Chapter 10
A Multi-scalar Approach to Long-Term Dynamics, Spatial Relations and Economic Networks of Roman Secondary Settlements in Italy and the Ombrone Valley System (Southern Tuscany): Towards a Model?

Stefano Bertoldi, Gabriele Castiglia, and Angelo Castrorao Barba

Abstract In Roman landscapes, the particular sites defined as secondary settlements (also known as *vici*/villages, minor centres, *agglomérations secondaires* and/or *stationes/mansiones*) have played an 'intermediary' role between the cities and other rural structures (*villae*/farms), linked to medium- and long-distance economic and commercial trajectories. The aim of this paper is to apply a multi-scalar approach to model their long-term spatial relationships and connectivity with the Mediterranean exchange network. On the macro-scale, we have analysed a sample of 219 reviewed sites to understand the diachronic trends and spatial dynamics of attraction/proximity to significant elements of the landscape such as towns, roads, rivers and coastline. The Ombrone Valley (Tuscany, Italy) represents a micro-scale case study of a complex system, in which the imported pottery (*amphorae*, African Red Slip ware, *ingobbiata di rosso*) found in the *vicus/mansio* of Santa Cristina in Caio, the Roman *villa* of La Befa and the town of Siena (*Saena Iulia*) provided diagnostic 'macroeconomic' perspectives. The results show how the secondary settlements occupied a nodal position in the Roman landscape in terms of resilience (long period of occupation until the Early Middle Ages) and spatial organization with a close relationship to natural and anthropic infrastructures and trade functions linked to Mediterranean routes.

Keywords Settlement patterns · Diachrony · Roman pottery · Network analysis · Statistics · GIS

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10.1 Introduction to the Study of Secondary Settlements: Theory and Method

Archaeological research into indicators for defining Roman settlements as 'secondary' (*agglomération secondaire*) (Leveau 2012; Garmy 2012), a theoretical intermediate between towns and *villae*, is still emerging (see Crogiez 1990, 391; Chevallier 1997, 284; Mezzolani 1992 113; Corsi 2000, 186; Maggi and Zaccaria 1994, 163–168; Cantino Wataghin et al. 2007, 88; Goffredo et al. 2013) (Fig. 10.1). This interpretation related to settlement hierarchy is also expressed in the definition of these sites as 'minor centres' (Tol et al. 2014). In the archaeological record, however, only a certain number of excavated sites were identified as secondary settlements: they are characterized as places with a specific role in the roads of the *cursus publicus* and/or rural agglomerations of the *vicanico* type (communities living in nucleated villages; Tarpin 2006).

Studying the topic of 'secondary settlements' requires the inclusion of a wide variety of themes, including the role of these sites, their abandonment and reuse, the organization of rural areas, trade, production, Christianization and land and river traffics.

The hypothesis that some of these sites seem to respect certain rules of spatial order oriented our research aimed to determine whether a trend or pattern in the spatial order of secondary settlements can be detected.

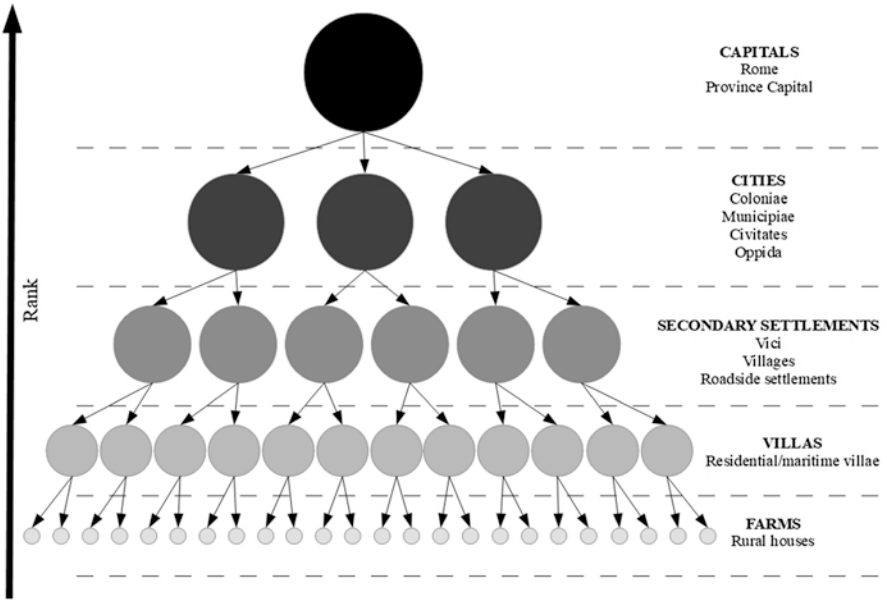

Fig. 10.1 Theoretical dendrogram of rank-size classification of Roman settlements, reworked from Garmy (2002, 31). About the classification of settlement types have been re-elaborated the macro generic groups proposed in Witcher (2012), and the typology of Roman cities has been taken from Nevett and Perkins (2000)

This kind of settlement is closely associated with economic functions: secondary settlements appear to fulfil the role of centres promoting and providing trades and services. The 'amount of services offered by a settlement' is a concept introduced in geography by Christaller (1980), who argues that it could be used as an indicator for defining the importance of an inhabited site with greater accuracy than the population of the site. The approach of the German geographer is crucial for addressing the problem of secondary settlements, the materiality and magnificence of which are insignificant in comparison to the monumental *villae*, but which held strategic importance in the 'State system'.

In this regard, the definition given by M. Corbier concerning the Gallo-Roman *vicus* is extraordinarily effective: 'A village that lives by exploiting a territory but not necessarily only through agriculture' (Corbier 1986, 691). A settlement of this kind often is involved in various productive crafts, such as the procurement of raw materials, leading to the construction of a system in which there are patterns ruling the space (Bischi et al. 2004); however, the outcomes are still influenced by many variables. In this system, even small changes can lead to very different results. Therefore, as in climatology and economics, it is very difficult to predict what may occur in the future. Following this line of reasoning, we can compare archaeology to burning matchsticks. Even with similar initial conditions, the smoke of each matchstick will follow very different trajectories, its path difficult to predict (De Guio 1992). This 'chaos theory' has also been studied in Physics, to explain how an attractor regulates a system governed by deterministic and causal dynamics (Lorenz 1963).

By looking at the settlements' network and its analytical composition, and the transformations and degradation thereof, one can observe a few spatial rules: whatever these rules are, we wonder what the driving forces behind them are.

In our work, the concept of 'cause' that Bloch had identified as 'the misstep of a man walking in the mountains' (Bloch 1998, 138–143) and that Flannery (1968, 67–87) and Plog (1975, 213–216) called the differential or 'kicking' element lost importance. What matters more here is to identify the forces generating these causations in their entirety. We will not aim to predict the past, nor will we deal with overly complex phenomena, thus leaving room for physicists, philosophers and theologians (Citter 2012, 13). We will use geographical and statistical methods only for descriptive analysis.

The theme of 'attractors' and the ability of some elements of the natural and human landscape to attract and/or repel goods, settlements, etc. is certainly not a novelty in archaeology (Wheatley and Gillings 2002, 134–135). The study of the diffusion of finds (in this case imported pottery) in certain types of settlements transforms us into a kind of Hop-o'My-Thumb (Perrault 2012, 42–46), in search of the traces left in the woods, with the goal of returning home. Unlike Hop-o'My-Thumb, however, we cannot tell if we are in front of a white stone or a crumb of bread. The truth of the past is difficult to grasp: not all of the material culture has survived, not all of the material culture can be found, not all the material culture has been excavated, not all the material culture indicates trade. However, studying the relationships and trade flows through pottery imports, and the products they carried,

requires investigating 'traces', without aiming for the completeness of the record, but nevertheless using the same methodology as the other branches of archaeology. Ultimately, rules exist in archaeology; however they are very complex.

10.2 Quantitative Approaches to the Analysis of Secondary Settlements in Italy in the Long Term

With a full knowledge of certain physiological problems of interpretation, we have tried to establish a program of cataloguing all of the published contexts in Italy, from both excavations and surface surveys, and interpreted in various ways (*stationes*, *mansiones*, *mutationes*, villages/*vici*, etc.), which may all be categorized as part of the group of 'secondary settlements' (Castrorao Barba 2016).

The compilation of a significant sample of sites formed the basis from which to undertake a quantitative approach to comparing the description of long-term historical trends with the spatial relationships to significant elements, both natural (natural coastlines and rivers) and anthropogenic (towns and roads).

The bibliographic inventory was stored in a database with information on the initial and final phases of the various settlements. The sites included in this study are those with a chronology dating between the first and sixth centuries CE and which have been identified by the excavators/publishers as those that may be defined as secondary settlements.[1] A sample of 219 sites (Fig. 10.2a) was collected (Table 10.1): 68.9% of them have been subject to excavation, while 31.1% are known only through field surveys.

For the purpose of 'data mining', descriptive statistics and spatial analysis were undertaken on this sample, in order to answer the following questions:

- When was the first phase of occupation of these secondary settlements?
- What percentage of the sites was active in the long term (third century BCE to thirteenth century CE)?
- How often did the sites remain active for a number of centuries?
- What is the relationship between abandoned sites and those permanently reoccupied after the end of the stage referred to as 'secondary settlement'?
- When did the phenomenon of reuse begin?
- What percentage of the sites being reused was characterized by the construction of a church?
- Was the location of the secondary settlements determined by the proximity (attractiveness) to certain important elements of the landscape (coastlines, rivers, towns, roads)?
- Which of the four 'attractors' appears to be the closest to a single site?

[1] This database is part of a PhD research project granted by the University of Siena (Castrorao Barba 2013), using the DBMS 'Carta Archeologica' (Fronza 2005) managed by the LIAAM laboratory at the University of Siena, under the direction of Marco Valenti.

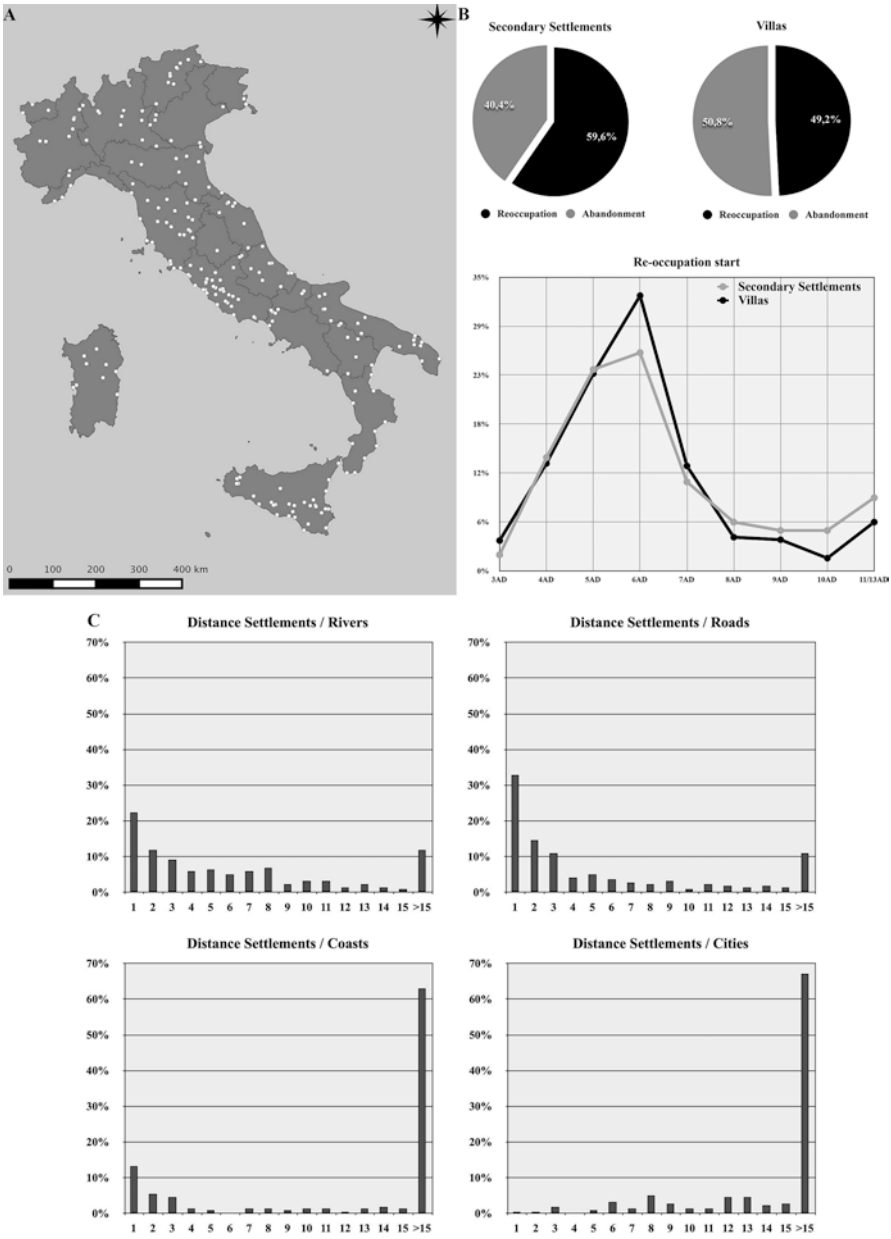

Fig. 10.2 (**a**) Distribution map with the sample of 219 sites used for the spatial and statistical analyses. (**b**) Comparison between *villae* and secondary settlements: percentages of deserted sites, of reoccupied sites and chronology of the reoccupation. (**c**) Frequency histograms of percentages related to distances (one class of 1 km from 0 to 15 km and then a unique class superior to 15 km) between secondary settlements and landscape elements (rivers, roads, coastlines, towns)

Table 10.1 Proportions of collected sites per region

Italian regions	% of sites
Abruzzo	4.6
Aosta Valley	1.4
Basilicata	3.2
Calabria	5
Campania	3.2
Emilia-Romagna	4.6
Friuli-Venezia Giulia	0.9
Latium	15.5
Liguria	2.3
Lombardy	5.5
Marche	3.2
Molise	1.4
Piemonte	2.7
Apulia	8.7
Sardinia	4.1
Sicily	14.2
Tuscany	11.4
Trentino-South Tyrol	4.6
Umbria	0.5
Veneto	3.2

- Were the reoccupations (with or without the presence of a place of worship) oriented towards sites in proximity to one of the four 'potential attractors'?

This statistical approach does not exhaust the knowledge that can be gained from this data source, nor is it its purpose. However, it is a robust tool for describing and quantifying a material reality (spatial relationships between sites and landscape) on a large scale, creating a 'normal' trend to be verified in agreement/disagreement with a different spectrum of variables observed on a micro-scale.

10.2.1 Descriptive Statistics on Diachronic Trends in the Roman Period and the Middle Ages

The quantification of the initial chronologies of secondary settlements shows that traces of human occupation dating from before the third century BCE can be detected in a fairly high percentage of sites (14.2%), while just over half of the sample (51.1%) shows an early stage dating to the first century BCE/first century CE. Following this, we see an accelerating decline in the number of new sites being settled, except for a brief period in the fourth century CE (8.2%).

By looking at the distribution of the frequency of sites in the individual centuries (Fig. 10.3a) between the third century BCE and the thirteenth century CE, a peak is observed in the fourth century CE (83.6%) and in the first century CE (81.7%) with

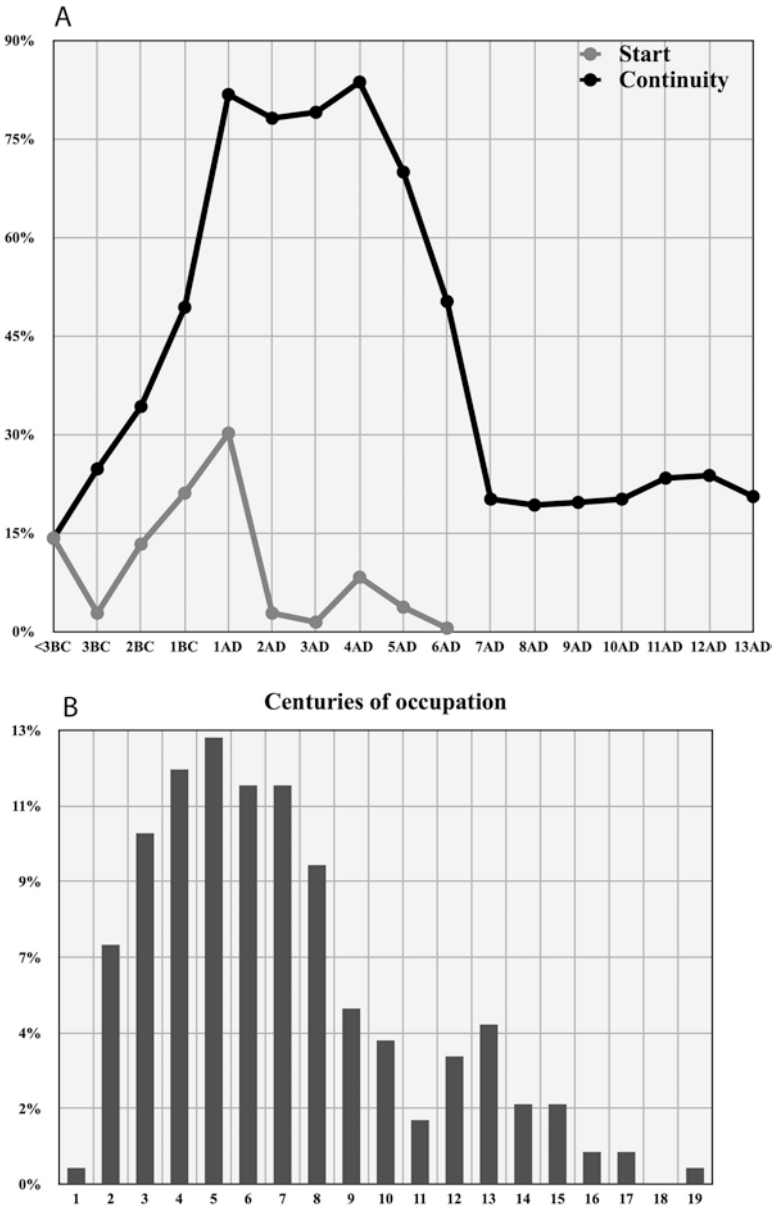

Fig. 10.3 (**a**) Diachronic trend of secondary settlements in Italy: start and continuity of occupation. (**b**) Frequency histogram with the secondary settlements' centuries of life

the period between the first and the fourth centuries CE containing an average 80.6% of the sample. In the following period, between the fifth and the seventh centuries CE, we see a progressive reduction of occupied sites with a growing decline: −16.4% between the fourth and the fifth centuries CE, −28.1% between the fifth and sixth centuries, and − 60% between the sixth and seventh centuries. After a stabilization between the seventh and ninth centuries CE (average − 3.4%), there were slight increases in the eleventh to twelfth century CE compared to the tenth century CE, + 18.1% and + 15.9% respectively, and a further decline in the thirteenth century CE (−13.5%). However, this last trend should be interpreted with caution as it often refers to the presence of religious buildings constructed in the High Middle Ages, which arose in those Roman secondary settlements for which we do not have reliable data on the different phases of continuity or discontinuity between Late Antiquity and the Early Middle Ages.

A frequency histogram (Fig. 10.3b) regarding the number of centuries during which a site was in use indicates a maximum peak for the class '5 centuries' (18.8%) and a maximum concentration (57.5%) in the classes from the third to seventh century inclusive (5 classes of 19). We can consider those sites occupied for the first century, or between the sixteenth and nineteenth centuries as abnormal exceptions, as each class holds a value of less than 1%, thus excluding these 'extreme' values. An average value (sum of the number centuries/occurrences sites/total sites) was calculated as 6.5, which indicates roughly the average number of centuries during which the secondary settlements remained active.

Regarding the phenomenon of post-Roman reuses, only the excavated sites have been taken into account, by comparing them with the Roman *villae*, 151 secondary settlements and 768 *villae* in total (for statistics about Roman *villae* and reuses, see Castrorao Barba 2014a, b). The comparison between the cases with traces of reuses and the definitively deserted sites reveals a clear difference between the two groups, with secondary settlements most likely to be reused (59.6%), compared to the villae (49.2%) (Fig. 10.2b).

Curves relating to the history of the initial phases of reuse showed similar trends: the fifth to sixth century CE is the period with the highest number of reuses both in secondary settlements and in *villae* (50% and 56.2% respectively). A similar peak can be seen during the sixth century CE, although more pronounced in the group of *villae* (32.8% vs. 26%). From the seventh century CE, the number of new cases of reuse begins to decrease, with the rates of reuse slightly higher in secondary settlements compared to *villae*, as well as in the eighth century CE (5.8% vs. 4% respectively), the ninth century CE (4.8% vs. 3.7%) and the tenth century CE (4.8% vs. 1.5%). The slight increase recorded for the period eleventh to thirteenth century CE (8.7% vs. 5.8%) is likely to refer to contexts in which reuse phases prior to the construction (or perhaps reconstruction) of churches in Roman sites have not been recognized.

Further data concerns the presence of Christian places of worship built on pre-existing Roman sites: the presence of a church is documented in 44.2% of cases of reuse of secondary settlements, with a lower proportion of reuses of *villae* (34.6%). In absolute terms, the number of *villae* in which a church has been identified is

higher, but this figure is highly biased by the higher total number of Roman *villae* and the greater spread of their territory. The high percentage for the secondary settlements indicates that this type of site was more attractive for the construction of churches, while *villae* had proportionally higher rates of other types of reuses (housing units or groups of tombs).

10.2.2 Spatial Statistics for the 'Attractive Force' of the Landscape's Significant Elements on Secondary Settlements

Assessing the relationship between settlement choices and landscape elements on a large scale, whether natural (rivers and coast lines) or anthropogenic (roads and towns), required an extensive amount of data processing.

To quantify the concept of 'attraction', it was necessary to connect it to the idea of 'distance': the closer site x is to place y, the greatest the attractiveness of y on x. Through a further effort of abstraction, the Earth's surface was considered flat and smooth, eliminating all geomorphological roughness, as if it were a two-dimensional Cartesian plane (Euclidean space). GIS-based spatial analysis made it possible to calculate all distances in meters between the individual sites and the four potential attractors: rivers, coastlines, roads and towns. The goal was to understand the distribution of the sample in various intervals of linear distances in relation to the attractors, in order to numerically verify the different levels of proximity.

A statistical indicator was used to summarize the relative percentage frequency of the values of the site/attractor distances within 15 size classes. This operation expresses the number of times (as a percentage of the total) in which a distance value is included in a class (Coccarda 2011, 64). The definition of the number and amplitude of the classes included only the sites' attractors within a 15 km limit, beyond which the relationship between the entities is practically irrelevant.

The reading of the frequency histograms allows us to make some observations. In general, the majority of sites are located within 1 km of a river (22.4%) or a road (32.9%), with the terrestrial communication routes representing the main attractor. A much lower proportion of sites are located within 1 km of the coastline (13.2%), while those in close proximity to urban settlements (0–1 km) represent only 0.5% of sites. The low combined force exerted by coasts and cities can be also observed in the high number of inhabited centres located over 15 km away: 63% and 67.1% for coastal and urban areas, respectively, while only 11 0.9% and 11% are positioned that far from rivers and roads (Fig. 10.2c).

The data on the first quartile for the four attractors, i.e. the value falling in the first 25% of the distances sorted in ascending order, mirror the patterns seen in the frequencies. The roads show the lowest values, an indicator of the higher proximity of sites to roads, followed by rivers and then by coasts and cities, where 75% of sites are at a distance that exceeds at least 4 km from the attractor.

A different spatial analysis allowed us to identify the 'unique element' closest to rivers, roads, coasts and cities for each settlement: also in this case, the proximity to roads constitutes the most attractive element with 46.6%, followed by rivers (41.1%), coastlines (11.4%) and towns (0.9%).

In order to evaluate the impact of the different surface occupied by the buffer zones of 1 km around rivers, cities, coastlines and roads, the statistics are weighed. The percentage of the sites inside this proximity area was subtracted from the total area covered by the single buffer zones in the entire surface of Italy. The results show – also in comparison with the villas – the stronger relationship between the secondary settlements and the roads, the coastlines and the rivers.

These percentages are a numerical representation of the close spatial link between secondary settlements and communication systems (major roads and rivers), a characteristic that demonstrates the importance of the inclusion of these populations within a complex system of interactions and flows of people, ideas and goods. In contrast, towns appear to exercise a centrifugal and bumping force, creating an area of 'respect' related to the authority of the town, which is not seen around 'secondary rank' settlement types. This 'hegemonic' role of the cities characterized by its surroundings empty of large sites, such as secondary settlements, is well explained in the classic geographical theories of central places (Christaller 1980) and rank-size law (Zipf 1949). Secondary settlements appear to have an alternative role and perhaps competition compared to cities.

The same pattern (proximity to rivers and roads and distance from towns) is also found in sites that were reoccupied for an extended period, with new functions between the Late Antiquity and the Middle Ages (fourth to thirteenth century CE), 47.5% of the total sample. Fifty per cent of the reused settlements were located at a short distance from a road compared to the other landscape elements (39.4% from a river, 9.6% from the coast, 1% from towns). Furthermore, the relative frequency percentages indicate the same trend outlined for secondary settlements: a maximum peak in the sites located 0–1 km from roads (34%) and rivers (27.9%) and a minimum for coasts (12.5%) and cities (0%). If we compare the histograms of the total with those of the reused sites, we notice an increase in the incidence of proximity to rivers in the reused sites (+5.5%) and a sharp decline in reused complexes in the vicinity of a city (& gt;15 km 73.1%, +6% compared to all sites).

Within the reused contexts, there were 46 cases (44.2%) in which the presence of a Christian place of worship can be identified. The places chosen for reuse for the construction of a church were those in proximity to a road (50%) or river (37%) and further from the coast line (13%); 39.1% of the sites were located within 2 km of a road, 30.4% within 2 km of a river and 13% within 2 km of the coastline.

10.3 From Global to Local: The 'Ombrone System'

The objective of the data presented thus far is the definition of an economic landscape that we have defined as the 'Ombrone System' (Fig. 10.4). The strength of our analysis comes from the fact that this system was not conceived a priori but was

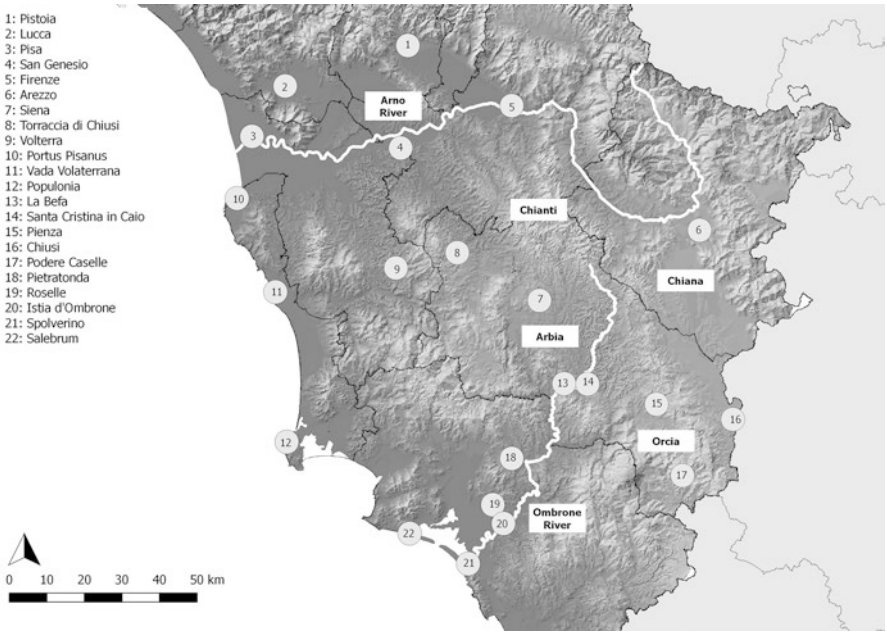

Fig. 10.4 Map of central and southern Tuscany (Arno and Ombrone valleys) with the sites mentioned in the text

based on analysis made in previous research (Bertoldi and Castiglia 2015; Bertoldi et al. 2015) which embraced landscape studies, spatial analysis and the study of material culture and settlements, which have gradually come to define the economic landscape. Research based primarily on the analysis of the secondary settlement of Santa Cristina in Caio (Bertoldi and Valenti 2016) gradually led to the framing of a much wider network, made up of roads, towns, commodities, rivers and people. From a positivist point of view, a base of quantitative data allows us to understand how countryside, urbanization and commercial trade (in different hierarchies) can interact with each other, despite some significant differences. The rigorous analysis of the origin of *amphorae* was undoubtedly one of the indicators with the greatest impact in this respect. This is not the place to dwell into the details of individual *amphora* types observed in the different contexts we have considered, as it would serve only to repeat a precise assessment already made in another study (Bertoldi and Castiglia 2015), but rather we want to dwell on a range of selected indicators, fundamental to the definition of the 'Ombrone system'. One of the most striking points in the comparison between the town and countryside is dictated by the presence/absence of the so-called '*amphora* of Forlimpopoli'. These were produced in the Adriatic side of Italy (in different types: see Aldini 1978; Aldini 1999; Panella 1989; Panella 2001) predominantly between the first century BCE and the third century CE. It is common in Santa Cristina in Caio, present in smaller quantities at La Befa, but is completely absent in Siena. In order to discuss this phenomenon, we

must first consider this important fact: Santa Cristina and La Befa, despite being settlements occupying different hierarchic levels, form part of the same economic 'system' (albeit with different roles). They were in dialogue with each other but also with entities at both the hinterland and the coast (via Ombrone), a 'block' that is both different and complementary to towns such as Siena.

This dichotomy is well readable also in the proportional values of African Red Slip (ARS) ware and *ingobbiata di rosso* (local red slipware produced as imitation of ARS, see Fontana 1998), which allows us to develop a hypothesis regarding the development of relationships within a network of settlements which, even on a heterogeneous hierarchical scale, seems to consist of a solid network of commercial/productive exchanges. Introducing the Roman *villa* of Aiano-Torraccia di Chiusi (within the territory of Siena) into these comparisons, we can see that the *ingobbiata di rosso* coming from this site (quite plausibly produced in situ, as indicated by the presence of a kiln; see Cavalieri 2008) is not comparable either with the area of Lucca or with that of Florence, Pisa or Empoli and only minimally so with Fiesole. The only stratigraphic basin with which there are actual and demonstrable affinities is that of Siena (Fumo 2010, 33). The same trend can be detected in the *ingobbiata di rosso* coming from Santa Cristina in Caio and the Chianti region, sites with which there are also striking comparisons for coarse ware, especially regarding the *ollae* (cooking wares). An important aspect of these three contexts is also the fact that they are, respectively, to the north, south and east of the city of Siena, with a practically equidistant mileage from the city centre. It is therefore plausible to think about this complex of settlements as a deeply interconnected economic system, in which each vector acts as both an origin and a destination for certain types of pottery.

Based on the fact that a kiln has been identified in Torraccia di Chiusi and on production waste from the Chianti region, the presence of *ingobbiata di rosso* manufacturing workshops has been hypothesized (Valenti 1995). This leads us to believe that the town of Siena was the primary destination of a production chain originating in rural areas. Furthermore, the interdependence of Siena with rural settlements seems well demonstrated by its relationship with the third region, namely, Santa Cristina in Caio. In fact, remarkable similarities between the artefacts can be recognized here too, so on the one hand, Siena could be the starting point of what was produced in the other two settlements/distribution areas but at the same time also the destination of the goods passing by Santa Cristina. In this regard, in fact, in a recent and already quoted article (Bertoldi and Castiglia 2015), we have shown (or at least have proposed an interpretive key worthy of further consideration) that the Ombrone river, on the banks of which Santa Cristina was located, represented a constant artery in the period between the first and seventh centuries CE, ensuring supplies to the hinterland of Siena to a greater degree than the roads. This, therefore, explains the arrival of *amphorae* to the city from overseas during the seventh century CE (Cantini 2005, 197), right through the *vicus/mansio* of Santa Cristina in Caio.

The River Ombrone was navigable for at least part of its course; Plinius describes it as *navigiorum capax* (Naturalis Historia, III, 51) and Rutilius Namatianus as *non ignobile flumen* (De Reditu Suo, I, 337). The Ombrone's navigability is controversial. Some argue that the river, at most, was passable until Istia d'Ombrone (a few

kilometres north-east of Rusellae) (Cardarelli 1971, 15), while others more recently have denied its navigability (Arnoldus-Huyzendveld 2011, 41).

However, addressing the problem from a wider standpoint, its navigability becomes a 'non-issue': the importance of a river is not determined only in terms of its use for aquatic transport. It is no coincidence that in Italy the systems of the Po and Arno rivers have been thoroughly studied. In order to understand the role of a river network, it is sufficient to look at the permeability (north-south) and convenience (east-west) of the Danube in Roman times, apparently used only as a natural border.

Returning to our subject, we know that there must have been a road that connected Siena with Populonia; at first, it was assumed that this road accessed not only the area of Siena but also the whole countryside south of the city.

Noting, however, the distribution of the extra Italic pottery findings, there is a clear 'penetration line' stretching from the coastlines to the hinterland, independent of the previously mentioned line of access, which connected Populonia and Siena. In this system, Roselle becomes a point of departure/sorting of products coming from ports along the coastline (as previously supposed for the town of Siena and the *ingobbiata di rosso*). From here, the goods traced the course of the Ombrone until the current town of Civitella Paganico, home to a site identified as a Roman *villa*, called Pietratonda (Barbieri 2004: the author thinks actually of a *vicus* or of a *mansio*, due to the thermal baths for public use). This site would act as a junction, with the goods that had been travelling north-east and then crossing the Ombrone at the confluence of the river Orcia and bypassing the hill of Montalcino in the south. This route guaranteed faster communication between the coastal area and the valleys of the Orcia and Arbia and the site of Santa Cristina in Caio. This settlement was the terminal of the trade network and a market place for a large area, south of the city of Siena. A similar settlement is likely to have existed in Val d'Orcia (likely in the south-east), although the current state of knowledge is insufficient for estimating its location.

10.3.1 Pottery Imports in the Sites of Siena, Santa Cristina in Caio and La Befa

As already noted in other papers (e.g. Bertoldi and Castiglia 2015), the definition of relational systems between settlements and other forms of secondary agglomerates, at different hierarchical levels, must be accompanied by a systematic analysis of the pottery finds, in order to identify commercial relations at various distances. *Amphorae* should be considered a key part of the economic system and, therefore, an indication of contact between human settlements. This approach should be complemented with the fundamental study of ARS ware and its imitations. This brief introduction is essential, as this methodological approach is useful not only for purely 'descriptive' goals but also for an understanding of what will be defined as

the 'Ombrone system'. In this context, it was decided to enrich previous research (Bertoldi and Castiglia 2015) with the analysis of a little-known and previously overlooked site, the Roman villa of La Befa. Located only a few kilometres away from Santa Cristina in Caio, it was partially investigated archaeologically during the 1970s. It is not necessary here to describe the entire stratigraphy and structural evolution of the complex (for that, see the integral edition of the excavation in Dobbins 1980). It is sufficient to point out how the structures, at least in the investigated area, were abandoned at the end of the fourth century CE and that traces of later settling are not recorded. What aim to outline here is the assemblage of the identified pottery types, which will be integrated with the assessment of the Santa Cristina in Caio archaeological record, in order to later compare them with the data related to the urban context of Siena.

It must be stressed from the start that *amphorae*, and in particular the ARS ware, are not found in large quantities in La Befa, although qualitative analysis can be used to draw significant conclusions. The chronological frame of interest was divided into two main macro-blocks, one from the first century CE to the first half of the third century and the other from the second half of the third century CE to the end of the sixth century. It can be noted that in the earlier centuries, imports coming from the coastlines formed greater than 78% of the total, while the goods coming from inland areas make up the remaining to 22%. In the second chronological period, the disparity increases further, with a coastline/hinterland relationship of 98%/2%. With regard to the ARS ware, only five fragments of this typology were identified throughout the stratigraphic sequence, with only two having a reliable chronology, dating back to the half of the third century CE (Dobbins 1980, 143). In the period between the first century CE and the first half of the third century, 63% of the amphorae originated from the coastline, while 37% was from inland areas; between the second half of the third century CE and the end of the sixth century, these values diverge further, with 74% of the goods travelling from the coast and 26% originating inland. Using the same kind of analysis on Siena shows that in the first period there is a prevalence of coastline-sourced (and therefore maritime) items comprising 91% compared to 9%. In the second period, this trend remains almost unchanged, with a ratio of 89–11% (for Siena, see Cantini 2005; Castiglia 2014, 2015).

These analyses reflect very clear trends: La Befa and Santa Cristina, while playing different roles in the landscape and having heterogeneous 'settlement hierarchies' (being in the first place a *villa* and secondly a *vicus/mansio*, probably acting in the role of 'central place'), reflect the same tendency towards trade related to coastal environments (and, therefore, in close relationship with the Ombrone river, as we shall see in the following paragraphs). The town of Siena itself displays the same trend, reflecting the inclusion of the urban centre in the same system. It does not seem to be accidental that the fraction reflected in the two chronological macro-groups corresponds to a very specific economic phenomenon that swept much of the Mediterranean from the third century CE. In all three analysed settlements, we witness, in the Early Imperial Age, a majority of goods coming mainly from the Iberian Peninsula (primarily from Baetica but partly also from Tarraconensis, especially

garum and oil), as well as high-quality *amphorae* coming from Italy, associated with the transport of wine. From the third century CE, a sharp decline in both Hispanic and Italian products is documented, corresponding to the explosion of goods from North African markets, which become a characteristic feature in the archaeological record.

This evidence is derived exclusively from *amphorae*, as the ARS ware is present in very low quantities, in some cases close to zero, although higher quantities are seen in towns. In this sense, it is very important to consider the role of local products imitating the ARS such as the *ingobbiata di rosso*. These are characterized by almost slavish reproductions of the original North African pottery, although are of lower quality, especially in the coatings (consisting of reddish or brownish engobe), and peak chronologically in Tuscia between the late fourth and the sixth to early seventh centuries CE (Valenti 1991, 1995, 1996; Cantini 2015; Vaccaro 2015). This class is widely seen in both Siena and Santa Cristina, revealing a desire to imitate forms that no longer reached inland markets and, a need to fill the gaps to which the available supply could not respond. This indicates that a demand for ARS ware still existed, so the lack of certain types of ARS ware reflects a decline in trade routes. At the same time, the need to imitate, and therefore produce, these morphologically similar types ties to Roman tradition, mirror of the presence of still configured (although resized) needs and requirements that cannot yet plausibly be read as a reflection of a real crisis, which instead will accrue and be completed only in later centuries (Valenti 1999, 85). The absence of this pottery class in La Befa, however, could simply be due to the fact that, following the disintegration and subsequent abandonment of the facilities of the villa at the end of the fourth century CE, it has not been possible to record anthropogenic activities for those centuries in which the *ingobbiata di rosso* was a 'guide fossil'.

Since we have completed all the 'descriptive' and quantitative assessment, in the following section dedicated to the definition of the so-called Ombrone system, we will trace the implications of the material culture on the 'settlement hierarchies' and how we believe that these implications can be read.

10.4 Approaching Network Analysis: The Case of the Ombrone Valley

Trade relations in archaeology, especially for products for which we know the origin, contribute to the understanding of the complex interchange systems, especially within the Roman globalized world (Pitts and Versluys 2015).

In archaeology, the concept of networks is not a novelty: commercial exchanges, ideas, artisans and road networks are studied, but generally the term is used in a very generic way, or as a synonym of connectivity (Leidwanger et al. 2014). Like many other disciplines, such as statistics and geography, the network analysis had already been intuited by the New Archaeologists (see Clarke 1998), long before the devel-

opment of software able to help us in the application of such methodologies. With the development of post-processual theories, during the 1980s and 1990s, an anti-network thought was affirmed, which criticized the excessive rigidity of the system, technique and analysis (Knappett 2013; Collar et al. 2015).

We used the software Cytoscape (version 3.4), which is created for the visualization of molecular interaction in bioinformatics.[2]

We have selected the sites where a specific ARS form has been identified (e.g. Hayes 61), to create series of relationships and then linking the sites with the GIS least-cost path algorithm, for example, from the Salebrum harbour to the city of Roselle, from Roselle to Santa Cristina in Caio, and from Santa Cristina in Caio to the La Befa *villa*.

Fundamental statistics in network analysis are those linked to the concept of centrality: the calculation of the degree of centrality for each vertex and the degree of centralization of the network in general (Freeman 1978).

Besides the graphic representation, it is interesting to analyse some values that the network analysis generates: in particular, the betweenness centrality, which corresponds to the sum of the length of the shortest paths between each node and all the others to which it is directly connected and the edge betweenness, that is defined as the number of the shortest paths that go through an edge in a graph or network (Girvan and Newman 2002; Fig. 10.5).

Between the second and the third centuries, the chronological period chosen for network analysis, we identify three major commercial flows: the Mediterranean imports (arriving in the Tuscan hinterland from the Tyrrhenian ports), the Empoli *amphorae* and the Adriatic productions.

Santa Cristina is a central place in the commercial network of Roman Tuscany and in particular in the subnetwork of the southern part of the region. In particular, the settlement was a node of the three commercial routes described. The Mediterranean imports arrived in Santa Cristina from the Ombrone valley and were sold in the valleys of the Arbia and Orcia (and perhaps up to Chiusi). The Adriatic productions came from the valleys of Chiana and Orcia and are sold in nearby areas (such as the La Befa villa). The amphora of Empoli came to Santa Cristina from Siena and then in Roselle via the Ombrone river.

During the second century, Santa Cristina in Caio was the third site for betweenness centrality: the settlement had a role of distribution of Mediterranean products coming from the coast, towards Pienza, La Befa and Podere Caselle, and the Adriatic products coming from the Chiana valley towards Roselle, La Befa, Siena and then Volterra. The other nine sites on the top ten list are Pisa, Vada Volaterrana, Portus Scabris, Lucca, Roselle, Pistoia, San Genesio, Firenze and Portus Pisanus.

During the third century, among the top ten settlements with higher betweenness centrality, there are four cities (Pisa, Firenze, Arezzo and Lucca), four ports (Vada Volaterrana, Portus Pisanus, Portus Scabris and Spolverino) and two inland secondary settlements (San Genesio and Santa Cristina), connected to Roman roads and

[2] This software was developed in Seattle by the Institute for Systems Biology in 2002, then released under an Open license and currently maintained by a group of developers.

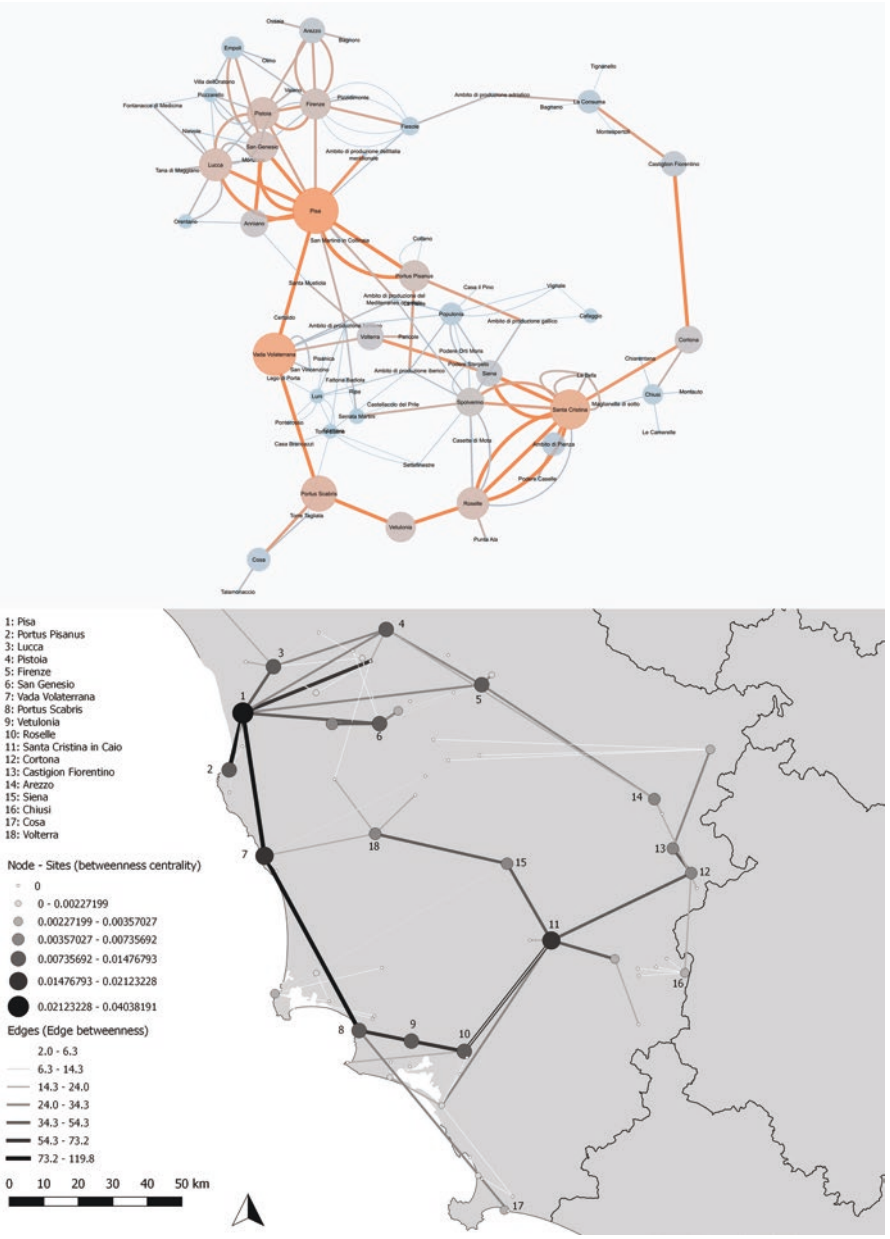

Fig. 10.5 (**a**) Network analysis of Tuscan settlements with ARS ware. The size of the sites is based on the factor named betweenness centrality, and the size of the edge is based on the edge betweenness. (**b**) GIS spatial representation of network analysis

important rivers (Arno and Ombrone). This type of sites was connected to commercial function. Secondary settlements were central places for the surrounding economic landscape and also to exchange goods with distant market places. It is not a coincidence that in these sites there were also productive activities, like pottery, iron and bricks (for Santa Cristina in Caio, see Bertoldi et al. 2017).

In conclusion, using this type of analysis, the principal network of Tuscany during the Roman period was the Arno system in the north of the region (Portus Pisanus-Pisa-San Genesio-Firenze-Arezzo). The second commercial network was located in the Ombrone valley (Salebrum-Spolverino-Roselle-Santa Cristina in Caio-Siena/Chiusi), and Santa Cristina in Caio was the principal node of the system.

10.5 Concluding Remarks: First Steps Towards a Model?

In order to define secondary settlements in their specificity throughout the transformations of landscapes between Roman times and the Middle Ages, we have chosen two different perspectives. Firstly, a macro-scale was used with the aim of understanding general trends by using 'data mining' methods (descriptive statistics), described by Richard Hodges (1989) as a 'parachutist's job' equipped with calculator. Secondly, we used a micro- or semimicro-scale (being 'cyclists' rather than truffle hunters) in order to study an economic system, the Ombrone valley, in which we can grasp the significance of the role of secondary settlements such as Santa Cristina in Caio, within a complex net of relationships between the hierarchy of settlements and commercial routes.

The first data coming from the sample of reviewed sites show some trends:

- The curves representing the continuity of use of the secondary settlements indicate a strong *longue durée* (an average of about six centuries), with a high percentage of Roman sites settled in areas which were previously already occupied.
- During the Imperial Age (first to fourth century CE), we do not record drastic phenomena of abandonment, and, indeed, in the fourth century CE, there is the creation of new rural settlements, contemporary to the maintenance of the vital role of the structures related to the *cursus publicus*.
- The remaining percentage of reuses, even more significant when compared to the trend seen in the *villae*, seems to reflect a greater attractiveness to new settlements formed during the difficult centuries of the deconstruction of Roman landscapes in the late fifth and especially the sixth century CE.
- In the secondary settlements (higher than in villae), the high percentage of reuses characterized by the construction of a church is a quantitative indicator connected to the organizational strategies of the Christianization of rural areas, probably planned by the Church itself from the fifth century CE onwards (this phenomenon finds a similar comparison in the Tiber Valley and is highlighted by the excavations at the Mola di Monte Gelato; see Potter and King 1997; more in

general, for Lazio, see also the fundamental Fiocchi Nicolai 1994). The position of secondary settlements in the landscape, favourable both for the interaction of man and environment and for its proximity to the crucial areas of the economic framework (roads, rivers and the sea), may have played an important role in the choice of secondary settlements as ideal places for the construction of rural churches, in a view of 'a precise plan of territorial occupation by the diocesan authority' (Cantino Wataghin et al. 2007, 105; Castiglia 2018).

- From a simplified and bi-dimensional point of view, the infrastructures of communication (roads and rivers) where goods and people travelled are phenomena of great importance in relation to the secondary settlements, which tend to be located in proximity to these infrastructures. In contrast, towns had their own area of influence 'rejecting' secondary settlements with a centripetal force, as in Coulomb's law, the coexistence of two poles with a strong 'charge' is impossible, especially in the paradigm of economic production, consumption and distribution of goods.
- The link of settlements with trade and the tendency of these to occupy nodes within economic trajectories in medium and large geographical areas is very important for understanding the continuity of employment of a site throughout the deconstruction of the Roman 'world system' and the complex emergence of the new Early Medieval world.

Under this general framework, however, lies a greater complexity in which certain factors and variables play a key role in our understanding of the historical processes.

The analysis of the 'Ombrone system' allowed us to compare the data of different kinds of sites (town-secondary settlement-villa) in the context of relations between sea and land along communication routes. In this framework, using the pottery analysis (*amphorae*, ARS and *ingobbiata di rosso*) as an indicator of economic flows has enabled us to better delineate connections between sites and between sites and the wider economic system.

Moreover, the detailed analysis of pottery held diagnostic 'macro-economic' perspectives, revealing how towns, secondary settlements and *villae* within this system, although playing different roles, managed to silently communicate. The city seems to be both the point of arrival and departure of certain types of goods, especially the *ingobbiata di rosso* produced in rural areas. The urban context, therefore, seems to remain an important point of reference in the hierarchy of commercial exchanges, despite the context of deep structural and topographic reconfigurations, such as the transition between Late Antiquity and Middle Ages. Nevertheless, the actual production needs to take place in rural areas and in the infrastructure connected to them, with workshops now constructed *extra urbem*, aiming to satisfy needs no longer tied to a large economic system such as that of the Empire but still anchored in the requirements of a market still influenced by it. The real turning point will take place only in the fully Early Medieval period, from the seventh century onwards. If we look at the nearby regional case of Lazio, the Tiber Valley Project, carried by the British School at Rome (Patterson 2010), represents a signifi-

cant and interesting comparison. In this case, from the third century onwards, there is a marked drop of settlements, with just an ephemeral reprise in the fourth and fifth centuries, with the secondary settlements going through a deep crisis: in the Tiber valley, only some *villae* and those sites that were reused for the building of churches ensured some tendencies of continuity (see Fiocchi Nicolai 1994; Patterson 2010, 145). But if we look at the material culture, mainly pottery, the trends are similar to those we identified in the Ombrone valley: from the fifth century onwards, in fact – quite analogously to what happens in our research area – the markets' needs were satisfied mainly thanks to local production that somehow guaranteed 'standardized good quality products' (Patterson 2010, 146).

Another interesting comparison is the Arno river: there were some secondary settlements that alternated with the cities in the valley. These minor settlements had a strong commercial vocation, as evidenced by the findings of imported ceramics (Cantini et al. 2009).

The Ombrone river is then a complex socio-economic system that favours long-term trade from the coastlines to the hinterland, through a 'winning' settlement type, the *vicus*. Santa Cristina in Caio and perhaps Pietratonda are the nodes of the system, living mainly on trade and crafts.

In conclusion, to define the economic and commercial role of secondary settlements in greater detail in the long term, two main things are needed: an increase in stratigraphic investigations of these contexts and an intensification of comparative analysis between the different provinces of the Empire and the individual systems, where rivers, roads and secondary settlements formed a segment of the economic history of the countryside between Roman times and the Early Middle Ages.

Authorship per Section

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