

EUROPEAN

POLICY BRIEF



THE IMPACT OF EUROPEAN WATER POLICY ON THE WATER CULTURAL HERITAGE

This policy brief summarises the findings of the MEMOLA project with regard to the impact of European water policy on the water cultural heritage associated with historical irrigation systems. The brief also presents suggestions for policy interventions in order to establish the mechanisms and criteria for the delimitation of their values and for their protection.

June 2015

Abbreviations: Historical Irrigation Systems (HIS); EU Water Framework Directive (WFD); River Basin Management Plans (RBMPs).

INTRODUCTION

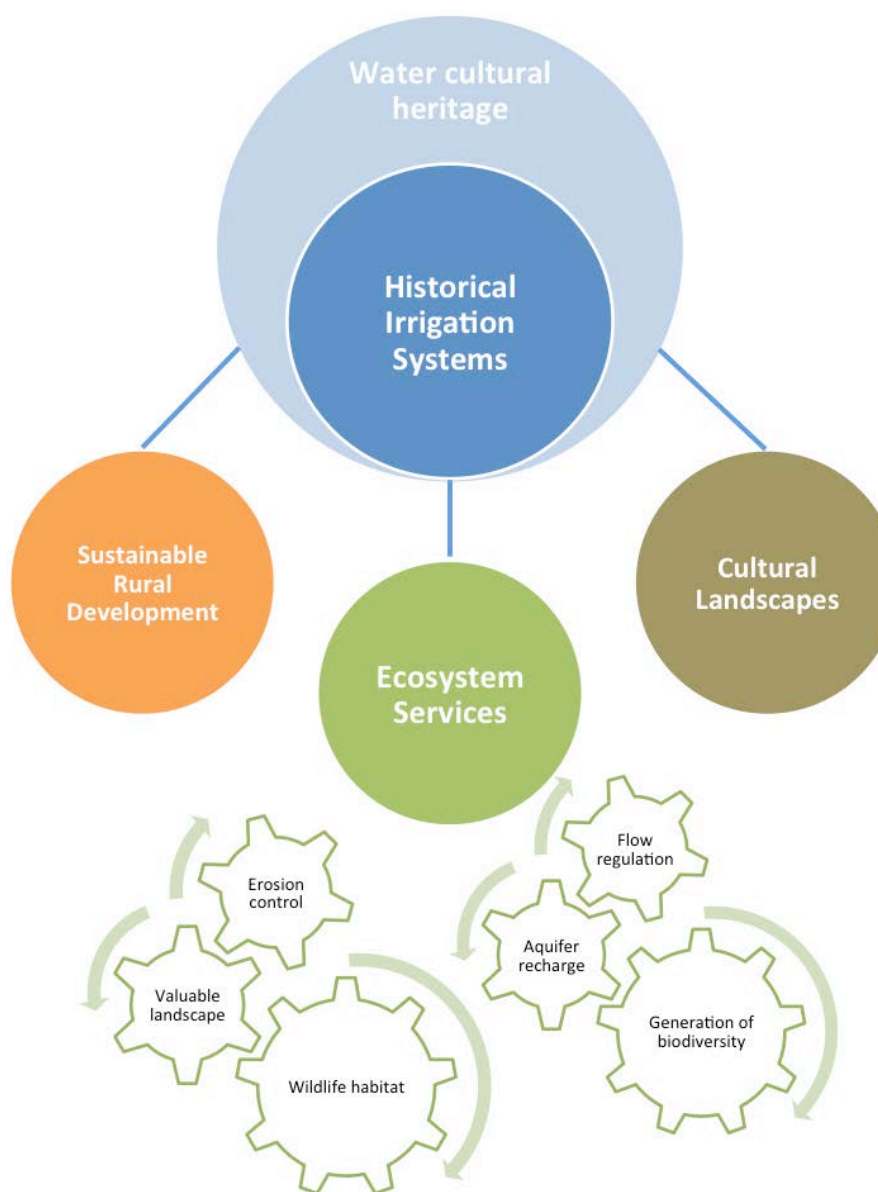
Historical irrigation systems as cultural and environmental heritage

Since antiquity, irrigated agriculture has had a significant impact on ecosystems in the Mediterranean basin, where water resources are limited and irregular in time. Furthermore, the 'historical irrigation systems' (HIS) have played a particular role in the ecological history of landscape, not only in southern Europe, but also in very different environmental regions across Europe¹. The HIS should be understood as complex land and water management systems, which use the water gravitational potential through distribution networks with simple structures, operated on a small scale and managed by local farmer communities. They work as a socio-ecological constructs which have been able to survive during centuries, thanks to a relevant resilience capacity and a sustainable use of the natural resources. These systems, which are still operational in many places, are **agroecological systems of great socio-economic, environmental and cultural interest**. They have generated peculiar **cultural landscapes as a result of centuries of sustainable interactions between people and nature**. The water cultural heritage associated with these systems relates not only to the technology, items and architecture developed, but also to practices, based on traditional environmental knowledge, which have generated intangible heritage values.

Beyond the intrinsic values held by the HIS, **important ecosystem services** are also provided by these systems, especially by those which are located in mountain areas. Among these services, it should be highlighted: headwater regulation, aquifers recharge, reduction of hillside runoff (erosion

¹ Leibundgut, C., Kohn, I. 2014. European traditional irrigation in transition. Part I: Irrigation in times past—a historic land use practice across Europe. *Irrig. and Drain.* 63: 273–293.

control), retention of storm-water flow and reduction of flood risks (flow regulation), support to wildlife habitats, generation of biodiversity and the maintenance of valuable landscapes. It is important to note that, Due to their beneficial services and values (tangible and intangible), for more than two decades, these systems have received attention and protection from several institutions (e.g. UNESCO). Nevertheless, it is now evident that in many parts of Europe the **HIS are under threat**, not only directly by changes of land use, but also because of the expansion of more intensive production systems and irrigation modernization plans. In addition to this, the abandonment of mountain agroecosystems is a common trend in European countries, and in recent years there has been increasing concern about its environmental consequences, being a controversial issue. From this standpoint, HIS deserve efforts to ensure their preservation, not only in the context of cultural heritage, but also as environmental and landscape value, with a firm view on their functionality as fundamental drivers of the current sustainable development in many rural areas.

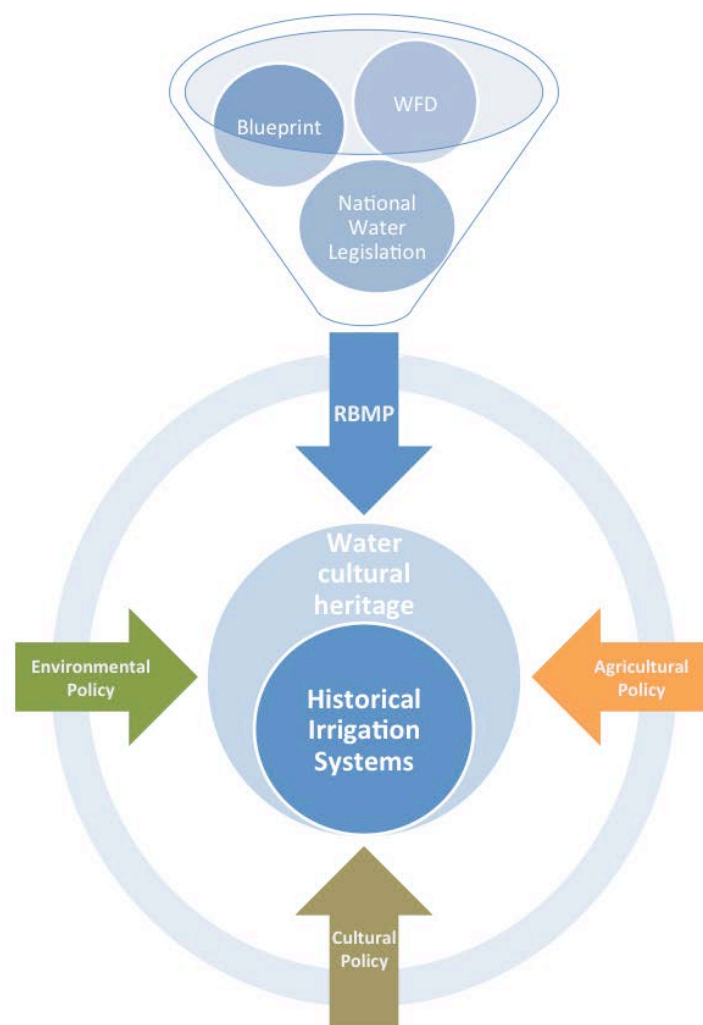


European water policy: An opportunity to protect the water cultural heritage

The EU Water Framework Directive (WFD) laid the foundation for a **sound water policy** whose key objective is to achieve a good ecological status for all water bodies, ensuring long-term and sustainable water use in harmony with the environment and with territorial development. Despite the efforts to implement the WFD (adopted in 2000), many EU waters have not reached yet good status in terms of quality and quantity, strengthening the need of new measures. In the pursuit of

this goal, the Commission launched in 2012 the ‘Blueprint to Safeguard Europe’s Water Resources’, a strategy for action with three main approaches: i) improving the implementation of current EU water policy by making full use of the opportunities provided by current laws (e.g. metering, water-pricing, better economic analysis, etc.); ii) increasing the integration with other relevant policy areas (e.g. agriculture); and iii) filling the gaps in relation to the increase in water use efficiency.

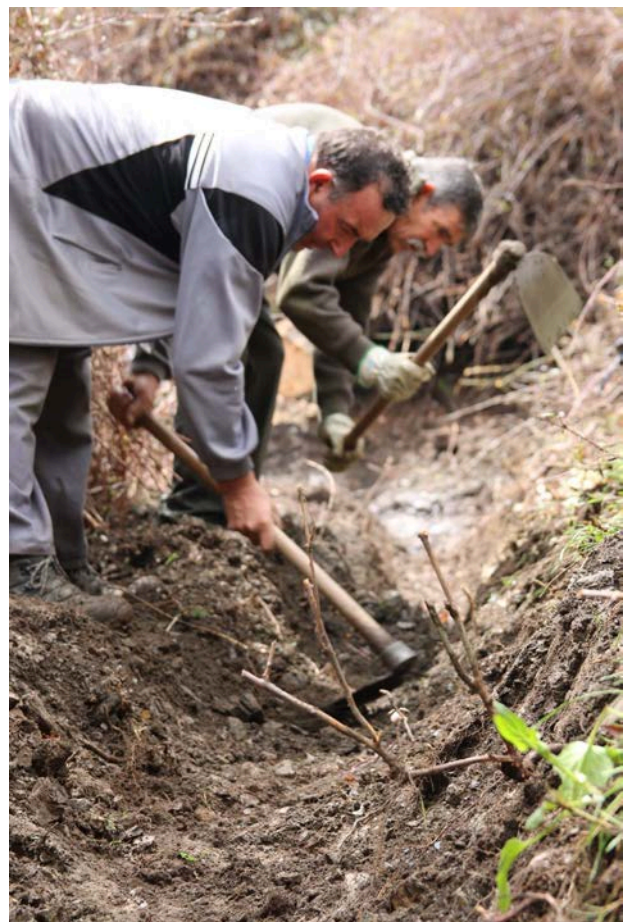
The main instrument for the implementation of the EU water policy is the River Basin Management Plans (RBMPs), which must articulate the water resources management, the satisfaction of the demands, and the programmes of measures to ensure the good health of the water resources. The elaboration of the RBMPs is not an easy task due to: i) the need for detailed information on multiple and diverse aspects required for meeting all objectives of the WFD and Blueprint; ii) a tight legal framework configured by EU water policy and its transposition into national legislation; and iii) the need for adequate coordination with other sectorial policies. In response to these factors, despite EU water policy proposes mechanisms for sectorial and territorial integration (‘not one size fits all solutions’, principle of subsidiarity), **in many cases the RBMPs does not safeguard the singularities of some systems**. This is particularly the case for the HIS located in some river basins across Europe, as will be discussed later.



In this policy brief, the impact of the EU water policy on the HIS, as well as on the values associated with them, are analysed and some policy implications and recommendations are derived. All the findings presented here were drawn from meetings with stakeholders and from the detailed assessment of EU water policy documentation and the RBMP corresponding to the study area of MEMOLA, ‘Sierra Nevada’. Currently, we are immersed in the second water planning cycle (2016-2021), and **this is a good opportunity for the recognition of the singularity of these systems and for a water management in line with their functions**.

Multifunctionality of the historical irrigation systems

The first step in the water planning process is the characterisation of the river basin, identifying, among other things, the different uses or demands, their economic importance, future trends, cost-recovery level of water services and the impacts on the achievements of the objectives stated by the WFD and Blueprint. In the national water policies, the water uses are usually classified in agriculture, industry, households and others, reproducing faithfully all the activities linked to water abstractions or impacts on the resource. However, some of the HIS, especially those located in mountain areas as the study areas of MEMOLA project, carry out a mixed use of the water. In fact, **a characteristic feature of the HIS is the interlinkages among irrigation and other uses**. In many cases, the water abstracted by these systems is not only used to irrigate the crops (agricultural use), but also to recharge artificial aquifers that feed springs and drinking fountains for household supply downstream. Also, some important ecosystem services (wildlife habitat, biodiversity, landscape, etc.) are provided by these systems, and an evidence of that are the conservation and restoration efforts² made by environmental organizations. Therefore, it is crucial that the RBMPs recognise the multifunctionality of the HIS (**extra-agricultural services**), in order to plan for suitable water resources allocation and to assess properly the impacts of these activities.



[Participative activity](#) carried on by MEMOLA project for the rehabilitation of a HIS in Sierra Nevada (Spain)

² Some examples of restoration projects of HIS: https://www.intwater.uni-freiburg.de/sites/index_html#ch-waessermatten

Legal Registration, a great need

Authorization procedures for water use differ significantly among Member States, and unregulated abstractions remain an important challenge in parts of Europe. It was found that this was particularly the case for many HIS, as highlighted in the study area. Despite its importance for management and planning purposes, the register of water abstractions from these systems is not yet completed. Thus, within the Programme of Measures linked to the RBMPs, the inventory and characterization of uses and demands of the HIS should be considered. The Commission propose to the Member States means and programmes (such as, the Global Monitoring for Environment and Security Programme) to face the problem of illegal abstractions. However, the unregulated HIS cannot be considered as illegal abstractions since they have historical rights dated several centuries back. In this way, **there is a need to design a specific procedure for the regularization of these systems**, tailored to their characteristics and local situation. Currently, the only valid regularization procedure is oriented to new concessions, that is, transformations from rainfed to irrigated agriculture, with complex administrative formalities. It should be remembered that the regularisation process of the HIS is closely linked to the suitable water planning and the aim of ensuring a **stable legal framework that promoted investment and economic development**.



Example of riparian vegetation associated with different HIS

Water use restrictions: Ecological flows and exemptions

Quantitative problems are progressively affecting more river basins across the EU, being the over-abstraction the second most common pressure on ecological status. The water abstraction beyond the renewing capacity of nature is especially relevant in irrigated areas of the Mediterranean countries, due to an overestimation of the available amounts, to economic or political pressure, to illegal abstractions or to drought problems. To address the issue of over-allocation, the identification of the ecological flow is essential in order to restrict water use so as to ensure a reasonable amount of water required for water-dependent ecosystems. However, the Member States do not implement standardised methods and common understanding for setting ecological flow, despite the guidance document proposed by the Blueprint in the framework of the WFD. The **estimation of ecological flow is a complex task**, because it requires a significant amount of hydrological data to enable a good estimation of the current flow regime and how it deviates from the natural flow regime. This information can be derived from monitoring the hydrological regime or using modelling approaches. However, these methods have **significant limitations to cover both**

the natural and current complex hydrology of the river basins where the HIS are located (multiple contributions, withdrawals, diversions and return flows, steep topography and high spatial variability, snow dynamics, etc.). On the other hand, the ecological flow regime is finally quantified from the further analysis of the habitat need for wet section and the associated flow velocity conditions, which is far from easy to establish and requires time and costly consuming efforts, not always feasible at the watershed scale. Moreover, the existing diversions sometimes balance the human modifications. For example, the assumed natural flow regime of some rivers may be maintained at certain times of the year by the recharge activities of HIS. On the other hand, the seasonality of some rivers is partially caused by the water abstractions of HIS. Nevertheless, this pattern has been occurring for at least ten centuries, linked to an adaptation process of the basin ecology to the flow regime and to the configuration of a high value landscape. From this viewpoint, the term 'natural conditions', used both in Article 4.4 and 4.5 of the WFD, should be revised for these systems. In this way, **the impacts of the ecological flow implementation should be carefully assessed under a broader perspective** (spatial and temporal), taking into account the ecosystem services and the specific values of HIS. These considerations may be used to **apply for an exemption** (as established in the WFD, as the designation of heavily modified water bodies) or to revise the calculation procedures associated with ecological flows. **An essential instrument for implementing ecological flows under this complex scenario is the stakeholders participation.** A pro-active approach to engage all stakeholders can deliver optimal decisions and facilitate a better implementation. The EU legal framework on water is flexible and provides mechanisms to address the singularities of each system. However, in most cases, these instruments have not been applied to preserve the values of HIS.

Between conservation and modernization

As pointed out earlier on, it is clear that the diversion or retention of water for irrigation, especially in Southern River Basins, may in many cases cause water scarcity problems or other serious downstream effects on the environment. Pressures from the intensification of irrigated agriculture should be mitigated or prevented through the Programme of Measures included in the RBMPs. After a suitable water demand management, alternative supply options are now unrealistic and may be only envisaged in cases where the potential water use efficiency has already been reached. For these reasons, in most Programme of Measures, the modernization of the irrigation systems is assumed as a priority action for increasing irrigation water use efficiency (one of the strategic actions of the Blueprint). Clearly, the adoption of irrigation technology, and in particular measures to reduce losses in the irrigation distribution networks, can improve efficiency and reduce gross water requirements. However, it is important to highlight that **the impact of these modernization plans on the achievements of the objectives stated by the WFD should be analysed in depth**, even though it is not undertaken in most Strategic Environmental Assessments of RBMPs. Uncertainty remains on how water saving at the field or irrigation scheme level is effectively translated into overall water savings at the river basin level. The effects of return flows and recharge should be considered, and there is also the risk of further unsustainable intensification of the agricultural sector or of expansion the irrigated areas. Also, these measures may lead to unsustainable energy consumption, heavy investments and high maintenance and operational costs. This could compromise the cost recovery objective of the WFD and the fair and reasonable water tariffs. Under this context, it should be emphasized that **irrigation modernization could have significant adverse effects on the HIS for the following reasons:** i) Substitution of existing distribution networks that have historical value and that have other functions such as contributing to groundwater recharge; ii) important losses of historical and cultural heritage in fragile and valuable landscapes with great tourist attraction; iii) adverse environmental effects due to a change in the local hydrology (such as drying up of springs and other changes in the hydrological regime, loss of vegetation and wildlife associated with irrigation distribution networks, erosion, etc.); and iv) a potential enhancement of intensification, putting many irrigation communities at risk, by weakening their resilience capacity developed during centuries, and affecting their traditional knowledge, uses and techniques, which are considered valuable immaterial heritage. Currently, **irrigation modernization plans are threatening many HIS without a proper (real) assessment of other alternatives that could be better environmental, cultural, social and economic options.** The Commission highlights that the efficiency problem can only be tackled on a case-by-case basis to assess the environmental and

economic benefits of reducing the leakage levels. The estimation of the Sustainable Economic Level of Leakage, instrument suggested by the WFD, but rarely used by the Member States, is best set at the local level by those stakeholders who have full knowledge of the water distribution network and the specific context within which it is operating, and who can ensure that targets are socially and economically coherent.



Modernization works of a HIS through the replacement of open channels by an underground pipe distribution network

Enhancing the dialogue between policies

As we have previously noted, HIS are responsible for valuable cultural landscapes. In the recent decades, the perception of traditional rural landscapes as heritage has been included in some agri-environmental policies as well as in the key priorities set by the Horizon 2020 strategy of the EU. However, the **cultural landscapes associated with the HIS have not yet received official recognition in most RBMPs**. Despite this fact, the WFD stresses that water policy should be consistent and function in synergy with other policies. Thus, the preservation of these valuable systems should be ensured through the environmental assessment required by the EU water policy, which should report the effects of the RBMPs on cultural heritage (including architectural and archaeological heritage) and landscape, among others, and the interrelationship between all factors (Directive 2001/42/EC; Article 5(1)). Also, the likely significance of effects must be determined in function of the value and vulnerability of the area due to special natural characteristics or cultural heritage (Directive 2001/42/EC; Article 3(5)). However, these assessments are overlooked in most RBMPs. The main reason for this is that, **in the regional legal framework (environmental or patrimonial), there is not a clear formal recognition of the intangible values of the HIS**, aimed at the conservation of the landscape and cultural heritage associated with them. Thus, it is necessary to enhance the dialogue between the policies to ensure the proper implementation of the WFD, avoiding negative effects on the environment and cultural heritage.

On the other hand, for a better implementation and an increased integration of water policy objectives into other policy areas, the Common Agricultural Policy's proposals for funding to improve irrigation efficiency is highly relevant. For example, most **irrigation modernization projects** in Spain are **supported by rural development funds**. However, **the impact assessment of these projects is not performed in line with the holistic approach of the WFD**, resulting in adverse effects as we have mentioned above. Once again, the coordination between water and agriculture authorities should be improved.



Representative cultural landscape configured by HIS in Sierra Nevada (Ohanes, Almería, Spain)

Towards bridging information gaps

As obvious as it is, for sound water management, it is necessary to use precise and transparent data and clear assumptions, supported by robust monitoring programmes and revealing the uncertainties. The assessment on water demands, water availability and impacts of the uses lacks adequate foundation in many RBMPs³ because the quantitative datasets are incomplete despite the considerable progress achieved in the last years (measures to solve this are present in 85% of the RBMPs²). In the cases of HIS, this situation is compounded by the complexity of their hydrological process, linked to the limited sources of information on these systems available at present. Therefore, it is necessary that the RBMPs with HIS develop a **specific programme of measures aimed at bridging the important information gaps**. For ensuring transparency and adequacy of the much-needed programme of measures, it is necessary to reach the **involvement and coordination among all public administrations concerned, scientists** (environmental economists, ecologists, hydrologists, engineers, etc.), **environmental organizations, farmers, and other stakeholders**. Appropriate coordination between the stakeholders will facilitate: i) the identification of the information gaps; ii) the selection of suitable methodologies or procedures; iii) the efficient management of public resources. The **site-specific implementation** of these measures is crucial, which combined with stakeholder participation will lead to a pro-active planning and the resolution of the existing social conflicts. In this regard, Local Action Groups (established under LEADER programme) could play an important role, as has been pointed out in the “WFD and Agriculture Linkages at the EU Level Report”⁴ and as MEMOLA project is implementing⁵. The need for inclusion of all local stakeholders is also in line with the recent conclusions of the EU Council on participatory governance of cultural heritage⁶.

³ Schmidt, G. & C. Benítez-Sanz (2012). Topic report on: Assessment of Water Scarcity and Drought aspects in a selection of European Union River Basin Management Plans. Study by Intecsa-Inarsa for the European Commission (under contract “Support to the implementation of the Water Framework Directive (2000/60/EC)” (070307/2011/600310/SER/D.2))

⁴ Dworak, T. et al. (2009). WFD and Agriculture Linkages at the EU Level. Summary report on an in-depth assessment of RD-programmes 2007-2013 as regards water management. Eco-logic and Vito.

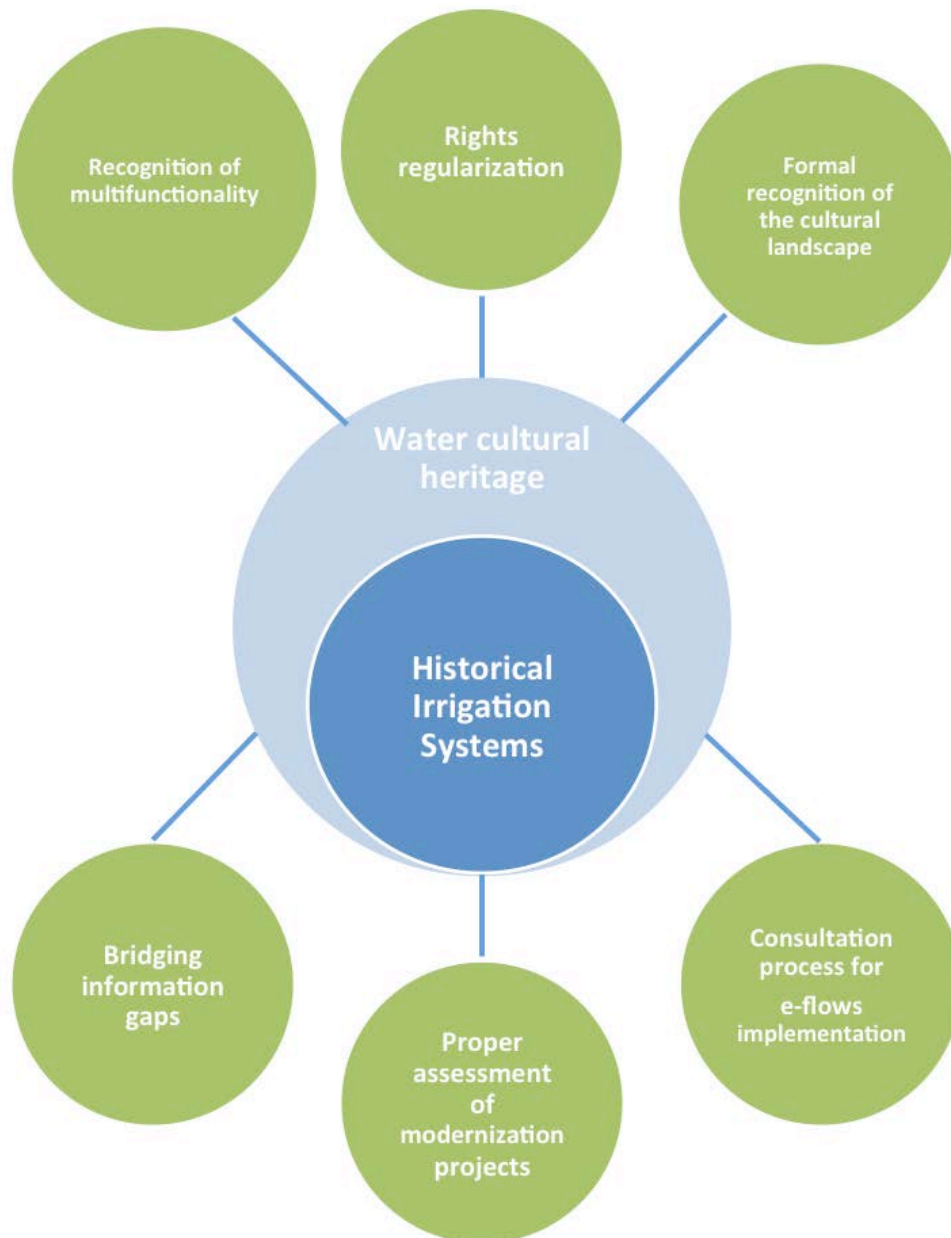
⁵ Collaborations with the Local Actions Groups of the study area to perform hydrological measures.

⁶ Council conclusions on participatory governance of cultural heritage. Official Journal of the European Union 463, 23.12.2014, p. 1–3.

The EU water policy, through the WFD and the Blueprint, is a flexible framework and provides mechanisms for sectorial and territorial integration, and for addressing the singularities of each system. Nevertheless, the principle ‘not one size fits all solution’ upheld by the WFD is certainly not a sufficient condition for proper water planning, since it requires its transposition into the national water policy and so into the RBMPs. According to the MEMOLA research, most RBMPs with HIS associated with their water bodies do not safeguard the singularities of these systems (cultural heritage, ecosystem services, landscape, etc.), preventing the WFD objectives from being achieved. On this basis, the following recommendations should be taken into account under MEMOLA criteria:

- National water policies should include the mixed water use (e.g. agricultural, household and environmental at the same time) as a category within water demands. In this way, the multifunctionality of the HIS can be recognised in the RBMPs; and thus, water resources allocation can be properly planned and the impacts of their activities can be assessed in the right way.
- It is necessary to carry out a detailed inventory of the unregulated HIS. Also, the need for a specific procedure for the regularization of these systems (tailored to their characteristics and local situation), when feasible, has been identified. These measures are crucial for suitable water planning and for ensuring a stable legal framework that promotes investment and economic development.
- Due to the complex hydrology of the water bodies associated with HIS and their singularities, the ecological flows should be implemented through a consultation process involving all the stakeholders. This pro-active procedure could provide the information needed to apply for the exemptions established in the WFD or to revise the values associated with ecological flows, while also facilitating a better implementation.
- Irrigation modernization projects of HIS, for enhancing the water use efficiency and for water savings, should be carefully assessed in order to identify their possible negative effects on the environment, socio-economy, cultural heritage and landscape, in accordance with the EU water policy. Also, the Sustainable Economic Level of Leakage, instrument suggested by the WFD, should be set at the local level by stakeholders who have full knowledge of the water distribution network and the specific context, and who can ensure that targets are socially and economically coherent.
- The rural development funds to improve irrigation efficiency (modernization programmes) should be in line with the holistic approach of the WFD. Thus, the coordination between water and agriculture authorities should be improved.
- The intangible values of the HIS, such as cultural heritage or landscape, should be formally recognised by the regional legal framework (environmental or patrimonial), e.g. the designation of Special Areas of Conservation or Special Protection Areas (Natura 2000 network). In this way, the proper implementation of the WFD would be facilitated, avoiding negative effects on the environment and cultural heritage.
- The concerned RBMPs should include, within their Programme of Measures, specific measures aimed at bridging the important information gaps on the HIS. For ensuring transparency and adequacy of the much-needed programme of measures, involvement and coordination between all stakeholders are necessary.

- Local Action Groups (established under LEADER programme) should play an important role to bridge the important information gaps on the HIS, encouraging the synergies between the different policies and leading to a pro-active water planning.
- The Programme of Measures of the concerned RBMPs should also include measures to tackle the maintenance and performance improvement (in line with the environmental and socio-economic objectives of the WFD) of the valuable HIS.



MEMOLA project aims to analyse cultural landscapes of Mediterranean mountainous areas, taking as a central axis the diachronic study of the relationship between human populations and natural resources, in particular soil and water. To understand the landscape it is necessary to investigate the historical processes that have led to a specific relationship with the environment, aimed at the extraction and use of resources in certain social contexts. These uses have deeply moulded the environmental context, generating not only its forms, but also the cultures that made it possible its management and maintenance until today. The implementation of a multidisciplinary approach (widening the range of specialists involved in cultural heritage study to agronomist, hydrologists, botanists, pedologist and hydro-geologists) allows the proper hybridization between the human and environmental sciences. The project focuses on the study of four Mediterranean Europe mountain landscapes: Sierra Nevada (Spain), Vjosa Valley (Albania), Trapani Mountains and Colli Euganei (Italy), in the period between Late Antiquity and present time.

Under the context of this Policy Brief, the following specific objectives included within the Work Package 9 'Socio-Economic Impact' should be noted:

- Analysis of the productivity and resource (water and soil) use efficiency in the study areas, through agronomic and hydrological methodologies.
- Analysis of the ecosystem services associated with the agroecosystems in the Mediterranean mountainous. Trace an historical trajectory of agroecosystems leading to the creation of a "High Nature Value farmland".
- Proposals for improving resources-use efficiency and conservation of cultural landscapes associated with traditional agricultural and livestock activities, in order to contribute to a sustainable development of the study areas from a social and environmental point of view, while enhancing their heritage and natural values.
- Analysis of the role and impact of the Water Framework Directive and EU Water Blueprint strategy on the current uses of water in the studied agroecosystems.

In order to achieve these objectives, the following activities are carried out: i) ethnographic studies (<http://memolaproject.eu/node/766>); ii) characterization of crop, soil and water management (<http://memolaproject.eu/node/771>; <http://memolaproject.eu/node/716>; <http://memolaproject.eu/node/706>); iii) hydraulic surveys (<http://memolaproject.eu/node/717>; <http://memolaproject.eu/node/748>); iv) hydrological measures (<http://memolaproject.eu/node/770>); v) water use efficiency modelling; vi) literature review; vii) specific seminars and meetings with farmers, professionals and organizations related to agricultural and livestock sector (<http://memolaproject.eu/node/773>); and viii) meetings with local and regional policy makers in the areas of agriculture, territorial planning, rural development, environment and/or cultural heritage.

PROJECT IDENTITY

PROJECT NAME	MEDiterranean MOntainous LAndscapes: an historical approach to cultural heritage based on traditional agrosystems (MEMOLA)
COORDINATOR	José María Martín Civantos, Universidad de Granada (Spain) e-mail address: civantos@ugr.es
CONSORTIUM	Agencia Estatal Consejo Superior de Investigaciones Científicas – CSIC – Escuela Española de Historia y Arqueología Roma, Italy Arqueoandalusí Arqueología y Patrimonio S.L. – ARQUEO – Granada, Spain Centro Unesco de Andalucía – UNESCO-AND –Granada, Spain Eachtra Archaeological Projects Limited – EAP –Cork, Ireland Qendra e Kerkimeve dhe Promovimit te Peisazheve Historiko-Arkeologjike Shqiptare – CeRPHAAL –Tirana, Albania The University of Sheffield – USHEFF –Sheffield, United Kingdom Universidad de Córdoba – UCO –Córdoba, Spain Universidad de Granada – UGR –Granada, Spain Universita degli Studi di Padova – UNIPD –Padova, Italy Universita degli Studi di Palermo – UNIPA –Palermo, Italy
FUNDING SCHEME	FP7 Framework Programme for Research of the European Union – Collaborative project – SSH.2013.5.2-2. – Transmitting and benefiting from cultural heritage in Europe
DURATION	January 2014 – December 2017 (48 months).
BUDGET	EU contribution: 2.499.772,70 €.
WEBSITE	http://memolaproject.eu/
FOR MORE INFORMATION	Contact: Maria Pilar Tudela Vázquez; memolaproject@go.ugr.es Conctac: Margarita García Vila: g82gavim@uco.es
FURTHER READING	The following publications developed in the MEMOLA project directed to policymakers and administrative staff responsible of River Basin Management Plans (RBMPs) <ul style="list-style-type: none">• “Alegaciones al Esquema Provisional de Temas Importantes del proceso de revision de la planificación hidrológica de las Demarcaciones de las cuencas internas de Andalucía”.• “Observaciones a la propuesta del proyecto de revisión del Plan Hidrológico, proyecto de Plan de Gestión del riesgo de inundación y Estudio Ambiental Estratégico de la Demarcación Hidrográfica de las Cuencas Mediterráneas Andaluzas”. Additional Bibliography <ul style="list-style-type: none">• Silva Pérez Rocío: “Claves para la recuperación de los regadíos tradicionales. Nuevos contextos y funciones territoriales para Viejas agriculturas”. Scripta Nova. Revista electronica de Geografía y Ciencias Sociales. Vol XVI, núm. 412, 1 septiembre 2012. http://www.ub.edu/geocrit/sn/sn-412.htm• Fleming, M. William, Rivera, José A., MILLER, Amy and Piccarello Matt: “Ecosystem services of traditional irrigation systems in northern New Mexico, USA”. International Journal of Biodiversity Science, Ecosystem Services and Management, 2014. Vol. 10, No. 4, 343-350. http://www.tandfonline.com/doi/abs/10.1080/21513732.2014.977953 - .VZfmZlofxVo• LEIBUNDGUT, C., KOHN, I.: “European traditional irrigation in transition part II: Traditional irrigation in our time- Decline, Rediscovery and Restoration Perspectives”. Irrigation and Drainage, 63: 294-314 (2014).• Hermosilla Pla, J. (Dir.), Los regadíos históricos españoles. Paisajes culturales, paisajes sostenibles. Ministerio de Medio Ambiente, Medio Rural y Marino, Madrid, 2010• Espín Piñar, Rocío, Ortíz Moreno Eduardo. y Guzmán Álvarez, José Ramón “Manual del acequero”. Agencia Andaluza del Agua. Sevilla, 2010.