth the production, distribution, commercialization and consumption of wine in Roman times.

Map 5. Figilinae of Hispania Ulterior Baetica according to Table 1. GIS data: D. Martín-Arroyo 2016.
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