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## *Crop production, forms and sustainability of Iron Age farmsteads in Northern France: differences and convergences*

*Schlagworte: Mitteleuropa, Latènezeit, Wall-Graben-Anlage, Siedlungstyp, Innenbebauung, Haustypen*  
*Keywords: Iron Age, ditched enclosure, Northern France, crop cultivation, storage, farmsteads*

### Summary

On the basis of the “Iron Age Farms” database, it was shown that the duration of the sites was regionally homogeneous, but at the same time varied from region to region.

This paper hypothesizes that the life span of the sites is related to the choice of crops and the storage modalities (dispersed/concentrated; long-/short-lived). This work focuses on North-Western France between the 6<sup>th</sup> cent. BC and the 1<sup>st</sup> cent. AD. It is based on data from 309 sites and 100 archaeobotanical studies. Mapping these data helped us to discern several geographical entities and highlight trends/dynamics concerning the investigated parameters, that are crops, storage facilities and duration occupancy of farmstead.

### Zusammenfassung

Ausgehend von der Datenbank „Eisenzeitliche Siedlungen“ lässt sich zeigen, dass die Dauer der Fundstellen innerhalb einer Region zwar homogen war, zugleich aber von einer Gegend zur anderen erheblich variierte. Dieser Aufsatz stellt die Hypothese in Frage, nach der die Siedlungsdauer von der Wahl der Feldfrüchte und Art der Vorratshaltung abhing (zerstreut/konzentriert, lange/kurze Lebensdauer). Die Untersuchung betrifft Nordwestfrankreich vom 6. Jh. v. bis zum 1. Jh. n. Chr. und beruht auf Material von 309 Fundstellen und 100 archäobotanischen Studien. Die Kartierung dieser Daten half beim Erkennen mehrerer geographischer Einheiten und Konvergenzen bei der Entwicklung der drei untersuchten Parameter (angebaute Feldfrucht,

Art der Vorratshaltung, Siedlungsdauer) über die Zeiten.

### Introduction

This paper **explores** three aspects of Iron Age farming: crop production, storage management and settlement sustainability. More precisely, we want to see if there were common causes that influenced crop choices, storage modalities, the **forms** of the settlements, and their ways of exchanging crop products. The geographical framework is North-Western France and the chronological limits are a little bit larger than the ones of the La Tène period. We combined three databases in order to work on: Iron Age sites, storage structures and archaeobotany. By plotting the main crops and the main types of storage facilities, the aim was to verify if (i) they clustered in specific areas, and (ii) there were link with the distribution of long-term settlements. The chronological evolution of the three features will be explored in order to point out if potential convergences existed in all periods or were restricted to certain phases.

### Data sources

This study relies on three databases, first of all the one created by the Institut national de recherches archéologiques préventives/Inrap (Malrain et al. 2013). This “Iron Age farms” database aims at collecting consistent data and sharing information on rural settlements at a national level (datA-Fer2). The first step consisted of entering the data relative to the rural settlements from Hallstatt D3 to Early Gallo-Roman times, which covers the time from 550 to 10 BC. The data mainly concern settlements studied either by excavation or by intensive trial trenching on areas sufficient for recognising their functioning. Several files codify all information relevant to the identity of the settlement and geographical referencing.

This paper (will) explore(s) ??

types or shapes?

Different headings give access to a wide range of archaeological material and related activities, environmental context, administrative data, as well as the chronological phasing. This tool compiles the data in a consistent way and offers the possibility to develop new investigation fields at multiple scales. The tool is not considered an archaeological map, but is build up to treat rural settlements and landscapes (Malrain et al. 2015). Approximately 700 sites and 1000 archaeological phases were recorded. This work is still ongoing. The major gain is to acquire a better definition of the function of the settlements, their territorial expansion, their hierarchy, and the related landscapes (Malrain et al. 2009). Lorho et al. (2012) further explain the aims and functions of this database. According to the geographical framework of the present study (North-Western France), 309 sites were selected, representing 371 occupation phases. They are irregularly distributed, depending on the importance of the excavation work conducted in each area. In some places, the number of excavations is three times higher than in other regions. Such differences imply that the cartographical picture acquired shows a trend that is only valid for a certain period in time. The map will evolve together with the advancement and the refining of the database.

The second database completes and adjusts the information found in the first one. Thanks to the work by S. Bossard (Bossard 2015; Bossard et al. 2018; Bossard 2019), it exhaustively compiles the storage structures mentioned in archaeological reports of Brittany, Normandy and the Pays de la Loire. This inventory gives a more accurate view of Iron Age storage facilities in North-Western France by taking into account records from archaeological surveys as well as from excavated sites. The mapping of these data highlights new features. The combined databases represent a global account of 606 sites.

Moreover, 100 archaeobotanical studies have been listed for the study area (data in Neveu 2017 and also by M. Derreumaux, F. Durand, F. Toulemonde, V. Zech-Matterne). Only sites with more than 100 remains of domestic plants (cereal, *Triticum spec.* excluded) were included in the database. We only compared assemblages composed of charred plant remains, to avoid a bias due to taphonomic selection. The relative frequencies of the main crops were then calculated for each settlement (in %, based on the MNI = minimal number of individuals = number of complete grains + number of fragments/2).

## Data dispersal

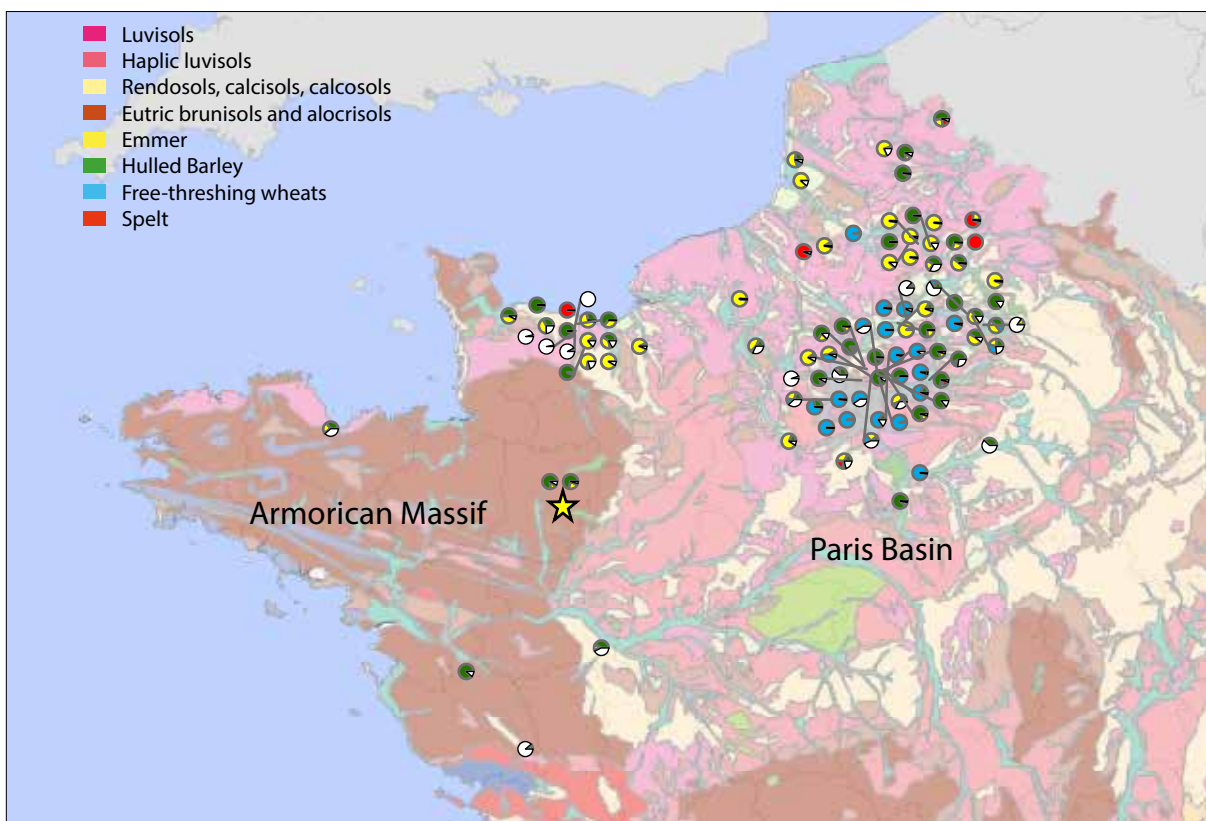
Our approach will proceed as follows: by plotting the dominant crop species, we hope to differentiate geographical entities. We will then

observe whether crop and storage structure distributions match each other and whether some types of structures were used specifically for some cultivated plants. Finally, we evaluate if long-lasting settlements cluster in a specific area in relation to plant husbandry practices. In the first part, we will consider the mapping of the data regardless of the phases; in the second part, we will focus on their distribution phase by phase.

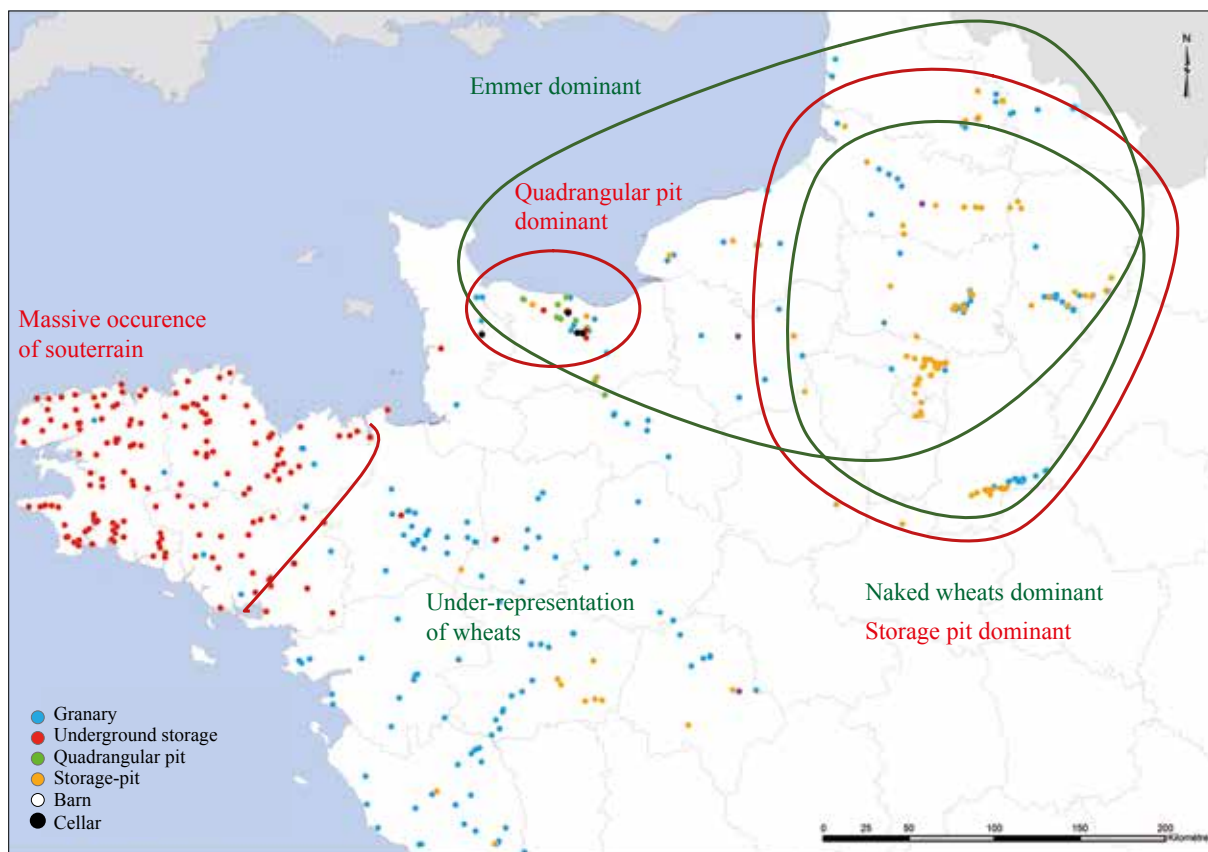
We plotted archaeobotanical data onto the basic map of the main pedological units in order to observe the distribution of the main crops. As agronomic properties result directly from the nature of the substratum and its superficial layers, it is more than likely that crop choices are directly influenced by soil characteristics and restraints. Main pedological units in the studied areas differ drastically. In North-Western France, we observe a striking contrast between the Armorican Massif Armoricain, an ancient mountain range from the Primary Era, where brunisols developed on a granitic and slaty substratum and the Paris Basin where luvisols on a limestone substratum predominate (fig. 1). Today, Northern France and the Paris Basin are cereal-growing regions, while the West of France is devoted to cattle breeding and market gardening. We can presume that the agricultural systems of the Massif Armoricain and the Paris Basin were also significantly different in the past (Zech-Matterne et al. 2013).

On our map (fig. 1) we have only plotted the four dominant cereals for each of the one hundred sites. One can immediately note that the data corpus is not representative for the West with most of the sites located in the department of Calvados only and moreover on luvisolic soils. Nevertheless, several observations can already be made. In the Iron Age hulled barley and emmer constantly maintained themselves as major crops (Zech-Matterne et al. 2009). But their distribution was inhomogeneous. Hulled barley supposedly has the capacity to sustain soils that are poorer in nutrients and to be less sensible to drought or salinity (Zohary et al. 2012, 52). This could explain the fact that hulled barley is present everywhere. But the presence of emmer wheat (*Triticum dicoccum*) is restricted to the luvisols so far. Free-threshing wheats are mainly associated with the Seine Basin.

Thereafter, we compared these results to the distribution of storage facilities. When plotting the dominant structures irrespective of phases, one can observe two distinct areas. In the west, underground storage in tunnels and cellars (souterrains) represents a specific pattern, whereas the Centre-North regions are mainly characterised by storage pits (silos; fig. 2).



**Fig. 1.** Spatial distribution of the four main cereals per site in relation to the main pedological units. The yellow star marks the location of the concentration of granaries at Entrammes. Emmer was the main crop identified in this site, but arable weeds associated with the stocks showed that the wheat had certainly been produced elsewhere and did not result from local cultivation surpluses (Guillier et al. 2015).



**Fig. 2.** Spatial distribution of the main types of storage facilities (after database S. Bossard).

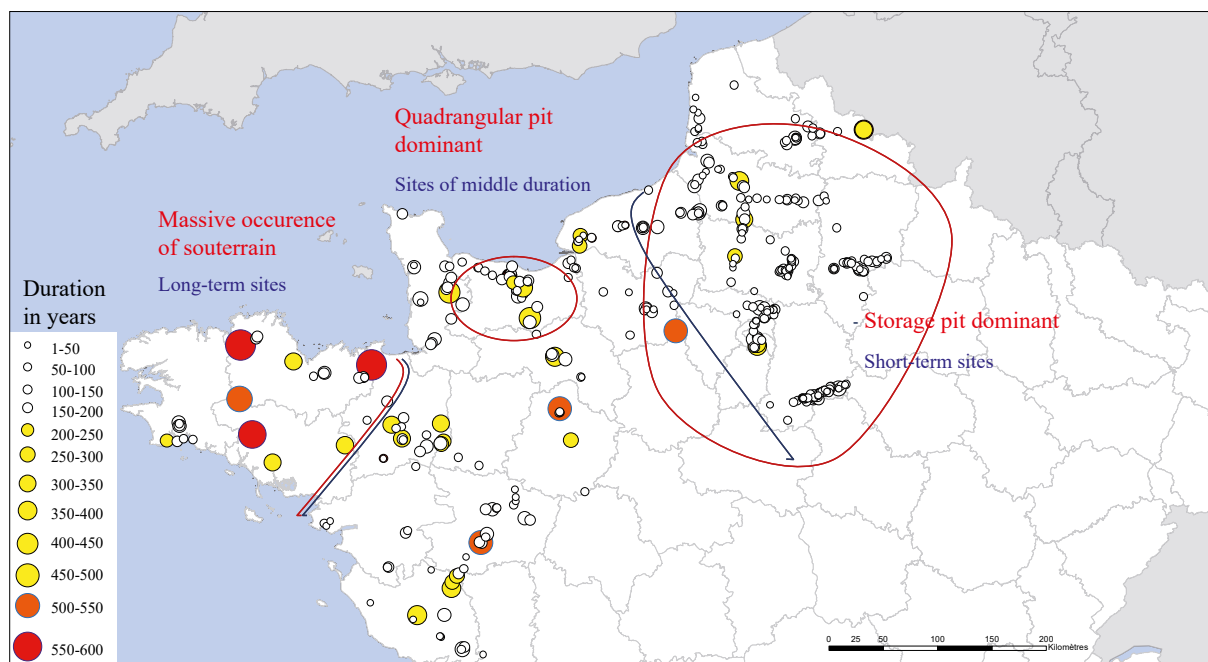


Fig. 3. Duration of the sites: spatial distribution of the categories classified by 50 year intervals.

In the Armorique region, souterrains are obviously numerous, and their repartition is clearly limited to the present-day departments of Finistère, Morbihan, Côtes-d'Armor, and the offshore bar of the Ille-et-Vilaine. In Lower Normandy, it is not easy to evaluate the extension of the phenomenon, well attested in the Plaine de Caen, but also more to the west, in the Calvados and Manche districts. Anyway, the Channel, as a maritime corridor, probably played a significant role in the dispersal of this kind of storage modality. Unfortunately, archaeobotanical data are too scarce to indicate what kind of crop could be stored in those structures.

This paper also offers the opportunity to study the duration of settlement phases. The longevity of the sites reflects the importance of the socio-economic factor in the organization of the countryside, and shows an increasing investment in land management (fig. 3). The northern part of the country is characterised by short settlement phases (usually 100–150 years). Brittany is quite the opposite. As an exception, it has longer-lasting settlements, from the 2<sup>nd</sup> half of the 6<sup>th</sup> c. till the end of the Gallic period. In between, sites with an intermediate duration are observed, e. g. in the regions of Normandy, Mayenne, and Pays de la Loire.

If we compare these categories with the repartition of storage structures, we observe that long-lived sites cluster in the zone where underground storage was preferred, mid-duration sites are encountered in Normandy and short-lived sites in the Paris Basin where storage pits and free-threshing wheats areas match.

These are the main features to be observed, but more local specificities can be noticed as well. The distinctive characteristics in the Plaine de Caen region are (i) the importance of quadrangular pits, and (ii) the high percentages of pulses, mainly Celtic bean and pea (fig. 4, top). The role of pulses in Iron Age plant husbandry systems is still under discussion. Their importance appears quite secondary in most areas of Northern France, since they are poorly represented (<1 % of MNI) in crop assemblages, except the ones from the Plaine de Caen. This situation persisted until the end of the 1<sup>st</sup> c. and the beginning of the 2<sup>nd</sup> c. A.D., when pulses finally reappeared as an important component of plant spectra (Zech-Matterne et al. 2009; Zech-Matterne et al. 2017). As cereals cannot be cultivated continuously on the same spot, fallow must have been used in between, instead of crop rotation including pulses. The change to other summer crops such as millets and oats could have been preferred alternatively. However, millet cultivation decreased everywhere from the 4<sup>th</sup> c. BC and the importance of oats is difficult to define, as the caryopses of wild oat cannot be distinctly identified and separated from domestic ones on morphological criteria.

Even if pulses certainly were no major component of Iron Age agriculture, they were used locally for specific purposes. For example, pulses can be mixed with oats to compose a high-quality fodder and increase its energetic value. Although oats played almost no role during the Roman period, it was an important plant during the Later Iron Age in western France but we cannot differentiate whether as a crop or as fodder.

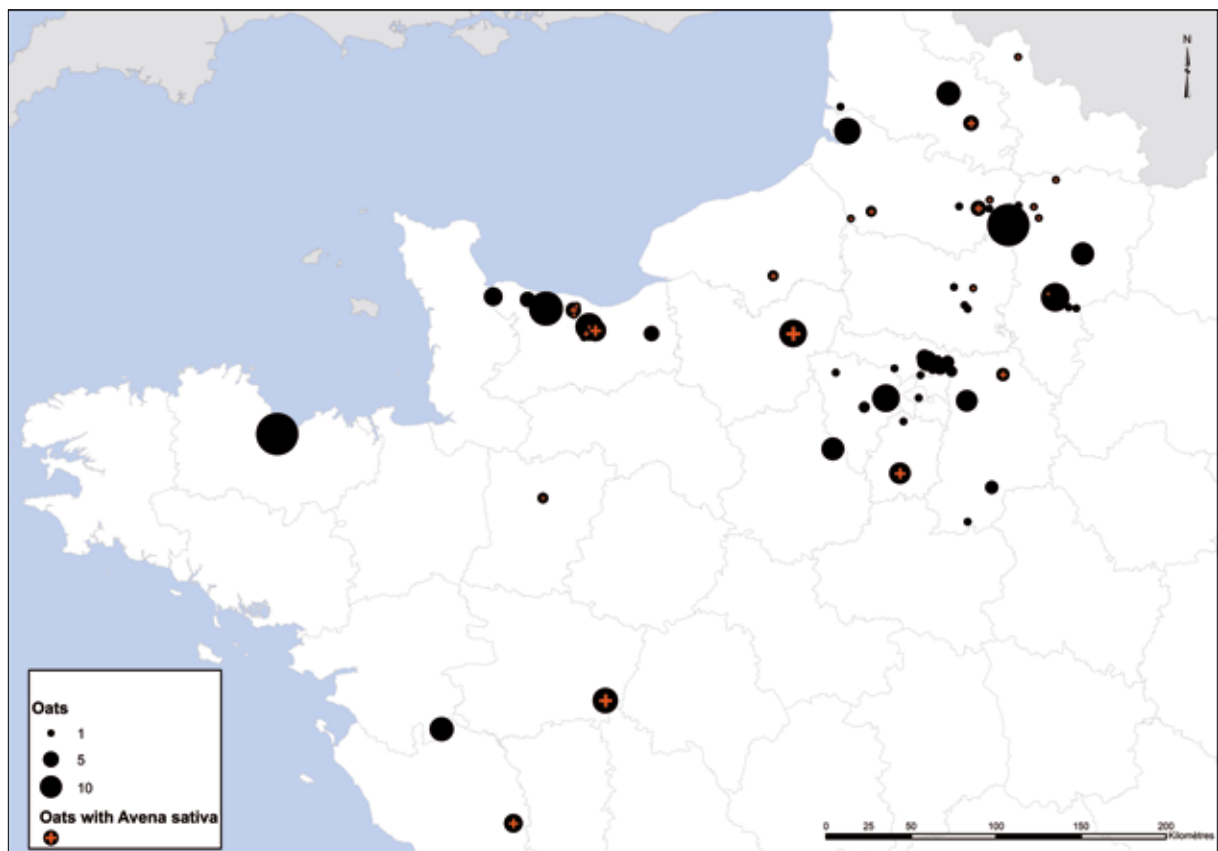
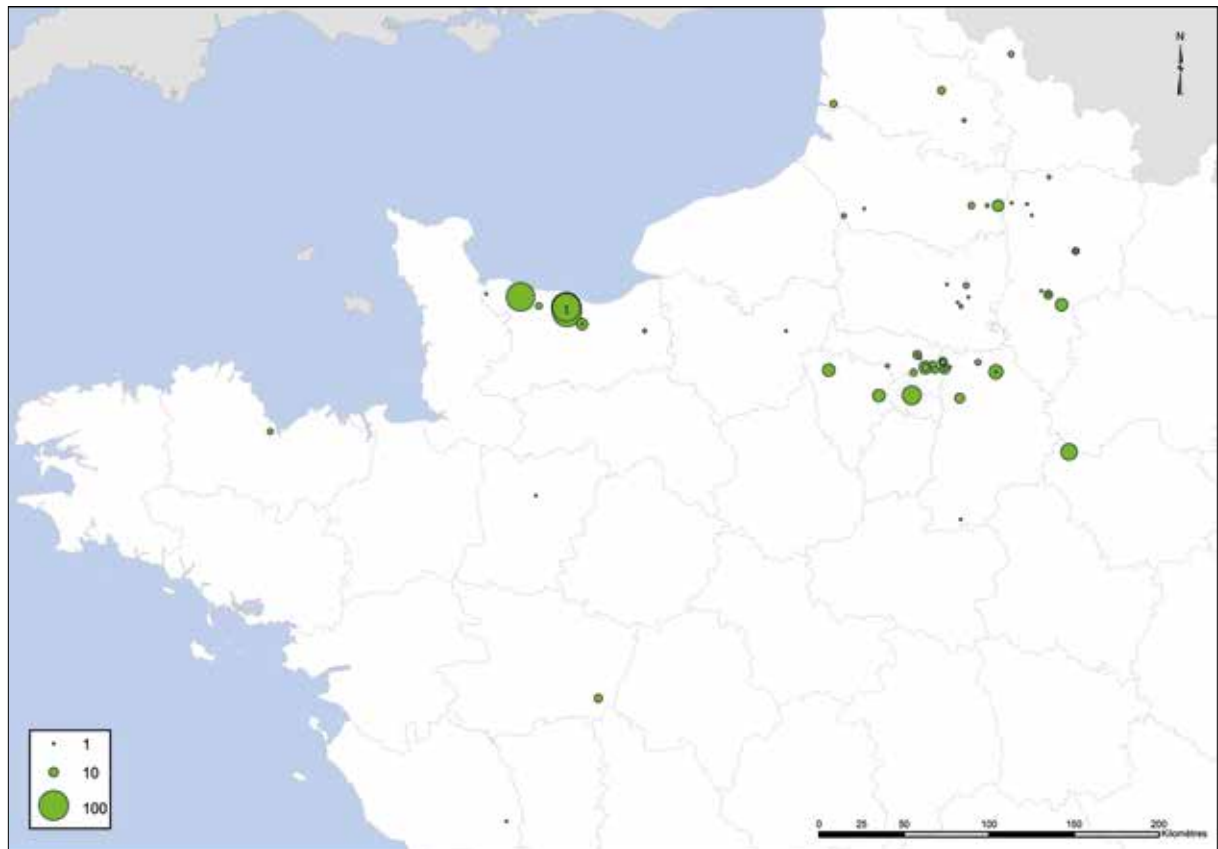


Fig. 4. (top) Relative frequencies of pulses (% of the MNI) showing high percentages where quadrangular pits are encountered. (bottom) Relative frequencies of oats (among them cultivated oat). Presence of *Avena sativa* (identified on lemma bases) = orange crosses. High percentages of oats are not exclusively associated with high percentages of pulses.

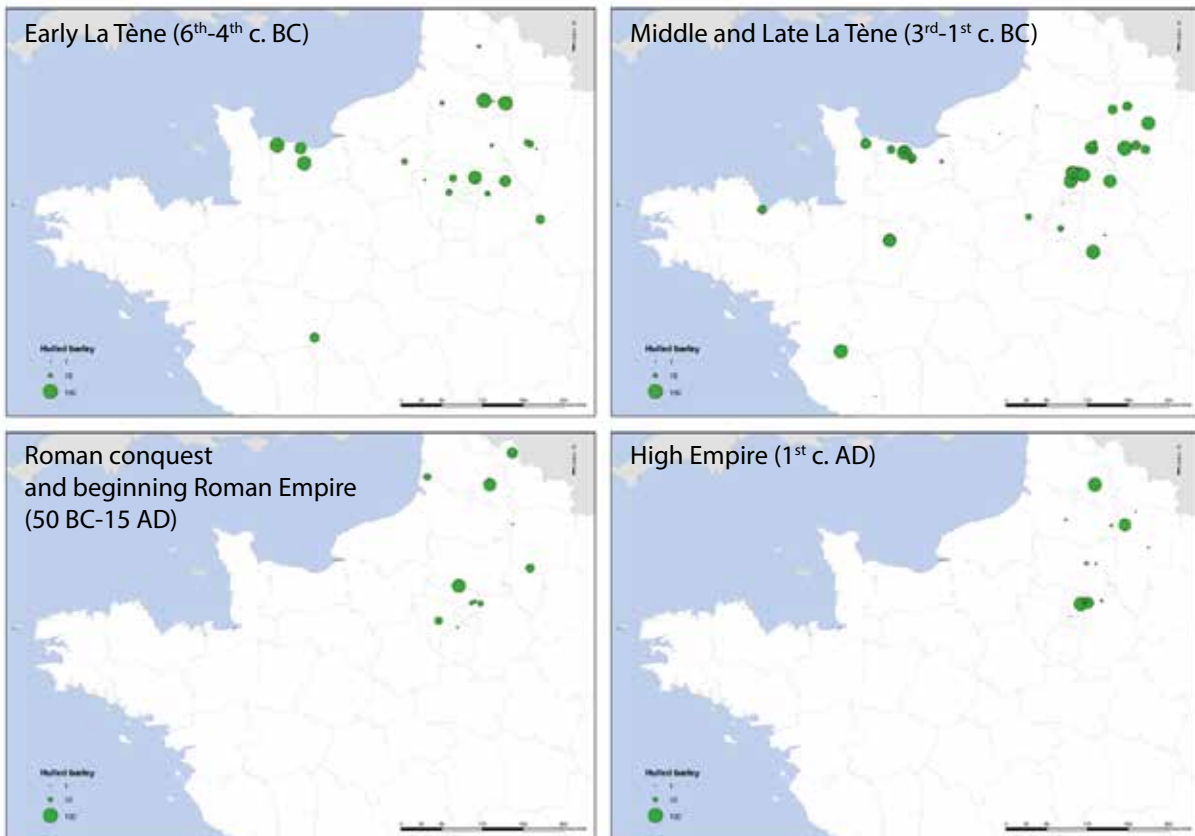


Fig. 5. Evolution of the relative frequencies of hulled barley (*Hordeum vulgare subsp. vulgare*).

We made a projection of oat percentages, also showing the occurrences of common oat (*Avena sativa*). One can see that oats are effectively well represented in the Plaine de Caen, but also in the North where neither pulses, nor quadrangular pits are recorded (fig. 4, bottom). So either oats can be considered a fodder only in the Plaine de Caen, or other reasons account for the high percentages of pulses and other particularities of this small region.

At this point, we should take a closer look at the evolution of crops and storage structures in order to determine potential breaks. The following map shows that hulled barley remained an important crop throughout the study area during all periods (fig. 5). Emmer, on the contrary, tended to decline during the Roman phases (fig. 6). The same pattern shows up for emmer (fig. 5-6-7). Moreover the abundance of free-threshing wheat rise from La Tène (Zech-Matterne et al. 2014) while oppida multiply (fig. 7).

In order to observe the evolution of storage facilities, the five centuries before Christ were similarly divided into three phases, according to the archaeological phasing used for the La Tène period. The first phase included sites inhabited from 550/500 to 300 BC, the second one from 300 to 180/150 BC and the third one from 180/150 until the beginning of the Christian Era. We only retained finely dated sites and rejected the ones

with broad chronological limits (600 to 50 BC) or an overlapping chronology (e. g. 200 to 100 BC). 428 sites have been listed, these sites correspond to 70 % of the primary inventory.

The largest number of storage structures (n=1362) corresponds to stage 1. For stage 2, the total number of structures is three times less important (420) and for stage 3 almost half (n=702). However, it needs to be put into perspective with the number of sites (column 2) and duration of each phase (column 4). So, we recalculated the number of storage facilities on a basis of 100 sites per stage and a duration of 100 years per phase. The results are shown in column 5 (table 1).

We observe a strong decrease of storage structures between Early and Middle La Tène that was even reinforced in Late La Tène. The increased scarcity of storage structures between Early La Tène and Late La Tène coincided with changes in the relative proportions of the types of structures recorded (fig. 8).

All types of structures are evidenced from the beginning of the chronological sequence (silos, granaries, barns, underground storage, quadrangular pits, cellars ...). However, their relative frequencies greatly varied from one phase to another.

Underground storage (souterrains) is reported everywhere in Brittany during the first chronological stage (550/500–300 BC; Bossard

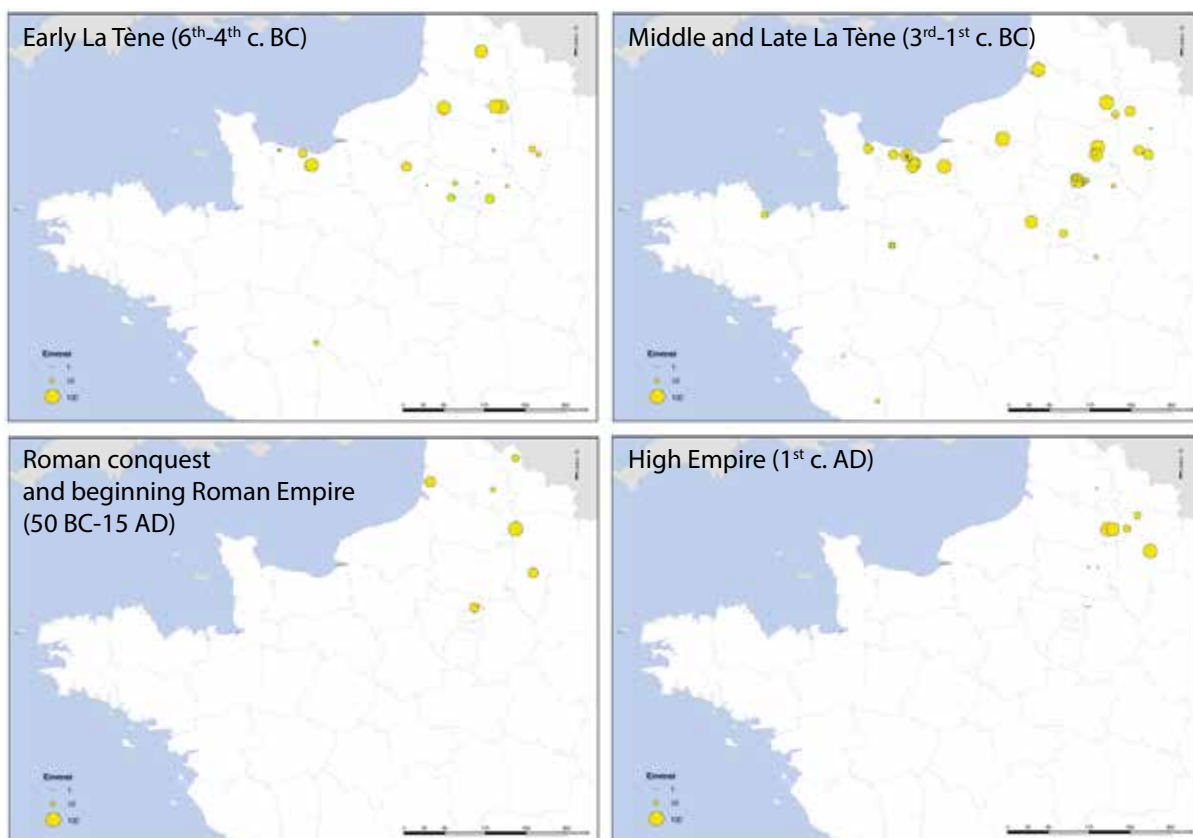


Fig. 6. Evolution of the relative frequencies of emmer (*Triticum dicoccum*).

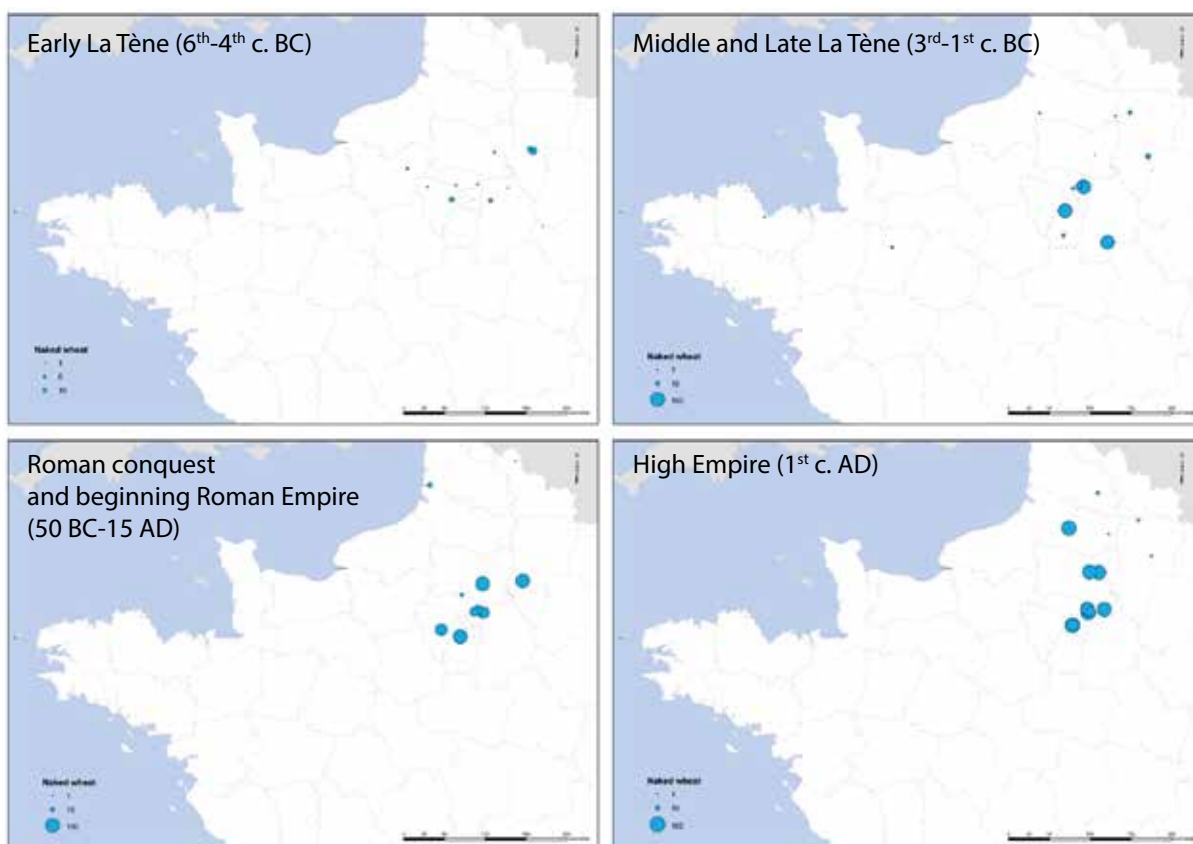


Fig. 7. Evolution of the relative frequencies of naked wheats (*Triticum aestivum/durum/turgidum*).



Structures	Sites	Structures theor. if sites = 100	Years	Structures theor. if sites and years = 100
1362	128	1064	250	425
420	93	451	150	300
702	163	430	150	286

**Table 1.** Number of storage structures on a theoretical basis of 100 sites per stage and duration of 100 years per phase.

2015). The last ones must have been established in the 3<sup>rd</sup> c. BC. They were definitively abandoned by the middle of the 2<sup>nd</sup> c. BC. The site of Inzinzac-Lochrist, located in the Morbihan and dated between 600 and 400 BC, is exceptional because it is the only site where granaries dominate. Forty-six of these structures were built all over the settlement enclosure, along the roads.

In Normandy, souterrains and wooden cellars are encountered a little later than in Brittany, which is around the 4<sup>th</sup> c. BC or even from the 2<sup>nd</sup> half of the 5<sup>th</sup> c. BC onwards. This type of feature is indeed lacking in settlements dated to the 6<sup>th</sup> and 5<sup>th</sup> c. BC. Granaries, silos and quadrangular pits are commonly used for grain storage in various quantities (Jahier/Vauterin 2011, 122). Several settlements such as the ones of Courseulles-sur-Mer (Jahier 2011, 226) and Entrammes (Guillier et al. 2015) distinguish themselves from others by their exceptional storage capacity, based on forty and eighty granaries respectively (LT A/B and LT C2/D1a). Souterrains and wooden cellars, from the Manche to the Plaine de Caen, were still in use by the 1<sup>st</sup> c. BC. At this stage of research, we might concede that underground storage probably first developed in the Armorique region and reached Normandy later. Meanwhile, quadrangular pits, often of a big capacity, became dominant from the 3<sup>rd</sup> c. BC onwards, particularly in the Plaine de Caen and the Bessin (Jahier/Vauterin 2011, 124). All these structures could have complementary uses and be devoted to specific products (cereals, hay, tubers...). Underground storage structures were mainly dug beneath or associated with buildings, but pits and granaries were completely separate from the residential parts of settlements, or even grouped in batteries in isolated enclosures. During the Middle and Late La Tène storage pits and silos were no longer in use in the Plaine de Caen but still encountered together with pits on the periphery of this area (fig. 9).

Further north, in the regions of Nord/Pas-de-Calais, Picardy and Île-de-France, storage was largely based on granaries and storage pits at all periods. Quadrangular pits rarely appear at two sites in the Oise river valley: Compiègne-“Le Fond Pernant” (Lambot 1988) and Pontpoint-“Les Près Véry”. At the second one, this type of structure even predominates (Malrain

et al. 2006). During the 5<sup>th</sup> and 4<sup>th</sup> c., settlements were characterised by large storage capacities, surpassing the needs of their inhabitants. They are **considered** centralised places of storage (Gransar 2001). Two of the most important examples are located in the Aisne department: the site of Berry-au-Bac-“Le Vieux Tordoir” exclusively consists of 80 silos, the other one, Ciry-Salsogne “La Bouche à Vesle”, of 62 granaries associated with 14 silos. At other sites, storage capacities might have been more adequate for regular supply. The duality granary/storage pit is still observed in the Middle La Tène period, but centralised storage is less present. From Late La Tène onwards, granaries became the main storage feature all over the study area. Many farms were created at the same time and most of them used granaries as the usual type of storage facility. From a balanced quota at the beginning of the chronological sequence, granaries became four times more frequent than storage pits at the end of the period (fig. 9). The fact of switching from an underground storage system to an open-air one must be considered relevant as an indicator for a time of fundamental change in rural societies and their economic situation. These changes already took place during the 3<sup>rd</sup>, maybe the 4<sup>th</sup> c. BC. This mutation, achieved in the 2<sup>nd</sup> c. BC, led to an abandonment of hidden and long-term storage facilities at most of the sites.

Indeed, demographic pressure brought about many changes in Iron Age society. This is also indicated by the way sites were positioned within the territory as a whole, e.g. by a clear delimitation of property by means of enclosures. At the same time, the consequences for land management were the establishment of an intensive system of mixed farming and regional specificities in cereal grain production (Zech-Matterne et al. 2013).

Storage structures were adapted to the needs of the consumers inhabiting the farms, but it does not seem that surplus was systematically passed back to the farms. We have to suppose that it was conveyed from the production area to other sites. Sites of craft productions were set up alongside sites of agricultural specialisation, while “oppida” were established by the end of the 2<sup>nd</sup> c. BC. By the beginning of the 1<sup>st</sup> c. BC, a clear diversity of Gallic settlement types appeared.

considered as?

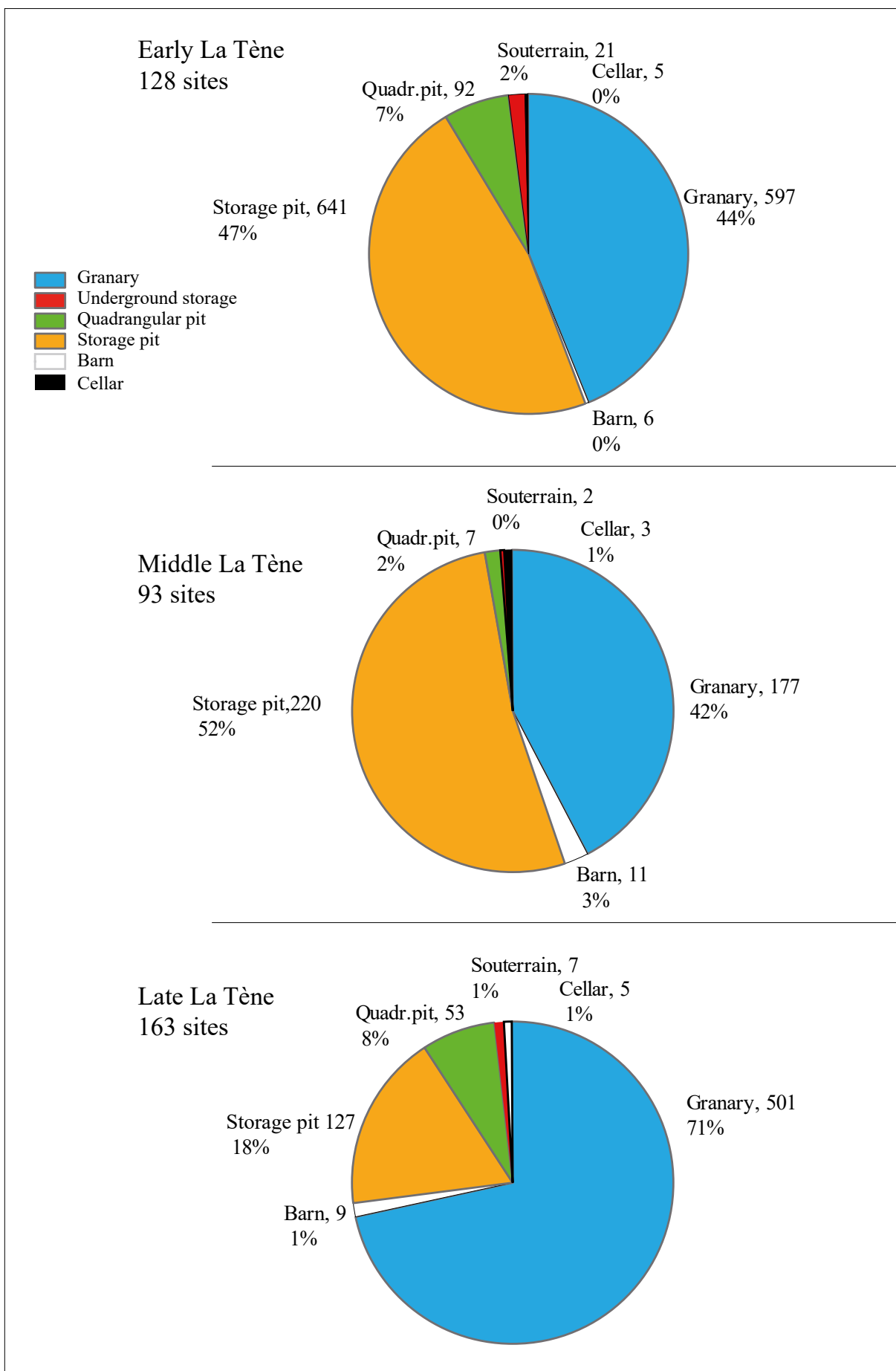
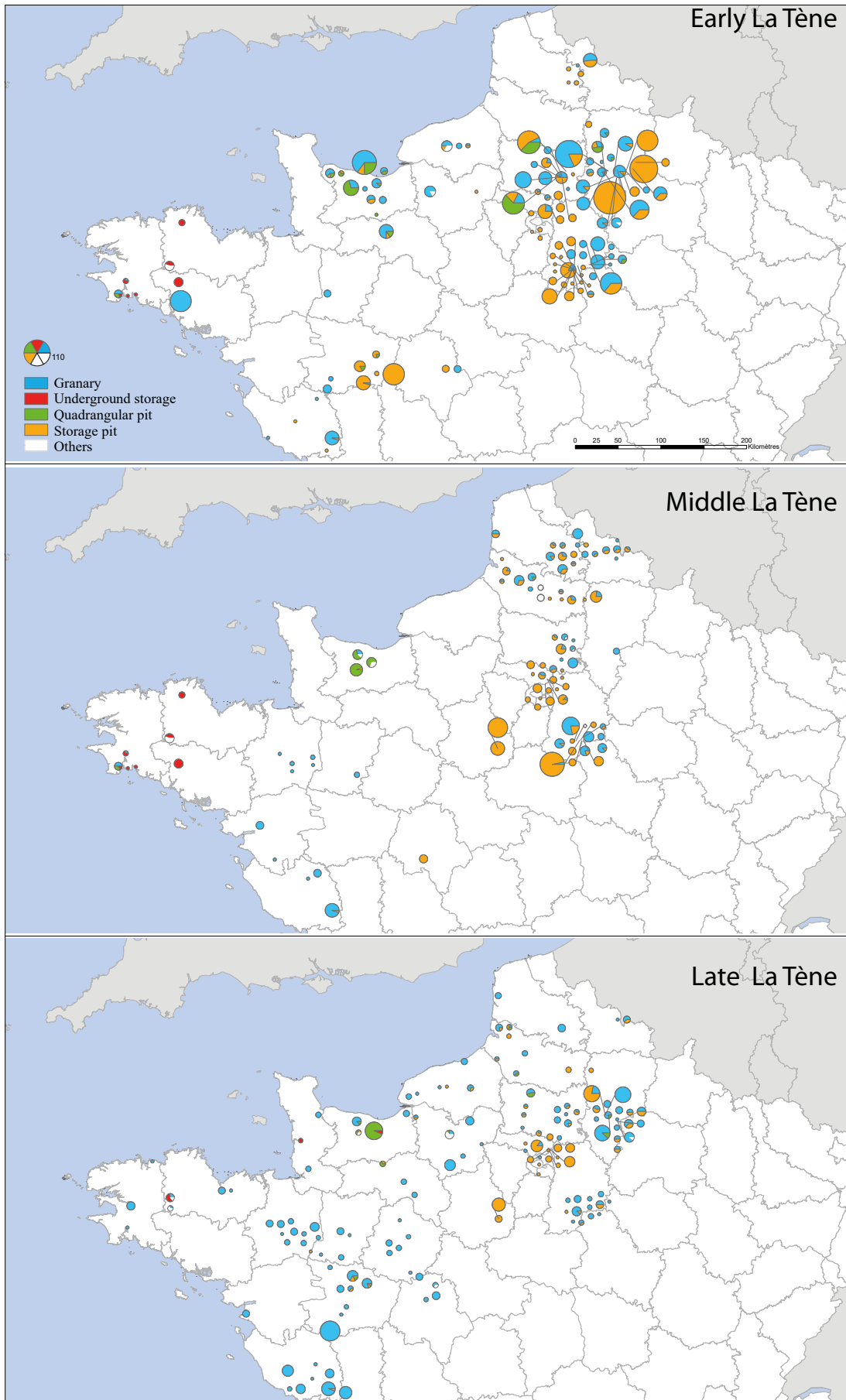
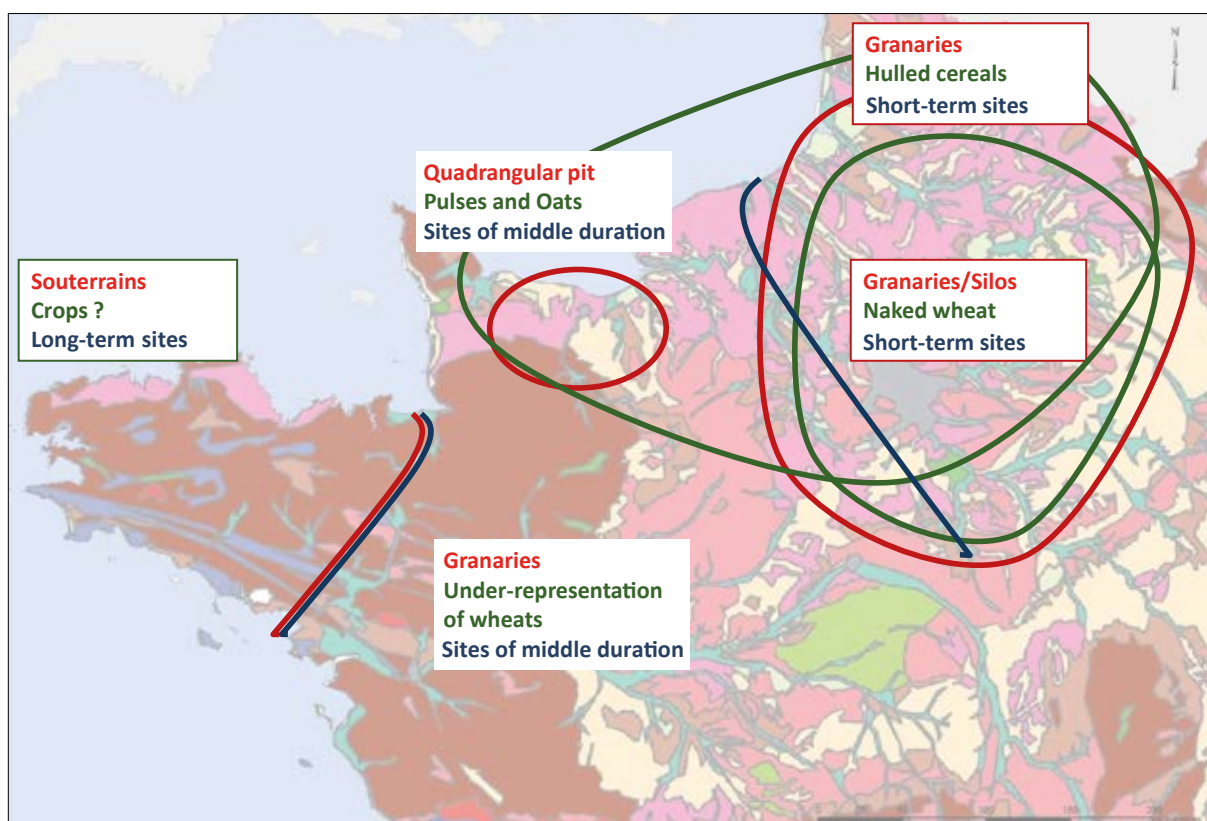


Fig. 8. Evolution of the average number of storage facilities per site during the Late Iron Age.



**Fig. 9.** Evolution of the spatial distribution of the main types of storage facilities. Silos are abandoned in favour of granaries.



**Fig. 10.** Convergences and divergences observed between the three parameters under study, i. e. crop type, storage facility, and settlement duration.

## Discussion and conclusion

To sum up the previous observations, one may conclude that the overall perception resulting from this interdisciplinary approach is that, in general, crop choices were derived from the agronomic potential of the soil and storage modalities from crop species. The infrastructure of sites was adapted to both aspects (fig. 10).

In the western zone, tunnels and cellars (souterrains) carved into the bedrock prevailed with some spectacular exceptions. No storage pits existed. The compactness of the substratum blocked moisture and lessened the probability of grain germination. In a storage pit, on the contrary, sprouted grains will release carbon dioxide, which induces seed dormancy. In both cases however, underground and thus hidden storage is implied. These “souterrains” were connected to long-term sites and a certain range of exploited plants, among them wheats as a secondary crop. This could result from the acidic and rather shallow soils of the region.

In the Plaine de Caen, local specificities such as quadrangular pits, pulses and oat cultivation went with sites of a middle duration.

In the northern Paris Basin (Seine Valley and tributaries), storage pits and granaries predominated as well as short-term sites. In this area, we highlighted the emergence and development of free-threshing wheats (bread wheat but

also durum/rivet wheat) cultivation possibly intended for grain trade.

In the north, we finally observed short-duration sites, granaries and a wide diversity of cereals (among them barley, spelt, emmer) but no naked wheats. This might be due to cultural influences or climatic restraints.

Convergences are thus observed locally or regionally from crop production to storage. However, no satisfactory reason can explain the convergences of these features by the sustainability of a site except for the fact that to build settlements and dig underground storage in the metamorphic substratum of Brittany and Mayenne requires much more energy and labor force than in the deep loessic soils of the Paris Basin plains.

We observed a densification of land exploitation during the Late La Tène period. This coincided with a massive utilisation of granaries and a decrease by 30 % of the total storage capacity. It may indicate a wider exchange of cereal stocks that were no longer kept in the settlements. Storage pits were still meant for close control of the grain reserved for sowing. They can thus be considered an indicator of production zones.

Long-duration sites, especially of high rank, may display another settlement scheme. To supply the aristocratic residence of Paule (Côtes-d’Armor) throughout several centuries of

occupation, a huge amount of food was stored, first in underground structures, then in storehouses, protected by the nearby fortress (Menez 2009). The storehouses had a much higher storage capacity. These features must have been looked after and their access was controlled. These storehouses could receive the main part of the cereal stocks of the residence and maybe even the harvests from satellite settlements, if they wanted or had to place them under the protection of the fortress (Menez 2009, 210). Besides, less spectacular sites with capacities of storage exceeding their needs existed as well, e.g. Pont-Rémy and Poulainville in the Somme department with 20 granaries related to four houses (Malrain et al. 2016). A similar pattern can be seen in Laniscat (Côtes-d'Armor); the mutualisation of harvested products from several farms, perhaps intended for milling activities, has been suggested (Roy 2009, 483). The same hypothesis was formulated for the site “H” at Chambry in the Aisne department which delivered four or six times the amount of grinding stones regularly recorded in rural settlements of the same sector (Audebert et al. 2016, 121).

These new aspects probably reflect the socio-economic mutations at work in Late Iron Age, which were also associated with the development of commercial networks. The centralisation of crop products also existed during Early and Late La Tène but with significant differences. We cannot be sure whether the centralisation observed in Early La Tène attests collective storage, representing the grain reserve of several families, or storage was rather overseen by the aristocracy (theoretically, both possibilities would produce a similar picture). For Late La Tène, the second option is preferred, considering the internal organisation of the settlements and the quality of the archaeological material found. At the same time, the emergence of grouped settlements and the increasing density of exchange networks had probably a major impact on agricultural systems and surplus management.

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