

SOCIAL ADAPTATION TO ENVIRONMENTAL CHANGE: LESSONS DRAWN FROM SOCIAL REPRESENTATIONS OF THE INTERACTIONS BETWEEN SOCIETY AND THE NATURAL ENVIRONMENT IN THE ROMAN WORLD

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ABSTRACT

Through case studies focused on paradigmatic cases of micro-climates such as the coastal areas of centro-southern Italy and of N-E and S-E of Spain, the drainage basin of the Rhone river in Gallia Narbonensis, pre-desert and steppe areas and the coastal areas of North Africa on the time scale of the Roman Empire, the paper identifies relevant social practices as a significant aspect of the representations of society-climate interactions which may highlight ancient knowledge on social adaptation to climate variations. The relevance of the latter may be evaluated through their examination from the perspective of two modern concepts – sustainable development and resilience – reflecting, on the one hand, the concern for the conservation and protection of water resources and, on the other hand, the adaptation of old management practices and normative measures to new situations involving climate change and variations. The conclusion of this analysis suggests that the Roman perception of water management strategies seems to indicate an underlying holistic conceptual framework which includes some significant elements of management ethics applied to situations of both water shortage and excess water related to climate change and variations. Such an approach to water management is considered as facilitating cultural transfers and building a common water culture.

Water resources are a natural heritage rendered a cultural heritage as well by the historical dimension of their management practices preserved over time by material remains and oral and written records. Water management is thus related to the field of patrimonial studies. Traditional knowledge associated with its practices appears accordingly as an effect of the relations between society and the natural environment. The water-related material and immaterial heritage of pre-industrial societies is thus, at least potentially, a valuable reference for present-day water managers in their efforts to implement integrated water management. Was the Roman Mediterranean Empire, which included different regions affected by climate variability and different geomorphological conditions, a significant source of historical heritage of management of natural and notably water resources? How the experiences of the Roman Empire informing about the sustainable management and natural risk management practices may provide us useful indications comparable to the "proxy data" regarding climate change and variations?

1. THE ROMAN EMPIRE AS AN INTERPRETATIVE PARADIGM OF THE INTERACTIONS BETWEEN SOCIETY AND NATURAL ENVIRONMENT.

This topic has been dealt with from 2003 in the framework of my Canada Research Chair in Society and the Natural Environment in the Roman Empire. The goals of this Chair included examination of environmental management approaches in the light of ancient relevant experiences in the Roman Empire and from the perspective of the new environmental history aimed at the study of the historical dimension of society-environment interactions or the relations between environmental phenomena, attitudes, practices and policies indicating the relevance of past experiences in dealing with present-day environmental concerns. Much of the research conducted in the framework of my research Chair aimed at presenting the Roman Empire as an interpretative paradigm with a view to analysing the relevance of some experiences in this context to the needs of modern societies.

Actually, the experiences of the Roman Empire attribute a paradigmatic value to this line of study given the relative stability of this political model of long term gradual change of a pre-state entity and the continuity of a natural resources management pattern in the context of regional environmental climatic diversity. The Roman Empire may be considered as a synthesis of Antiquity, a stable political structure by its relative longevity, its institutions, its social and cultural eclecticism, its global policies and the degree of coordination of regional and local policies they ensured, its heritage transmitted to Mediterranean societies and still noticeable even in other parts of the world. The Mediterranean societies disposing of rather scarce water resources largely depend on their adequate management which includes water harvesting, conservation and distribution. Roman law attributes a privileged status to these water management practices which to some extent are often still relevant.

On the time scale of the Roman Empire, the Mediterranean region represents from an environmental perspective a group of regional hydroclimatic units with paradigmatic cases of micro-climates such as the coastal areas of central-southern Italy, of N-E and S-E of Spain, the drainage basin of the Rhone river in Gallia Narbonensis, pre-desert and steppe areas and the coastal areas of North Africa. Other regions, such as Atlantic Gaul, have recently gained special attention due to recent theories on ocean influence on climate put forward by climatologists. Actually, research carried out by climatologists and paleoclimatologists facilitates relating the long term perspective of their studies to the historical time scale (Hermon, Elly, 2009) by using "proxy data" for examination of climate change events like the Little Ice period "LIP" and the warmer period which preceded it (Ortolani, F.& Pagliuca, S. 2009).

Our referred research aims at highlighting the significance of water integrated management practices applied in the context of various experiences with similar practices in different points in space and time in the Roman Empire. This research has been conducted in the light of relevant documentary and material evidence as well as social representations which may be considered as "proxy data" informing about climate evolution.

2. SOCIAL REPRESENTATIONS: CONCEPTS AND PRACTICES

2.1. Integrated spaces and their management

We defined in the reported activities of my research chair the integrated spaces as non hierarchical interactions within a socio-environmental system related to water management involving ancient environmental challenges similar in some respects to those addressed by modern ecosystem management approach (Hermon E. 2004).

Integrated water management is largely based on a conceptual approach taking into consideration the relations between managers and stakeholders. It can be implemented through a holistic vision of all social as well as environmental and their interactions water management dimensions. The concept of integrated water resources management (IWRM) was selected for the purposes of our analysis given that it tends to deal with water management challenges taking into account the relations among the various actors and stakeholders and the different areas of water management. It reflects thus the interactions between society and the natural environment, which facilitates the examination of their historical evolution with respect to water management (Hermon E., dir., 2008a; Hermon E., dir., 2008b).

2.2. Traditional knowledge, cultural heritage and integrated water management.

The relations between traditional knowledge and cultural heritage, on the one hand, and water management, on the other hand, are dealt with from the perspective of the comparative environmental history with an emphasis on the Roman period (Hermon, E., dir., 2008b).

The 2003 UNESCO Convention for the Safeguarding of Intangible Cultural Heritage. The adoption of this international instrument emphasizing the importance of the cultural dimensions of traditional knowledge developed through interactions of local communities with their natural environment highlights the evolution in the conceptualization of the scope and significance of this type of knowledge. This is referred to in the cited 2003 UNESCO Convention as "knowledge and practices concerning nature and the universe" defined as including "knowledge, know how, skills, practices and representations developed and perpetuated through language, oral traditions, attachment to a place, memories, spirituality and worldview" (Text of the Convention, Article 2 –Definitions–<http://www.unesco.org/culture/ich/index.php?pg=00056>). The conceptual evolution reflected in this document illustrates the growing diversification of the challenges of the valorization of traditional knowledge associated with the evolving concepts reflecting the various dimensions of the interactions between society and the natural environment. The valorization of traditional knowledge thus appears to be characterized by an integrative approach involving society, culture (including material and technical culture), economy, natural environment, as well as a long term perspective, contrary to modern environmental management practices driven rather by short term objectives and specialization (Laureano, P. 2008).

While the concepts of cultural and natural heritage are concerned with conservation of the authenticity of the object of study, the mechanisms for the transmission and transformation of the latter entail the valorization of traditional knowledge and its potential contribution to ensuring the transmission as well as the transformation of the object. The technological and scientific aspects of traditional knowledge have been extensively valorized and the above mentioned 2003 UNESCO convention underlines the need for valorizing the intangible aspects of traditional knowledge which are necessary for implementing the integrative approach inherent to this concept. The recognition of its importance represents a significant advance as this concept is applied to the living heritage of local communities and their oral traditions (Figure 1).

Mediterranean techniques of rainwater harvesting; underground channels for water collection and distribution, water storage facilities; mountain water harvesting systems including channels and barrages, aqueducts (Leveau, Ph. 2008); fountains (Dessales, H. 2008); water mills (Lo Casio, E. & P. Malanima, 2008) are part of the tangible heritage of the Mediterranean societies transmitted from Antiquity to the present. A part the impressive presence of ancient aqueducts in the Mediterranean landscapes, we should be aware also of the whole Mediterranean technology associated with the above mentioned traditional water harvesting and storage facilities, as well as of the barrages intended to mitigate

flooding and soil erosion in areas affected by mountain streams such as those of the Apennine and Alps mountains (Quilici Gigli S. 2008) and the water mills used for energy production. Technological transfers as well as land use in areas bordering water bodies and wetland zones are a common feature of water culture, but another major element of the Roman heritage is the cadastres. Such practices represent an element of intangible heritage indicating integrated water management practices developed by certain Mediterranean pre-industrial societies, A relevant example is provided by the Nabateans whose social organization and water management practices played a significant role in this regard (Oleson, J.P. 2008). Stabilization of streambeds appears, as another kind of investment in hydraulic technology for agricultural purposes in addition to irrigation and drainage. As a result of this development, the vineyards, the arboriculture, the aquaculture were disadvantaged while the irrigated plains and prairies prospered in this period as indicated by the rural villas in central Italy.

The significance of hydraulic energy is highlighted by the use of water mills since the Roman period at Barbegal in Arles and the Gaul Narbonensis (Leveau, P. 2008), which, with the recent discovery of the water mill of Coninbriga in Spain, supports the thesis of the constant use of hydraulic energy in the Roman period (Prieto, A. 2008). Water mills are associated also with wastewater of thermal facilities and the water mills complex improvised by Belisarius with water taken from the Tiber River to substitute for water brought by aqueducts, the functioning of which was interrupted during the siege of Rome by the Goths in 537-538 (Balastarcci, D. 2008).

The mines of Las Medulas in Spain (Orejas, A. *et al.*, 2008) are a good example of integrated resource management which does not dissociate water and soil use in the exploitation of gold mines, although research results are not conclusive yet regarding a number of issues such as the role and status of the native inhabitants of the region in the exploitation and maintenance of the mines, the evacuation of wastewater, the resolution of water use conflicts resulting from the competing water uses for mineral and agricultural exploitation. Hydraulic technology is diversified: small barrages, pools and canals, sometimes very long, tunnels where the Roman technology is harmoniously combined with local knowledge. The innovations, or rather the technical adaptations for the purposes of water use including those of hydraulic energy production, are part of the medieval water culture. Water use practices and their transfer over time are part of the intangible heritage of societies with a special interest in sustainable water management and prevention of environmental hazards. Social representations of water uses, conflict resolution regarding competing water uses and interests of different actors and stakeholders, but also the environmental risk prevention appear thus as a legacy of water related knowledge of certain pre-industrial societies for future generations.

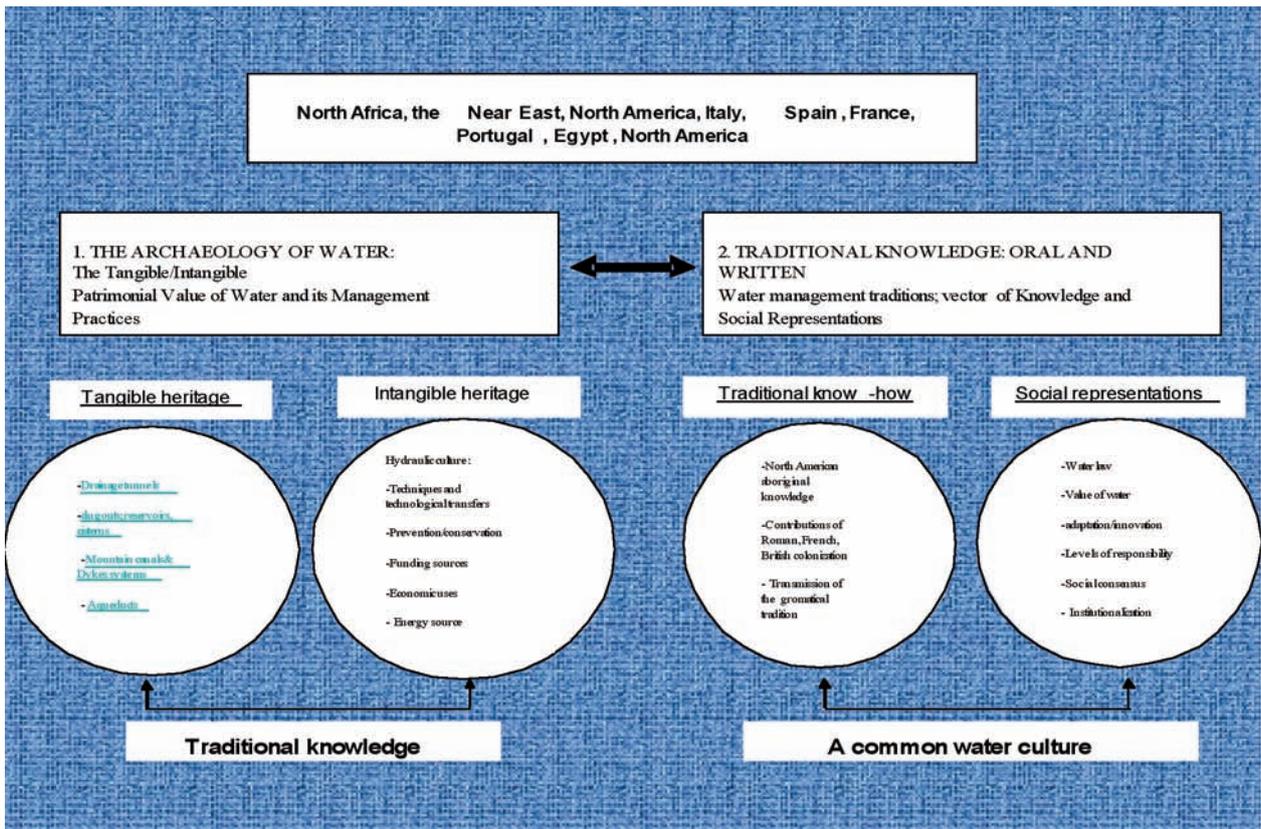


Figure 1

However, while the significance of these traditions should not be underestimated, that of written traditions and the mechanisms for their transmission over time must be acknowledged as well, and the richness of the water management related written tradition of the Roman world is a case in point. I shall illustrate the issue with the graphic representation n. 20. I shall illustrate this case with the poster of the conference on integrated water management in environmental history I organized in 2006. In my view it represents a significant relevant example of the issue of traditional knowledge and its transmission through history. The illustration 20 of the medieval manuscript Arcerianus A (6th century) of Fron-

tinus' treatise on land surveying included in the *Corpus Agrimensorum Romanorum*, illustrates the controversies on the nature of the land while highlighting two cases of private appropriation of natural resources and public goods: the *Mons Mutela* in Sabinia and an ancient streambed belonging to the Roman people, which the waterstream, by interposing an island (*insula Septiciani*), left to the nearest landlord, an individual called Septicius.

This graphic illustration (figure 2) which has significant topicality has also an obvious didactical purpose as it cumulates problem cases of managing natural resources and public patrimonies such as mountains and water streams affected by similar processes involving environmental degradation. This involves deforestation of mountain areas with the resulting soil erosion and their adverse consequences for water conservation including causes fluvial transportation of sediments downstream which may result in significant modifications of streambeds with adverse repercussions on the environment and human settlements. Even without attributing such a comprehensive grasp of environmental risks to the author of this illustration, the latter reflects somewhat of a genuine global vision of environmental problems associated with water management comparable, at least in some significant respects, to that orienting present-day integrated natural resource management. The illustration highlights, among other things, the public status of water streams as a constant since the formation of the tradition of Roman knowledge on land management and related natural resources by land surveying (gromatical) practices in the period between the height of the Roman Empire (1st-2nd centuries) until its fixation through the medieval manuscripts in Late Antiquity (5th-8th centuries) (Hermon, E. 2008a; Campbell, B.J. 2010)

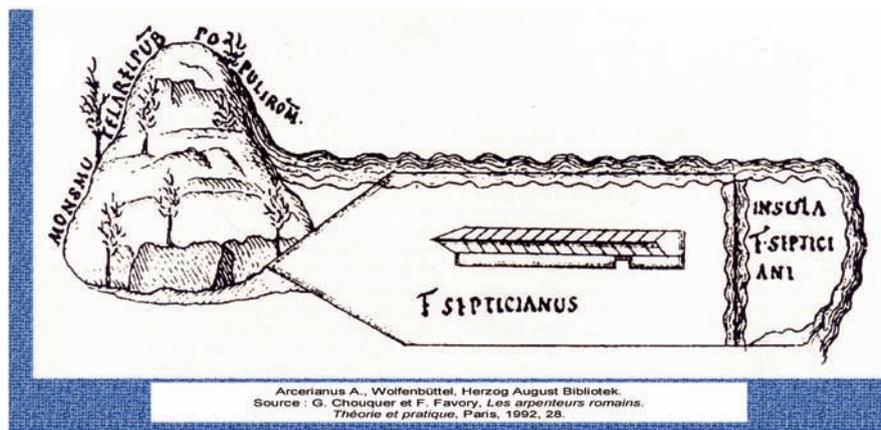


Figure 2

Water, a natural heritage and a public good, became a significant element of cultural heritage in the Roman world through the combination of the norms of Roman law and its specific modes of resolving societal and environmental problems throughout the Roman Empire. Water management became a cultural heritage also through the Roman knowledge in the area of what we may consider as a reflection of significant elements of integrated water management. This knowledge was transmitted to future generations by various water infrastructures as well as by an oral and written tradition, an example of which is the *Corpus Agrimensorum Romanorum*, this disparate collection of treatises on land surveying and geometry, and of extracts from the laws and history of the Roman Empire.

2.3. Cultural heritage and historical "proxy data"

We consider the potential use of the cultural heritage (remains of infrastructures and water management traditional knowledge) as historical «proxy data», or indirect indices of climate evolution. These include literary testimonies about exceptional temperatures and precipitations; remains of neglected water management infrastructures (Jaillette, P. 2008; Pasquucci, M. 2008; Leveau, Phil. 2008a; Jaillette, & Reduzzi, F. 2009). The climate factor is of primary significance in this context as illustrated by the case of riparian areas which provides a topical example of applying an integrated water management approach to an ecosystem particularly sensitive to climate variations. The climatic factor was discussed also at our conference *Sociétés et climats dans l'Empire romain*, 2009, highlighting its significance from the perspective of the interactions between society and the natural environment. The transformation of the ancient site of the city of Salapia in swampland corresponds to the occurrence of a phase of warmer climate in the 1st century B.C in Italy (Compatangelo Soussignan, R. 2008). Whereas some scholars underline climatic variations in their characterisation of the increased rainfall in the period from the 1st century B.C. to the first century of our era, others stress anthropic forcing in discussing causes of environmental change occurred between two periods of "worsening" climate in the Neolithic and Late Antiquity (Berger, J.-F. 2009). Actually, from the perspective of climate evolution, Roman history may be characterised by five phases, corresponding to the periodisation of Roman history since the Republic to Late Antiquity (Allinne, C. 2008). The Roman period, is preceded by a climatic phase beginning with the Iron Age and extending to the Hellenistic period considered to be cooler and rainy.

The secret of the significant vitality of the oases, cradle of ancient civilisations, still remains to some extent an enigma. However, there is little doubt that this secret is associated with an ingenious water management (Laureano, P. 2008). In the oases, ancestral rules regulating water partition still remain valid through a collective survival conscience. Thus, in pre-Saharan Tunisian oases, an immemorial tradition of water par-

tion recorded in a special "Water Book" has been perpetuated over time until recently. Different remains like a milestone of a fountain in Pompei, Italy (Dessales H. 2008); a water tank at Delos in Greece (Brunet, M. 2008); a cistern or interior canal in Jordan (Al-Muhsein Z. 2008), an operating *noria* in Morocco (Maury, R. 2008); the form of *foggara*, the canal for water distribution in the arid and semi-arid zones in Algeria (Moussaoui, A. 2008) indicate the existence of ingenious water management practices. Climate change may appear more explicitly in the light of the testimony of Strabo (1st century AD) who told us about seven branches of the Nile river presently replaced by only two branches (Hassan, F. 2010); the occasional numismatic or pictorial testimonies like the reverse coin of Neron (64 AD) showing the destroyed harbour of Claudius at Ostia (Nielsen, T.B. 2010); the harbour of Pozzuoli and the Baia coast seen from the sea in a fresco of Stabia which fits the description of Strabo, *Geography*, 5.4.8 in the 1st century AD, probably before its decline in favour of Ostia harbour, and so on .

3. SOCIAL REPRESENTATIONS AND LESSONS OF THE PAST

Integrated water management related knowledge has been thus conserved through by traditions, customs and oral and written memory which reveal its patrimonial value. Elements of this knowledge compatible with the modern concept of integrated water management and which often may be integrated in modern water management practices have been thus preserved. With respect to the Roman world, I would stress the ethics of water management which is a legacy of the Roman law.

Before concluding my presentation, I would like to take up again the complex issue of the transferability of integrated water management related knowledge and practices. First, I will consider the transfer modes practiced in the Roman world. These transfer modes involve notably the continuation of technical and legal practices and adaptation of old ones to emerging needs and values. In some regions, such as Spain, there is a selective use of Roman water technology (Prieto, A. 2008; Orejas, A. *et al.*, 2008; Bruun, Chr. 2008). This transfer is carried out also through incorporation of local technological and legal customs as in the case of water partition rules in North Africa, and by the transmission of written traditions as a cultural legacy of the Roman world (notably the technical sources, the juridical sources as the Theodosian and Justinian codes, and a new cycle of continuation of Roman technological and legal practices adapted to the needs of new generations and historical periods. (Jaillette, P. &, Reduzzi, F.2009). Thus, in Middle Age Italy, the omnipresence of monumental remains of Roman water works stimulated municipal authorities to undertake water management, as indicated by Duccio Balestracci, *cit*. The extensive use of Roman water infrastructures in Arab Spain led scholars to attribute mistakenly these infrastructures to the Arabs and hence underestimate for quite a long time the significance of the Roman contribution in this field, as indicated by Alberto Prieto, *cit*.

This shows the vitality of the Roman water management related to traditional knowledge (conservation, protection and generally the sustainable use of the resources) and its relevance for current water management challenges or the potential for its integration in present management practices.

3.1 Which Models?

The Roman Empire owes to a large extent its longevity to water policies characterising a monolithic State. However, the consideration given in devising its water policies to regional and local particularism, as well as to maintaining a certain balance in water management practices, played a significant role in this respect and contributed to the emergence of the Mediterranean region as a cradle of a common water culture, largely based on adaptation to climate variations. This reflects, on the one hand, concern for water conservation and also a water ethics largely derived from the normative character of Roman law and institutional and legal experiences including evergetism, and on the other hand, a significant degree of adaptability to challenges of environmental risk management. The remarkable capacity of the Roman society to adapt to situations of excess water as well as water deficit indicates possession of a technical know-how surely less sophisticated than the modern water technology but also quite advanced from the perspective of the sustainability of the management practices compared to present-day practices aimed at maximizing short term benefits.

From the perspective of globalization and regionalism, I would like to refer here to a phenomenon particularly significant in the Roman world: colonization with the related rural-urban relationships. The cadastral matrices ensured a genuine "territorialization" and in some case a "riparian space" of integrated sustainable water management. Sustainable water management practices have the potential to adapt to rapid population growth - as in the case of Delos in ancient Greece, (Brunet, 2008) - by the simultaneous use of different techniques and management practices which avoid overexploitation of water resources. The Greek colonization of southern Italy was adapted to local environmental management practices without imposing the resource management practices of the metropolis. Accordingly, instead of drying-up swamp areas which represented a natural defence offered by the Gods, the Greek colonizers of Magna Grecia respected local customs and beliefs, avoiding land reclamation in wetland zones (Bouffier-Collin, 2008). The proximity to water was a rule applied to the foundation of cities, but the Roman colonisation settlement process and the agrimensoral practices of land surveying determined the spatial configuration of a "riparian" system around water resources of variable nature and range of proximity. The location of these settlements was thus determined by the situation of drainage basins and the use of their resources along the mountain-river-wetland-sea complex and the bordering territories. The graphic reproduces ecosystemic entities which may be considered as riparian, Figure 3:

In the Roman world the concept of *riparia* is deemed to apply to a transition area between water and land, a highly risky environment including streamside as well littoral environments. Despite a rich bibliography on various aspects of this issue area – agrarian structures, law and water management – the riparian environment in the Roman world is not considered as an ecosystem generating its own specific patterns of interactions between society and the natural environment. However the literary sources place the emergence and definition of the *riparia* issue area in the period between the agronomist Caton in the 2^{ed} century B.C. and the early mediaeval charts, including Ciceron’s political vision, the agrimensoral sources and their mediaeval manuscripts (until the 14th century A.D.). The holistic vision integrating all the major components of this environment – river banks, lake shores, littoral areas, wetland – within an ecosystemic vision of their respective biotic features – influenced the genesis of the *riparia* concept and became obvious in the 1st century with Varron. Nevertheless, the awareness of the importance and full scope of the definition of the *riparia* concept is associated notably with the late Antiquity and early Middle Ages, when it was attributed a special status from a political, fiscal and juridical perspective. We have identified the period of the 6th century A.D. as the convergence point which integrates the different early approaches to configuration of the riparian environment as a “known space” according to the definition of R. H. Naiman, Décamps, H., M. E. McClain, *Riparia, Ecology, Conservation, and Management of Streamside Communities*, Amsterdam, Boston, 2005, p. 11. The subsequent mediaeval charts consolidated the political, economic, communitarian and cultural perspectives of the spatial configuration of this environment and the development of its management (figure 4).

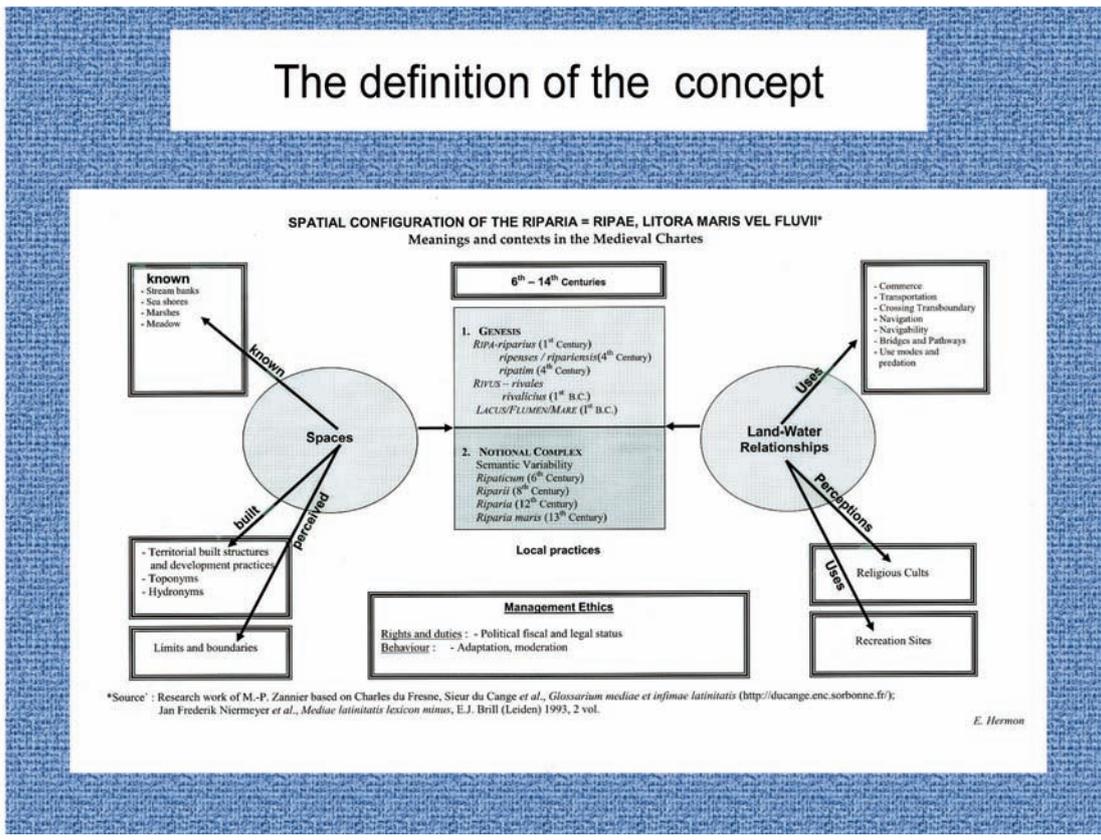
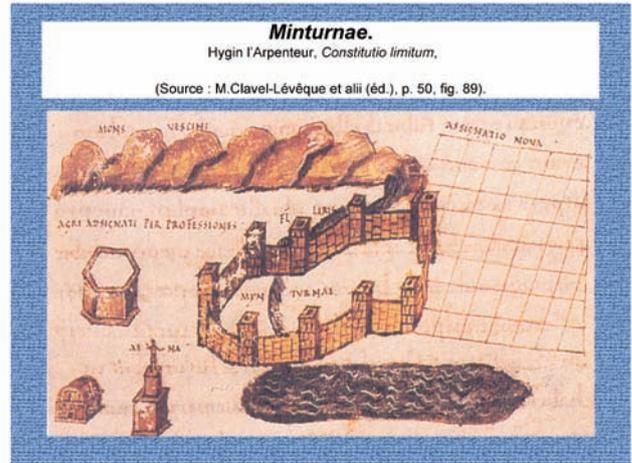


Figure 4

The conclusions of the reported research tend to indicate that the rich traditional knowledge developed in the Roman world included some elements of water management comparable, at least in some respects, to those characterizing the modern integrated water management approach, though such elements were reflected mainly in water management practices rather than in a water management theory. In this regard, the Roman colonisation settlement process determined the spatial configuration of a sensitive climatic «riparian» system determined by the situation of drainage basins and the use of their resources along the mountain-river-wetland-sea complex and the bordering territories. The consideration given in devising its water policies to regional and local particularism of Roman world, as well as to maintaining a certain balance in water management practices, played a significant role in this respect and contributed to the emergence of the Mediterranean region as a cradle of a common water culture largely based on adaptation to climate variations.

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