

MOOC sobre Sierra Nevada

MODULE 2

2.5 TAMING THE WATERS: THE IRRIGATION CHANNELS OF SIERRA NEVADA

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Introduction: Cultural landscapes and historical irrigation systems

The current landscape is the result of the accumulation of the various historical landscapes that have evolved over time. It is, in short, a social landscape, one that has been *produced*—and, therefore, it forms part of the material culture of the societies that created those ancient landscapes. Critical to their formation are, among other factors, the interaction between human beings and nature, but also the manner in which a particular social formation is expressed in physical space. In reality, a landscape, understood as a synthesis of social relationships, can be considered an archaeological site that is extremely far-reaching in time and space.

Within the Sierra Nevada landscape we find numerous elements created or modified by human beings throughout history. Some have been “fossilized,” such as castles or former mines, and others are still in use, such as irrigation systems or the population hubs themselves. Indeed, today’s towns and cities are also living archaeological sites, some with a history stretching back over a thousand years.

There is currently a high risk that all these elements will either be transformed beyond recognition or abandoned altogether. Knowledge of them and their conservation are of enormous value if they can be integrated into a model of development that respects both the environment and its heritage. The extraordinary balance between human development and the environment that has been achieved, for example, in the use of water resources in a mountainous area like this cannot be simply wasted. The landscape, once humanized, cannot be destroyed just like that.

Historic irrigation and hydraulic management systems are one of the main hallmarks of Sierra Nevada. Their construction in medieval times has indelibly marked not only the ways of life of local inhabitants and the exploitation of the mountain’s resources, but also the transformation of the landscape of this tamed and humanised space. These networks of traditional irrigation channels, known as *acequias*, are essential both for refilling high-mountain aquifers and for creating pastureland in irrigated areas that are intensively farmed. This is in addition to maintaining the biodiversity of this mountain area by means of a whole series of ecosystemic services that, until now, have remained undervalued by the scientific field. However, the tremendous territorial impact of the thousands of kilometres of *acequias* and the agricultural terraces and infrastructures associated with them is now threatened by their unprofitability in the current economic context. The progressive disappearance of forms of



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traditional exploitation and the gradual decline in agricultural yields have, in many cases, led to these systems being marginalised, left in a state of decay, and partially abandoned.

What are historical irrigation systems?

An irrigation system is a complex man-made construction that collects water from one point, conducts it through a main conduit or channel, and distributes it via more minor channels that take it to its final destination—that is, fields and other farmed plots of land.

And while it is vital to calculate where exactly to take the water, to correctly establish the optimal slope to avoid land erosion, and to raise the agricultural terraces sufficiently, the really difficult part is to reach an agreement on how the water is to be allocated, in terms of how much corresponds to each plot of land, and when. In order to regulate all such matters, the *Comunidades de Regantes* were created. These are self-organising community groups that come together to discuss and agree the necessary measurements (such as the terrain and the water) and the rights and obligations of each farmer, so that all can enjoy the irrigation system and keep it clean and well-functioning at all times.

Not all societies have built such irrigation systems, and nor have all been able to reach agreements that enable such good organisation. That is why historical irrigation systems are so unique and special; they are an important part of our history and our heritage, and a fundamental component of our landscapes.

Research on water management systems

At the University of Granada's MEMOLab Biocultural Archaeology Laboratory, we have been studying some of these systems for several years. The research methodology has been complex, and has included hydraulic prospecting (to document and conduct a topographical survey of the *acequia* systems) and ethnography. The latter has involved conducting surveys among the *acequeros*—the individuals with expert skill in water catchment and allocation—and those familiar with the *acequeros'* work, and studying the traditional forms of agricultural exploitation. The topographical fieldwork is performed using GPS, combined with orthophotography and cartography (including, where possible, historical cartography). All this documentation is complemented by the use of databases and geographical information systems. The research has included documentary and bibliographic sifting and analysis, toponymic analysis, and even the excavation of several agricultural terraces to enable the soil dynamics to be studied and to better understand the formation of these terrace systems.

The most striking result of the research to date is the documentation and topographical study of just over 3,000km of *acequias* in Sierra Nevada and its immediate surroundings. These represent just a small proportion of the entire system, however, and much more research needs to be done. This figure alone, relating to the length of this stretch of the network, gives us an idea of the impact of these infrastructures and the agrosystems linked to them on the landscape, the environment, and

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the land. This is a highly complex system of exploitation, not only of the water itself, but also of soils, pastureland, and mountains, and, of course, a crop and animal management system.

The main activity on Sierra Nevada has traditionally been intensive irrigated agriculture. This is a social approach—perhaps not even the most “logical” one in a mountain or high-mountain environment. This option has deep historical roots that crossed a fundamental milestone with the 8th-Century Arab–Berber conquest, when the networks of *acequias* began to proliferate. These networks include mechanisms for the artificial refilling of the high-mountain surface aquifer and refilling of chasms, as well as the creation of *vegas* (fertile plains).

Sierra Nevada fulfils an essential “natural reservoir” function. However, the sheer extent of the irrigation there is possible not only because of the abundant water resources that derive from the snow, but also thanks to the active control and organisation of those resources into an extensive network of hydraulic structures comprising numerous *acequias*, ponds, and cisterns. The entire infrastructure is closely linked to the presence of fortifications, since entire populations—that is, the network of settlements that has existed, from the time of al-Andalus through to the present day—are shaped by irrigation and the *vegas* it produces. It is these, the irrigated lands, that structure the territory; it is these lands that constitute the pivotal element around which village life revolves (or once revolved); and it is thanks to these lands that the villages came to be where they are.

It is precisely here, in these communities, where we find the key to understanding the complexity of these systems. The extensive network of infrastructures for pooling, diverting, and distributing water is truly admirable, for the technical complexity of guiding water along kilometres of *acequias*, overcoming all manner of obstacles due to the difficult lie of the land, or refilling high mountain aquifers. But, without question, the main challenge/achievement lies in the *social* management of water. The distribution of a scarce resource—at times, requiring measurement to the last millimetre—properly allocated and monitored, is a source of conflict almost to the same degree as it is a source of life. In this sense, distribution is even more important than the infrastructure itself. Generations of collaborative endeavour have been poured into the opening of the *acequias*, the terracing of the mountain slopes, and the upkeep of the entire system, sculpting these mountains and leaving an indelible mark on the landscape.

By examining these systems of water exploitation, we can therefore trace back through a major part of the history of Sierra Nevada and its people, to understand how its landscapes were formed, along with the thinking and rationales that govern them.

From an environmental standpoint, historical hydraulic systems also play a fundamental role in Sierra Nevada. While their contribution from the point of view of diversity is yet to be fully assessed, the considerable ecosystem services they provide cover an extensive geographical area—for example, the refilling of high-mountain aquifers and floodplains in the low-lying areas, or agricultural supply in the *vegas* of such widely-dispersed zones as Guadix, Granada, the Delta del Guadalfeo, or Almería.



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The importance of historical irrigation systems

The historical irrigation systems are an example of human beings' modification and adaptation to the natural environment. Their operation is linked to the complex, localized ecological knowledge of the populations that have historically maintained them. This knowledge encompasses plants and animals, soils, surface water, and groundwater.

Managing water is a communal affair, which means that those needing to irrigate their land must allocate the water efficiently and fairly. For centuries, they have resolved the frequent conflicts that arise, and in so doing they have shaped the rural population, maintaining its cultural identity and bringing the community together.

In addition to a rich and varied agriculture, these systems generate landscapes of enormous biodiversity, regulate hydrological cycles, and refill aquifers and springs by means of filtration through the *acequias* and flood irrigation.

Flood irrigation fertilizes the soil and prevents salinization. At the same time, the irrigation zones increase the humidity index, bring down maximum temperatures in the immediate area, and contribute to the formation of storms.

For centuries, these systems have proven to be sustainable and highly resilient to social or environmental changes. They are also an effective tool for adapting to climate change, and a heritage asset that we must preserve for future generations as an example of sustainable development.

Irrigation systems and irrigation communities in crisis: Socio-ecosystems at risk

As we have seen, these "irrigation communities" have historically been responsible for the management of water and the production associated with it, performing an invaluable task in productive, environmental, and social terms. But now, these communities are facing a crisis brought about by an ageing process that is affected by a lack of generational hand-over and by transformations in the rural way of life. The current economic context and the continuing crisis in agricultural yields render this type of agriculture uncompetitive in pure market terms, making it impossible for a new generation of young farmers to earn a living in the primary sector.

The know-how that is rooted in rural life regarding the management of hydraulic systems, crops, and livestock is rapidly disappearing, and must be preserved as much as possible. The search for solutions to preserve this major material and intangible heritage necessarily involves looking for alternative forms of sustainable production, from an environmental and social point of view, which include changes in consumption habits and in the relationship between city-dwellers and the nearby rural world.



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What are the historical irrigation systems?

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