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TRADITIONAL USE OF MUDDY WATER ON THE FOOTHILLS OF THE SOUTHEAST OF SPAIN: THE CURRENT SITUATION OF THESE CASUAL IRRIGATION SYSTEMS[1]

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I. THE TRADITIONAL MANAGEMENT OF AGRARIAN LANDSCAPES IN THE SOUTHEAST OF SPAIN: SYSTEMATISATION BASED ON SOIL CONSERVATION AND THE INTEGRAL USE OF WATER RESOURCES

In the southeast of the Iberian Peninsula, the features of the climate (scant and sporadic precipitation, totalling around 300 mm a year) combined, at times, with the dictates of the relief (steep slopes) and the dominant lithology (limestone and marl) provided few opportunities for the development of intensive human occupation, as the lack of rainfall and poor soils were major constraints.

Said features determined the basic lines along which rural communities had to run in order to be able to make rational use of the land – a rational use which would enable their survival. In a society like the traditional society in which agriculture is the economic mainstay, soil and water become particularly important. As a result, when the surroundings land is deficient in these elements, efforts to maintain the one and increase the other are the guiding force behind Man's actions in these semi-arid lands. Such actions are two pronged: on the one hand they look to make use of the rains, generally concentrated into a few episodes of rainfall during the autumn and, on the other hand, they seek to control their erosive capacity on the soil and to adopt the necessary measures to reduce the run-off coefficients generated by the various watercourses and thus minimise the loss of topsoil and the more weathered soils.

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II. THE MANAGEMENT OF SEMI-ARID MEDITERRANEAN SPACES: SYSTEMATISATION BASED ON THE IMPLEMENTATION OF VARIOUS TECHNIQUES

To minimise the effects of the aforementioned features, farmers developed a territorial system which is the result of twin needs: to have land available for cultivation and to supply watercourses with at least enough water to ensure the harvests, which is not always possible. They did this by adopting systems to capture the volumes of water which flowed through the dry riverbeds (*ramblas*) and gullies during heavy rainfall and other systems designed to retain the scant rain which fell directly on the parcels or on the higher land surrounding them.

Hillsides, slopes, gullies and watercourses were organised and arranged so that run-off water would be diverted and channelled towards the cultivated parcels lying at lower levels. This organisation was achieved through the adoption of various practices:

1. *Terracing parcels*. This was done by constructing ridges or stone walls across the slope, thereby interrupting the run-off and forcing the water which has fallen on the farmland to accumulate in the upper part.
2. *Using the diffuse run-off upstream of the farmed parcels*. The water circulating on the hillsides above the farmland, and on those either side, was channelled towards the farmland, thereby increasing the volume received by the farmland during the downpour. This is what is known as "furrow irrigation" (riegos de vertiente). This was achieved through a series of small actions (stepped ridges laid out obliquely to the slope and confluences at the lowest point of the hillside from which the sluiced irrigation channel or *boquera* sprang) to prevent the water from flowing laterally, away from the cultivated area, and by clearing the immediate surrounding of undergrowth in order to encourage a diffuse layer of water to reach the upper part of the parcel.
3. *Using the water flowing along the riverbeds* in situ. This procedure involves raising a wall which is usually made of compact earth and stone, is up to 8 or 10 metres high and which stands perpendicular to the direction of flow. Building this wall meant that, on the one hand, the water flow was intercepted and channelled towards either end, where a conduit would release the retained water and direct it to the lower-lying fields, and, on the other hand, that solid material being carried by the water was deposited upstream, thereby encouraging the formation of soil.
4. *Diverting the storm-water flowing down* ramblas *and gullies*. This method basically involved installing a dam in the bed of these watercourses of intermittent flow. The dam would intercept part of the floodwater, which was then diverted to a side channel known as a *boquera* (Morales, 1969: 170). Once taken from the riverbed, the water is then distributed via a network, the complexity of which depends upon the size of the surface area to be irrigated. The importance of these occasional flows to the local agriculture-based societies led to rather complex systems, with several dams often being installed along a single gully.
5. *Mixed systems:* boqueras *and hillside terracing*. *Boquera*-based irrigation systems are often associated with hillside terracing. This combination provides twin benefits by increasing water resources and "controlling" slopes. The use of terracing is perhaps the most direct expression of the need to preserve soil and humidity in mountainous areas. With this system, the ground can retain a large part of the volumes provided

directly by precipitation or by run-off while at the same time preventing the soil loss occasioned by the free circulation of water.

6. *Drainage galleries.* These are tunnels on a slight gradient (around 0.5 in 1000) which use simple gravity to channel the water which has accumulated on quaternary sediments towards the surface of the soil (Hermosilla, 2006). Constructed horizontally, with vertical wells, these galleries are known by various different names: *qanats, kettara, foggara,* infiltration galleries, etc. (Gómez, 2006:18). They are systems dug into glacis and into the beds of *ramblas* and gullies and would occasionally yield volumes of between 1 and 10 l/sec. and provide water for settlements of some 20 to 100 inhabitants.
7. *Constructions for harvesting rainwater.* The run-off from hillsides and even gullies was captured and channelled along small *boqueras* to join the water held in cisterns, pools and ponds (Box, 1995). With these, the idea was to store enough water to supply the local population throughout the year and to meet the water requirements of livestock and draft animals. These water capture systems required various tasks to be carried out on the basin from which the water flowed. First of all, the existing vegetation was cut back to reduce the water consumed by plants. Then the water was channelled through a *boquera* into a settling tank. Given the high turbidity of the circulating flows, the settling tank was needed to decant the sludge and thereby increase the volume of useful water stored.

III. *SECANO MEJORADO* OR IMPROVED DRYLAND FARMING LANDSCAPES: SPATIAL DISTRIBUTION AND HISTORICAL REFERENCES

This set of actions allowed large areas of land to be organised, which, in the southeast of the Peninsula, involved almost all of the land on which dryland farming (*secano*) was practised. The floodwater irrigation system created what some authors have dubbed *secano mejorado* or improved dryland farming (López, 1951) – a type of water use which falls somewhere between dryland farming and irrigation, with the increased water supply tempering the unpredictability of dryland farming yet not quite permitting the development of irrigated farming as such. What it did permit was the painstaking growth of plantations of olive trees, almond trees, carob trees and even fruit trees and, through the practice of fallowing, the cultivation of cereals with low humidity requirements. Combined cropping was another technique adopted by farmers to minimise the impact of a significant reduction in precipitation: the loss of the cereal harvest was compensated by the harvest from the tree crops, which would be the only harvest to be had in dry or very dry years. The predominance of tree crops is another characteristic of these landscapes, with the trees being planted at wide intervals and developing deep and widespread root systems, which enabled their survival and ensured at least part of the harvest during periods of drought. The spacing between the trees also made combined cropping easier.

The war against aridity and rapid run-off, whether in the form of channelling water to the crops via rudimentary temporary irrigation systems in times of drought or in the form of terracing sloping parcels against erosive processes, can be traced back to agrarian colonisation in the Neolithic age, according to various archaeologists (Chapman, 1981). It was a war

indisputably waged during Roman times, as evidenced by the traces etched by Roman centuriations at Jumilla, Yecla, Sax and Elche, and by the remnants of dams such as the Presa de Román on the Rambla del Moro (Morales, 1992). Such harnessing was extended and developed under the Arab occupation, as evidenced by the 13th-century Book of the Distribution of the Gardens and Fields of Murcia (*Libro del Repartimiento de la Huerta y Campo de Murcia*), which alludes to areas of cultivation benefitting from *riegos de alfait*: literally irrigation by floodwater (Torres, 1960: 279). Following the expulsion of the Moors, vast areas of generally marginal land were abandoned and remained uncultivated for many years due to a shortage of labour. This process was then turned around in the 18th and 19th centuries, when population growth triggered a process of land reclamation which was further spurred on by the confiscation of church and private property and which brought into cultivation large areas of glacis which has hitherto only been used for gathering esparto grass or firewood.

The importance of these sporadic contributions to these semi-arid lands has been clearly expressed in several media. Numerous historical documents refer to these channelling systems, such as deeds naming the owners of these infrastructures and other papers detailing the various construction techniques and maintenance tasks. Similarly, regulations were laid down to ensure fair distribution, and legislation was drawn up to preserve the rights of those who owned land lower down. The earliest text to refer to how floodwaters ought to be used is a 7th-century legal work called *El Fuero Juzgo* or *Libro de los Jueces* (Morales, Box and Marco, 1989). Likewise, *El Código de las Siete Partidas* (1256-1263) shows how to make use of diffuse run-off, with other local regulatory texts such as *Ordenanzas del Campo y las Huerta de Murcia,* which contains ordinances approved by Carlos II (1695), *Ordenanzas y Privilegios de la Muy Noble y Leal Ciudad de Lorca* (1713) and *Reglamento para el Aprovechamiento de las Aguas de Riego de la Huerta de Alicante* (1849) mention the utility of harnessing these waters (Mondéjar, 2010). The first Spanish laws to govern water were pronounced in the late 19th century and they very much take note of the use of floodwaters. Using floodwaters reduced a farmer's reliance on dryland farming, granting the land intermediate status between irrigated land and strictly dry-farmed land, and this status is reflected in the public records, which show the payment of a higher contribution than for other unirrigated lands, as stipulated by the tax regulations. The importance of floodwater is also evident in the fact that the word *boquera* and other terms relating to floodwater irrigation systems (*azud*, *derramador*, etc.) frequently appear in place names in the southeast.

IV. DISINTEGRATION OF THE TRADITIONAL FARMLAND MANAGEMENT IN THE SOUTHEAST OF SPAIN, LOSS OF HERITAGE AND LANDSCAPE AND AGGRAVATION OF NATURAL HAZARDS

It was their use of the environment based on deep-rooted knowledge of the area and its natural dynamic that permitted people to adapt to the prevailing conditions in south-eastern Spain, and to make the most of their surroundings while also controlling the floodwaters: breaking up slopes through terracing, and channelling flows along *boqueras*, significantly reduces run-off coefficients and enhances the soil in an organic and natural way. It is a way of distributing and reducing the volume of flooding and, in short, minimising the destructive effects of flooding along the lower stretches of rivers. Similarly, retained sludge creates agricultural soils and increased ground infiltration refills aquifers.

The resulting landscape is therefore, and above all, fruit of the extremely laborious and painstaking efforts of the farmers who, through the sweat of their brow and using rudimentary tools, have moulded hillsides and watercourses to an almost unimaginable extent. Yet society has not only played a fundamental role in the creation of these landscapes; it is also essential to their conservation.

Neglecting these farmlands and omitting certain tasks leads to the progressive destruction of the entire system. Firstly, a dereliction of duties (failure to repair the ridges, walls and dams, or to regularly clear the *boqueras*, for example) has triggered the reactivation of erosive processes – processes which are being accelerated by the lack of vegetation and, above all, by the fact that floodwaters will be affecting soils which have been stirred up by previous farming activity and therefore have no consistency. The lack of maintenance work has also meant that run-off is no longer distributed as it once was by the terracing and the *boqueras*. So now, when there are short, intense downpours, the surface floodwater flows faster than it did in previous centuries, causing a considerable rise in the circulating flows and naturally increasing the erosive capacity of the *ramblas*. All of which means that the streams of water generated by these downpours gain a greater load capacity. The consequences of this situation have been felt not only at the site at which these phenomena have been triggered, but also, unsurprisingly, in the lower parts of the drainage basins.

Added to the processes of environmental degradation and increased natural hazards is the loss of landscapes and heritage. It is also hugely important to reflect upon the intensity of the process: systems which took centuries to put in place have disappeared within just 50 years. But it is not only the physical destruction of many of these works that is striking; more striking still is the fact that most people currently living in the southeast of the Peninsula are ignorant of these hazards, and they have forgotten how these floodwater systems worked right up to their grandparents' generation. These systems are now scorned, and those few that still remain in spite of the neglect are even seen as hindrances to the new productive systems – both agricultural irrigation systems and productive systems in built-up areas – leaving us to witness, mouths agape, the destruction of thousand-year-old dams such as the Presa de Román in the Rambla del Moro and the 200 year-old dam at Puerto de la Cadena near the Virgen de la Arrixaca hospital complex, both in the province of Murcia.

V. CLOSING REFLECTIONS

It was the organisation of the landscapes in the south-eastern Peninsula – an organisation based on society's deep-seated knowledge of the local area and its natural dynamic – that enabled people to adapt to the prevailing conditions in these lands and thereby make the utmost of their surroundings, while their regulation of the *ramblas*, distributing and controlling their floodwaters, created agricultural soils by retaining sludge and refilled aquifers by increasing ground infiltration. Today's society appears to have forgotten all of these advantages, as it organises agricultural land according to principles of quick economic return. The abandoning of the old systems, as a result of the cultural, social, economic and technological transformations of the past 50 years, has exceeded the local population's capacity to learn how to manage territory through sustainable practices; a process which has led to a major loss of knowledge in land management.

Over the past 20 years, various collectives (conservationists, environmental scientists and government agents local for development, among others) have pondered the feasibility of restoring and maintaining the old systems of terracing and irrigation by *boquera*, not only with a view to the advantages offered by a cultural environment respectful of its physical surroundings (soil conservation, refilling of the aquifers, distribution of surge water, etc.) but also from the oft-overlooked perspectives of economics (diversification of the economic activities linked to the conservation of these landscapes) and culture.