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Dialogues on Mediterranean water challenges: Rational water use, water price versus value and lessons learned from the European Water Framework Directive

Bari : CIHEAM

Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 98

2011

pages 85-95

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=801471>

To cite this article / Pour citer cet article

Buxó R. **Water management in the Western Mediterranean basin: An archaeological approach (II)**. In : Junier S. (ed.), El Moujabber M. (ed.), Trisorio-Liuzzi G. (ed.), Tigrek S. (ed.), Serneguet M. (ed.), Choukr-Allah R. (ed.), Shatanawi M. (ed.), Rodríguez R. (ed.). *Dialogues on Mediterranean water challenges: Rational water use, water price versus value and lessons learned from the European Water Framework Directive*. Bari : CIHEAM, 2011. p. 85-95 (Options Méditerranéennes : Série A. Séminaires Méditerranéens; n. 98)



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Water management in the western Mediterranean basin: An archaeological approach (II)

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Abstract This paper presents an approach to different aspects related to water management of the prehistoric societies in the Iberian Peninsula. It tries to evaluate and assess the water needs and the potentially exploitable water resources in prehistoric times: uses of water, drainage and water infrastructures, industrial water uses and water use in agriculture. The results provide a deeper knowledge of water management through analyses of the architectural and functional infrastructure designed to solve the problem of water supply and drainage. Water supply sources can be categorized in three main groups: underground water and springs, water courses and masses of accumulated water. Furthermore, the paper discusses archaeological evidence of water management from prehistoric times in the south-eastern Iberian Peninsula. The societies in that area already then had channelled water and probably had irrigation systems that channelled water from galleries cut into the rock to the cultivated crops. This is a sign of a true culture of water that has remained constant from the prehistory to the Hispano-Islamic culture and to the present day.

Keywords. Water management – Prehistoric human communities – Archaeological approach

La gestion de l'eau dans l'occident du bassin méditerranéen: une approche archéologique (II)

Résumé. Cette étude constitue une approche des différents aspects liés à la gestion de l'eau dans les sociétés préhistoriques de la péninsule Ibérique. Il tente d'évaluer les besoins et les ressources hydriques potentiellement exploitables durant la Préhistoire: usages de l'eau, le drainage et les infrastructures de l'eau, les usages industrielles et l'utilisation de l'eau dans l'agriculture. Les résultats fournissent une connaissance plus approfondie de la gestion de l'eau qui inclut l'analyse architectonique et fonctionnelle des solutions infrastructurelles destinées à résoudre le problème de l'approvisionnement et le drainage de l'eau. Les sources d'approvisionnement en eau peuvent être résumées en trois groupes principaux: les eaux souterraines et les sources, les cours fluviales et les masses d'eau accumulée. En outre, on atteste des évidences archéologiques de la gestion de l'eau, dès la Préhistoire dans le sud-est de la péninsule Ibérique. Les sociétés dans ce région à cette époque déjà avait canalisé l'eau et a probablement eu des systèmes d'irrigation qui transportaient l'eau de galeries creusées dans la roche à l'plantes cultivées. C'est un signe d'une véritable culture de l'eau qui est demeurée constante de la préhistoire à la culture hispano-islamique et jusqu'à nos jours.

Mots-clés. Gestion de l'eau – Communautés préhistoriques humaines – Approche archéologique

I – Introduction

The availability of sufficient water was one of the factors that conditioned the choice of location for prehistoric human communities, especially in areas with unfavourable climatic and hydrological conditions. The fact that they were organised in urban or proto-urban areas also implies that they were not able to depend exclusively on the irregular and often insufficient rainfall for their basic needs. Thus, human settlements were located at sites with direct access to water or were provided with water collection systems. However, water management was not limited purely to guaranteeing a supply for the population; it was also concerned with removing excess water.

This paper constitutes the second half¹ of an exploration of different aspects of water management in ancient times in the west-Mediterranean basin. It tries to evaluate and assess the water needs and the potentially exploitable water resources in prehistory, and also to analyse the architectural and functional infrastructural solutions designed to solve the problem of water supply and drainage. While it is true that the lack of archaeological data and written sources for this period in relation to water constitutes a major difficulty, it is not impossible that certain issues can be explained based on existing evidence and comparison in order to elaborate and develop proposals to further the knowledge of this matter.

The paper discusses the uses of water in prehistoric Iberian societies. From examples observed at several archaeological sites in the Mediterranean Iberian Peninsula, we evaluate the structures of water supply and drainage and water removal infrastructures, aiming to understand the global urban networks and hydraulic methods used to exploit water resources and their subsequent management. The study concludes with an assessment of irrigation water use in agriculture.

II – The uses of water in prehistoric Iberian societies

Water use in prehistory would have been very limited in comparison to the periods immediately following it, such as the Roman era. Apart from domestic consumption, which was mainly limited to drinking and cooking, certain artisanal and industrial activities required water, particularly metal working, pottery manufacture, building and some textile and leather treatment processes. We also have to consider the water needed for livestock.

The aquatic world was a fundamental part of the Iberian idea of the universe. Water enables the eternal resurgence of vegetation, a never-ending cycle in which, in one way or another, human life and activity have to fit. Depictions of fish are quite common on Iberian vessels and they rarely appear alone, as they are closely linked to vegetation, making up two of the elements that symbolise the eternal rebirth of the natural cycle.

1. Water demand

So far we have little archaeological evidence of the domestic uses of water, although drinking and cooking obviously formed part of basic subsistence. As far as drinking was concerned, apart from water, there is evidence that people drank beer (made by fermenting certain kinds of cereals in water) and wine, which was mixed with water or mead (an alcoholic drink made by fermenting honey dissolved in water). Water was also needed to cook and prepare many foodstuffs and we have evidence of the pottery vessels used for cooking, as well as of certain plants (mainly cereals and legumes) that appear to have been consumed from Neolithic times. We also find animal bones from the Iberian period that show signs of having been boiled.

Artisanal and industrial uses included pottery manufacture, metal production and working, building materials, textile manufacture and probably also livestock management. In the case of pottery manufacture, water would have been needed to purify and model the clay. In pottery production centres we usually find manufacturing facilities, kilns and annexed rooms identified as decantation pools. This type of settlement was also usually in a place with easy access, good communications, nearby raw materials and, above all, plenty of water. In some settlements we also find evidence of areas dedicated to pottery production and storage. In areas where metal was produced and worked, we usually identify containers for holding the water used to cool the blacksmith's tools and the metal objects that were hardened by tempering.

Water was also used to make and work with building materials. We have evidence of its use in making adobe and walls and in the direct application of earth, which was mixed with water in different proportions according to the manufacturing method. Water was also needed to obtain

calcium hydroxide or slaked lime, for which it was mixed with limestone in a suitable proportion for the required purpose. At some archaeological sites there are signs of rooms or areas used for the production of this material, with the remains of lime in the process of being transformed or tanks (that may have contained water) used for slake lime manufacture.

Water is also linked to the production and treatment of textiles and was used in the different processes for transforming vegetable fibre (flax, hemp, etc.). We have evidence of structures associated with this activity, mainly water tanks in which the fibres were treated, soaked or dyed before being made into fabric, although it is also possible that some of these tanks were used for tanning hides or treating wool.

2. Potential water supply sources

Water supply sources for prehistoric settlements can be summarised in three main groups: underground water and springs, water courses and masses of accumulated water (lakes or lagoons).

As far as the first group is concerned, the use of surface water and the digging of wells in search of underground flows were rare in the Iberian societies (7th - 2nd centuries BC). In some cases we find wells that may have doubled as cisterns (as appears to be the case in the settlement of Els Vilars de Arbeca, Lleida) (Alonso *et al.*, 2005). However, there are also some examples of true vertical wells of more than 1.5 m in diameter with depths of up to 9 and 11 m in La Ciutadella de Calafell (Tarragona) and the settlements of Can Xercavins (Cerdanyola, Barcelona) and Castell (Rubí, Barcelona), structures that were abandoned between the 5th and the 3rd centuries BC (Sanmartí and Santacana, 2005). In the settlements of Ullastret (Girona) (Prado, 2008) and Ensérune (Languedoc, south of France) (Blétry-Sesé, 1986; Schwaller, 1994) well parapets have been preserved and a fountain has been identified in the settlement of La Muela de Arriba (Requena, Valencia), which is dated to between the end of the 4th century and the beginning of the 2nd century BC (Valor, 2004).

On the other hand, rainwater collection can be identified from reservoirs cut into the rock and the construction of cisterns. Such underground structures were a simple solution that had been used on the Iberian Peninsula since the Bronze Age. An example of this is an almost circular, stone-lined, 3.5-metre-deep structure with a 9-metre-wide mouth built at the end of the second millennium BC, in the post-Argaric phase of Fuente Álamo (Cuevas del Almanzora, Almería) (Schubart *et al.*, 2000).

The cisterns are large tanks that were located in the centre of the settlement, although they are also found in other areas. Covered cisterns (most of which had a flat roof made of large stone slabs) provided an optimum water storage solution, given that they maintained a constant cool temperature and protected the water from impurities. Despite this, prolonged stagnation of the water in the tanks would have inevitably led to its putrefaction².

The stored water came from collecting and channeling the rainwater that fell on the roofs of the houses and the streets into the cisterns. We also believe that they would have had some kind of system for filtering the impurities before the water was stored, although so far we have not found any evidence to confirm this.

The evidence shows that the use of cisterns for water supply was, without a doubt, one of the most important devices reserved for basic drinking water. However, despite their capacity in relation to a rainfall regime slightly greater than that of today, they appear to be insufficient to guarantee supply. Moreover, we cannot rule out that their main function was to provide water in the case of a siege, as appears to be the case in other parts of the Mediterranean, particularly in the areas of Greek (Hellmann, 1994) and Phoenician (Fantar, 1975) influence, although this was not a widely used tactic in Iberian conflicts (Moret, 1996). Apart from this collection system, the use of different types of vessel (such as jugs with spouts) to collect and store water for domestic use, leads us to surmise on one hand, that the rain water stored in cisterns was used for household purposes, on the other, that water was also collected from other sources than the local cistern.

The presence of cisterns appears to be common from the second millennium in the Ebro Valley, in settlements such as Zafranales (Fraga, Huesca) and El Regal de Pídola (Sant Esteban de Litera, Huesca). However, these structures built by the indigenous population survived for a long time, into the Iron Age and shortly before the cultural eclosion of the Iberian period, at other sites such as El Tossal de les Tenalles (Sidamon, Lleida), Roques de Sant Formatge (Serós, Lleida) and Jebut (Soses) (Moret 1994, 23-24). In the same region, the fortress of Els Vilars (Arbeca, Lleida) presents a monumental structure built at the end of the 5th century BC; it had a descending paved ramp and was used as a cistern to collect rainwater, at the same time as acting as a well, as it was deep enough to reach the water table, providing it with another water source (Alonso *et al.*, 2005, 29-30).

Cisterns continued to be used until the final days of the habitats on higher ground, a fact attested in the Ibero-Roman period. The cistern at El Pilaret de Santa Quiteria (Fraga, Huesca) belongs to this era; in it we can observe the transition to the elliptical form commonly found in the Greco-Carthaginian cisterns of the Western Mediterranean. During the full Iberian period we find this type in large settlements, although the most spectacular structure (built in the Ibero-Roman period) is at Azaila (Teruel), which was used to collect rainwater from the road network.

In the Catalan pre-coastal mountains, we know of cisterns in the settlement of Turó del Vent (Llinars del Vallès, Barcelona). These have wide mouths, are very deep and were built at the end of the 4th century BC. Further to the north, in the Empordà region, the Iberians also built perfectly elliptical cisterns with straight walls; these were cut into the living rock, lined with well-cut ashlar and finally plastered with lime mortar. Although they are not easy to date, they are probably from around the 3rd century BC. The meticulous technique used to build them shows Greco-Punic influences from the nearby Greek colony of Empúries. We know of a cistern of this type in the large settlement of El Puig de Sant Andreu (Ullastret, Girona), whose structure also includes a half-round lead conduit next to the opening to facilitate filling and an overflow channel on the other side to allow excess water to flow out (Fig. 1). We have also identified other smaller rainwater collection facilities at the settlements of Montbarbat (Vilà *et al.*, 1992) and Puig Castellet (Pons/Llorens/Toledo 1989), which appear to date mainly from the 3rd century BC.



Figure 1: General view of the cistern n° 2 (Ullastret, Girona province).

Photo: courtesy Museu d'Arqueologia de Catalunya-Ullastret.

Despite numerous excavations of Iberian habitats in the Valencian Country, a cistern has only recently been located at one end of the settlement of El Molón (Requena, Valencia). However, it is in the south of the Iberian Peninsula where we have the least knowledge of Iberian cisterns, despite the fact that they were also common there and some were built to high quality standards. There are elliptical examples in the settlement of El Cerro de la Cruz (Almedinilla, Córdoba), where they are covered with stone slabs. These cisterns date from the 3rd and 2nd centuries BC and may well have Greco-Carthaginian influences. Undated elliptical cisterns, which could be either pre-Roman or Roman, are also found in the ancient towns of Acinipo (Málaga) and Cástulo (Jaén), sites with a continuous human presence.

As far as supply from water courses is concerned, rivers and streams near settlements would have been the main potential source due to the volume of the basin and the proximity. However, we have to bear in mind that the water courses in the Mediterranean area are mainly of a torrential nature. This means that their surface flow depends largely on rainfall and diminishes notably, and even completely disappears, in some stretches during dry periods.

Finally, bodies of standing water have to be taken into account on various levels: on the one hand, as a possible water supply and, on the other, as a possible agricultural resource by taking advantage of the rise in the level of the lake or the flooding of the land on the shores of the area occupied by the body of water.

III – Drainage and water removal infrastructures

Architecture and town planning in the Iberian period were governed by organisational and planning criteria that we can see exemplified in the degree of complexity they were able to attain in rainwater drainage infrastructures. In some Iberian settlements the solutions documented are not limited to the construction of drains, but demonstrate a global concept that takes into account factors ranging from the orientation and configuration of the roofs to the discharge of the water from the settlement itself.

This concept responds to two interrelated needs: on the one hand, the necessity to remove the water from structures and buildings into adjacent streets and other open communal spaces and, on the other, to channel this water via these areas to a point outside the settlement.

As far as the first of these needs is concerned, the building roofs were of vital importance. Archaeology provides us with little evidence of these structures, although experimental reconstructions carried out in recent years appear to point to a type of wooden beam structure covered by a layer of plant matter, with single pitch and gabled roofs. Likewise, it is also widely agreed that the structure would have had a perimeter border that channelled the water to wooden gargoyles. Once collected, the water would have been directed towards the street and, in some cases, to cisterns where it would have been stored. In this way, the roofs had a primary function of protecting the interior of the buildings and a secondary purpose of collecting rainwater.

We know of few examples of rainwater drainage systems, but in the settlement of Ullastret (Girona) a structure from the second half of the 5th century BC has been identified (Fig. 2); it consists of a base of stone slabs with a channel in the middle bordered by worked stone and paved with small stone slabs (Prado, 2008). It was used to collect the rainwater that fell on the roofs of the rooms and subsequently to channel it to the street. Another example of a drain has been described at the fortress of Els Vilars (Arbeca, Lleida); this dates to the 8th – 7th centuries BC (Alonso *et al.*, 2005, 30).

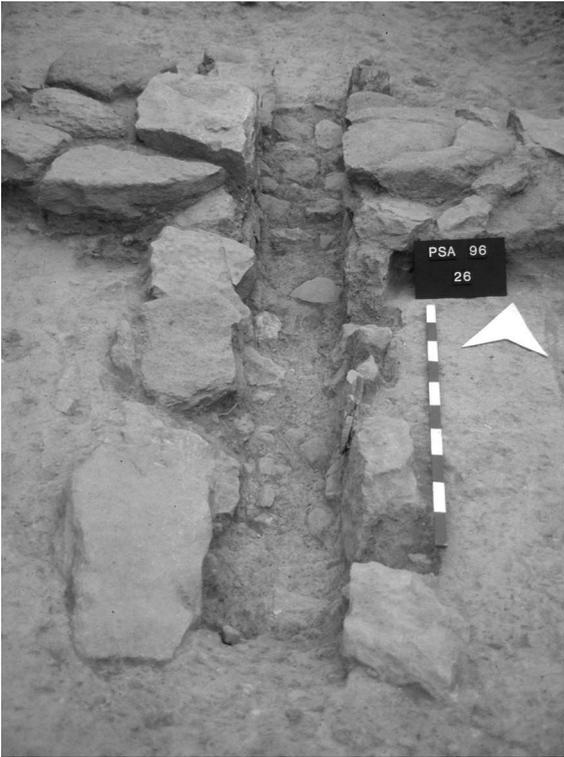


Figure 2: Detail view of example of rainwater drainage systems (Ullastret, Girona province).
Photo: courtesy Museu d'Arqueologia de Catalunya-Ullastret.

The streets were one of the basic elements in the second objective described above: channeling this water from inside the buildings to outside the settlement. As well as performing their primary function of linking the different parts of the settlement, the streets were also part of the drainage system and by arranging their inclines they were able to channel the rainwater away from the inhabited area. The drainage systems in Iberian settlements were linked to the main street that collected the water from inside the buildings, as well as that from the side streets that led into it.

The last of the drainage elements were the gates and openings in the walls that allowed the water to flow to the outside. Known as *barbicans*, they were built on slopes where the walls blocked the flow of water and would have undermined their foundations (Moret 1996). In the studied cases, channels have been identified that transversally cross the walls and, although they have not been preserved in other cases, we assume that similar structures existed in the settlement entrance gates.

There is a final element that crosses the wall on its interior. This is a channel located at its base with a kind of gargoyle on the outside designed to prevent water from pouring out along the wall.

IV – Water in industrial uses

Once harvested, certain plants used to make textiles, such as flax, hemp and esparto grass, needed a process known as *retting*, which consisted of soaking it in water to separate the fibre from the stalk.

There is little evidence of this activity in the prehistoric archaeological record of the Iberian Peninsula, although the excavations carried out at the settlement of El Coll del Moro (Gandesa, Tarragona) brought to light a flax retting workshop from the second half of the 3rd century BC (Rafel *et al.*, 1994). It has two adjoining, symmetric tanks measuring 1.80 by 1.60 m with one meter high walls; the floor and walls were made of adobe and the floor was paved with small stone slabs with the joints sealed with purified clay, which also covered the partition walls, making them waterproof. The presence of flax was also confirmed by an analysis of the preserved organic sediment and the phytolite technique.

Another recently identified industry practised by the Iberians, which also required large amounts of water, is wool dyeing. At one end of the settlement of Olèrdola (Barcelona), in an area bordered by the wall, an artisanal area was built around the second half of the 4th century BC that included a dyer's and a blacksmith's (Fig. 3). This zone had a small channel that drained the excess rainwater from the hill and channelled it outside the walls. The dyer's area, reconfirmed by the analysis of the recovered residues, contained channels cut into the rock with small stone slabs and various tanks for soaking and washing the wool and had fires to heat the liquids (Molist *et al.*, 2005).



Figure 3: Detail view of an artisanal area used by a dyer (Olèrdola, Barcelona province).
Photo: courtesy Museu d'Arqueologia de Catalunya-Olèrdola.

In the settlement of El Oral in Alicante channels were also found that passed through the thickness of the surrounding walls, although the fact that they only originate from certain rooms leads us to believe that they were used to drain the water resulting from the industrial activities carried out in those rooms (Abad and Sala, 1993).

To the manufacture of textiles from plant fiber and wool dyeing, we have to add a third industrial activity: the extraction of iron from ferruginous clay dug in open-cast mines. In order to be used, the clay first had to be washed and subjected to a decantation process that separated the heavy mineral before it was crushed and reduced in a furnace. This process needed a sufficient water supply. An open-air decantation pool has been documented in the Iberian settlement of Les Guardies (El Vendrell, Tarragona), which was active around the 3rd century BC.

V – Irrigation and water use in agriculture

Although cereals, basic agricultural products in the Iberian diet, depended on rainfall, analyses of the plants consumed appear to show in some cases a major presence of water. It remains to be shown whether water was transported to irrigate a limited plot of land or whether they knew how to use channels to carry out more widespread irrigation. A Latin text designed to be displayed in public was found in the Celtiberian town of Contrebia Belaisca (Botorríta, Zaragoza). It contains the orders of a Roman provincial governor who ratified a sentence issued by the local town senate. This body had acted as a court in a case brought by a community known as the Alavonenses over the ownership of land that an Iberian town, Salduie, had purchased from another Iberian community, the Sosinestanos, for digging an irrigation channel. This is proof that such a practice existed in the north of Zaragoza, at least at the time the text was written, on 15 May 87 BC, to be precise.

The most interesting example of water resource management in the Bronze Age is linked to the control of water in the emergence and development of complex societies in the southeastern Iberian Peninsula. It is associated primarily with the Argaric society (2200/1400 BCE) and the studies undertaken have been based on two fundamental circumstances: the climatic and environmental conditions and the interpretation of certain structures supposedly related to water management, most of which have been found at Los Millares and Cerro de la Virgen (Lull, 1983; Buxó, 1997; Castro, *et al.*, 1999, 2001).

Gilman and Thornes' model (1985) was based on the supposition that the climatic and environmental conditions had not changed and that the arid or semi-arid conditions were identical to those existing today, suggesting that an agricultural economy would have favoured the development of irrigation to combat the aridity of the environment. The emergence of social stratification in the third millennium would have been associated with the intensification of subsistence production: the exploitation of secondary livestock products, forestry and irrigation, among others. Chapman's studies (1991), like those of Gilman (1987), were based on the same supposition, although the former believed that the control of water was one of the factors in the intensification process, although not necessarily the most important. Both Gilman and Chapman sought to explain the social development of the area as a result of the responses to adapting to an unfavourable environment; they agreed that, given the arid conditions of the southeast, the intensification of farming came about through the use of irrigation as the only way of building a productive agricultural system.

The arguments put forward by Chapman to justify the need for water in southeastern farming were based on the studies carried out by Helbaek (1969) at sixth millennium BCE sites in the Near East and Anatolia. According to these studies, certain cereals, such as barley and flax, need more water when they are grown in arid zones. Barley needs it because it suffers more from the effects of evaporation and flax cannot grow without an artificial water supply in areas with an annual precipitation of less than 450 mm a year. Chapman (1991) used these requirements to point out that the success of these crops was not guaranteed without water control. He argued that wheat, barley and flax would have been growing in a hostile environment and that to achieve a normal yield it would have been necessary to use water control technologies.

The current data obviously differ in part from the interpretations that can be deduced from the earlier research. The availability of specialised palaeoecological studies and systematic documentation on landscape reconstruction and climate change allows us to reconstruct the dynamic and evolution of the ground cover, together with the influence of human intervention on the modification of the area.

Firstly, palaeoenvironmental studies show that the characteristics of the third millennium landscape differed (and were changing), from those of the second millennium, suggesting wetter climatic conditions than those of today. From the beginning of the Holocene, the pollen register and anthracological analyses reflect a marked thermophilic nature for the zone, with mild bioclimatic parameters, although with abundant indications of water resources available in the area's

hydrographic network (Yll *et al.*, 1995; Rodríguez Ariza, 1992; Pantaleón-Cano *et al.*, 2003; Fuentes *et al.*, 2005). Likewise, the isotopic discrimination of carbon in the seeds of different cereal and leguminous plant species reveals that the current climatic conditions of eastern Andalusia are more arid, in other words with less rainfall, than those calculated for recent prehistory (Araus *et al.*, 1997).

The most significant changes in the ground cover come about between the Chalcolithic and the Bronze Age. The palaeoenvironmental data support the general notion that the Chalcolithic marked the last period of forestation in the semi-arid southeast, which was followed by a decline clearly related to increased anthropic pressure on the environment and an intensification of the trend towards aridity. The establishment of new environmental conditions, together with the extension of open spaces is linked to an intensification of farming and pastoral activities, although with variations in the environmental framework. Nevertheless, if aridity existed or spread over the area, it was not generalised over space and time as it did not cause the immediate disappearance of the wetlands, which continued to exist during the Bronze Age. Thus, it appears that neither for this period large scale irrigation was necessary in the region.

Secondly, the diversity of the exploitation system could have included rainfed agriculture on the low-lying plains and in the interior, although agricultural specialisation may have been linked to the monoculture of certain cereals in the two periods.

Thirdly, there are data that indicate a process towards an intensification of production during the Copper Age, which did not necessarily include the practice of irrigating some of the crops, which were mainly cereals. On the other hand, leguminous plants or flax, for which it is assumed more water is needed, can take advantage of the fertility of easily-flooded lands or those with sufficient water. The high values registered for the broad bean in the region's archaeological sites are indicative of the importance of that crop from the Late Neolithic onwards. Considering the argument that defends different environmental conditions to those of today, broad bean cultivation could only have taken place under two circumstances: firstly, that there was sufficient water to grow them during this period, and secondly, that specific actions were taken to encourage their development, such as the use of irrigation. Isotopic studies of carbon in the seeds of different species found at Chalcolithic and Bronze Age sites in the southeast indicate that leguminous plants were cultivated in conditions with more water than cereals (Araus *et al.*, 1997).

In general, with the exception of the models proposed by Gilman and Thornes (1985) and Chapman (1991), the most recent studies show that most of the cereals were grown in rainfed farming conditions and that if irrigation was practised, it was limited to small scale watering of leguminous plants on plots of land with favourable soils, perhaps using simple irrigation mechanisms (Castro *et al.*, 1999, 2001; Cálmalich and Martín Socas, 1999).

VI – Conclusions

The evaluation of the water needs of prehistoric settlements on the Iberian Peninsula is still based on relatively incomplete data. The construction of cisterns or reservoirs for rain water in the region can be dated back to the Bronze Age. These reservoirs in the villages retained a water reserve, but the periodic transport of other water to the living quarters remained necessary. The presence of artificial facilities or sources, organized by a distribution set or a single contribution as we find in the Greek and Roman world, were not documented in any Iberian sites.

However, capturing rainwater is not the only source of supply; we must consider that the supply of water was necessarily based on the use of other resources at their disposal, in a proportion we can not determine. Potable water from rivers and lagoons could be a key factor in understanding its possible use. Regardless of the quality of the water, its use is understandable for non-domestic artisanal, industrial or even agricultural purposes.

The early onset of the cisterns or reservoirs tanks occurs in places where the weather is more severe, which could indicate a possible environmental stimulus (the water demand) that would be stronger than other regional circumstances. In prehistory, the climatic conditions of the Mediterranean area of Iberian Peninsula were different from those found today. The agricultural systems of prehistoric societies may have different effects on the environment, increasing the depletion of aquifers, and probably the soil salinity. However, the degradation processes in areas that possibly suffered from floods and erosion in the region, take place over time, and it is also shown that more severe disruptions (although not the first) of the landscape are typical of this period. Although cereals, the basic agricultural food in prehistoric times, depended on rainfall, the other studied crops required in some cases, a significant presence of additional water.

Looking at the different social considerations of water management during this period we have been able to define the construction of infrastructures, tanks or cisterns for supplying the population and for draining off excess rainwater. These are examples of collective utilitarian structures and, like the settlement walls, show the existence of a strong social structure (Moret 1994). In this respect, the structures linked to supply become strategic elements for the survival of the group and correspond to a desire to undertake joint planning that was, apparently, supervised by elite.

Acknowledgements

This work was partly supported by the European Project INCO Melia (Coordination Action 517612)

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(1) Part one was published in *Option Méditerranéennes* A, 83: Buxó, 2008. 'The water management in an ancient Greek-Roman city: an example in the North East of Spain'

(2) For this reason the classical Greek authors expressed a unanimous preference for water in motion originating from springs, although they endorse the use of water from cisterns in cases of necessity. (Hellmann 1994, 274).