

FUNCTIONAL CHANGES IN THE IRRIGATION AT THE EBRO BASSIN: A SURVEY OF THE ROLE OF IRRIGATION THROUGH TIME

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1. INTRODUCTION

Irrigation systems have been changing their function through time. Initially they provided specific products (especially fruits and vegetables) for local population, but later they were directed towards a great market with a highly diversified range of products.

Thus, neither every irrigation system is the same, nor they may adapt to market demands equal at each moment. The shape and size of their plots, their extent, the climatic and soil features, the distance to the markets, the trade networks or the way of farm management are reasons that could cause the different uses of irrigation systems. Due to all this issues, we may wonder what type of role has played irrigation through time and how the creation of new irrigation systems has influenced on the older ones. In order to answer all these questions, this paper studies the irrigation systems at the Ebro Basin, giving information about their spatial evolution and about the uses and roles they have previously played and those that they have nowadays.

2. IRRIGATION SYSTEMS AT THE EBRO BASIN

The Ebro Basin has a total extent of 85362 square km, what means the 17.3% of the Spanish territory. The irrigation systems occupy around 800.000 hectares and have a long history. They began at the Roman Period, maybe Pre-Roman in some cases, and they last till nowadays.

The long period of time passed from the beginning of the transformation of dry farming into irrigation explains the presence of different types of irrigation systems. In order to summarize we have identified three different types, which we have named as ancient or traditional irrigation systems, modern irrigation systems and new irrigation systems or major colonization plans.

The antiquity of the irrigation systems has a close relation with the ability to obtain water by the technical means of each period. At the beginning, irrigated fields were not always close to river banks but also in other places where water was easily delivered by irrigation channels with more or less rude techniques; that is to say located at plains close to mountain areas, with strong slopes, rivers and subsurface waters not pretty deep.

As technical means were improved and the financial capacity increased, dryland areas were transformed into irrigated ones, first of all by the creation of channels in tributary rivers

and further at the Ebro river. In recent times great dams and conduction channels were built, being more complex structures in a technological point of view, and also more expensive.

Great extensions were irrigated by means of these channels, usually far from rivers and independently of them, demanding also expensive infrastructures, complex management and distribution water systems.

380.000 hectares were irrigated in 1905, extension that was slowly increased till 1933, where 450.000 was the figure reached. In the following years there was a small decrease, so in 1945 around 450.000 were irrigated. From that date a sustained growth was initiated which implied 702.140 irrigated hectares in 1975 and 770.000 hectares in 1980. The widest extension was reached in 1995 with 830.000 irrigated hectares, which has been reduced to 783.948 in 2006.

3. TRADITIONAL OR ANCIENT IRRIGATED SYSTEMS

First small reservoirs and dams were built many centuries ago at the Ebro tributaries. Lower fields of rivers (valley bottoms) were transformed into fertile orchards that guaranteed local subsistences and supplied close urban centers.

These irrigated systems have been clasified as ancient ones. Their fields, with small sizes, sometimes divided by little walls, had deep soils and were enriched by continous contributions of organic materials.

They were fed by water through little channels with short run and they were cultivated with garden products as fruits and vegetables; Fruit trees were always lined at the borders. During a long time, the irrigation of areas close to the rivers and some low terraces was a good solution to feed close population. So, the volume of many rivers and some spring water and little steep riverbank were profited, what allowed giving short irrigation to small surfaces. After the construction of modern irrigation systems with the mechanization of fields and the incorporation of rural world to market economy, orchards lost their function, being set-aside, cultivated by black poplar or changing to leisure fields for urban inhabitants.

4. MODERN IRRIGATION SYSTEMS: INTENSIFICATION TO REACH MARKETING

A great amount of field was irrigated since the end of 18th century until 80's in 20th century. They are known as modern irrigation systems. They are located at medium terraces and lowest glaxis. The building of great irrigation channels and some dams guaranteed the irrigation of wide areas that were receiving since then a later irrigation in spring and also delivered water to some other fields. Plots have greater sizes than those in ancient irrigation systems, sometimes placed in regular slopes and with similar sizes as a result of redistribution among farmers.

Their soils, though fertile, do not reach the quality of ancient orchards. In these irrigation systems, intensive cultives (garden products, fruits and vegetables) coexisted during decades with very mecanized ones, usually in winter cereals.

Cultives were managed with a commercial orientation, because the economic development of the counties was based on them. Modern irrigation systems have a long history of decades, in some cases till two centuries, so their uses and landscape have been modified in the same way as market mechanization, labour force availability and subsidies policy.

During the last 20-30 years, intensive cultives have reduced their extension, at the same time that this type of irrigation system has lost their leadership from a social and economic point of view.

5. NEW IRRIGATION SYSTEMS: THE SPREAD OF EXTENSIVE CULTIVES

New areas of irrigation have been recently developed, in some highlighted places as Bardenas and Monegros. These irrigation systems are known as the new ones that, broadly speaking, match with those derived of great colonization plans.

They are based on big size farms, with great fields in their plot distribution, and irrigation systems based on sprinkling or drip irrigation. Among these cultivates Alfalfa, Corn, Rice and winter cereals stand out, all of them being highly mechanized cultivates. They required great amounts of water and fields prepared to be laboured with tractors.

On the other hand, intensive cultivates have little presence. These and those are usually managed through integration techniques, between local farmers and companies located far from the counties, so the socioeconomic and demographic effects are smaller than in traditional irrigation systems.

New irrigation system management has a big dependence on subsidies from the Common Agricultural Policy; the amount of subsidies is a key factor to explain the contraction or spread of crops in a short period of time.

6. DISCUSSION AND CONCLUSIONS

Ancient or traditional irrigation systems played a role of feeding local population and supplying close markets. Modern ones were used with intensive crops to supply supra-regional markets and they contributed in a high extent to fix population and county development. New irrigation systems are based on highly mechanized crops, little demands in labour force and with high necessities of water, and have little socioeconomic effects. Each type of irrigation system played a specific role, which has been modified according to their physical conditions (soils and climate), human aspects (irrigated surfaces, farm size, labour force availability, technical means and irrigation systems) and on the market it has to reach: local, regional, national or international.

Other aspect that has to be remarked is how the issue of new irrigation systems implies the loss of leadership, sometimes even the abandonment or set aside of the older ones. Therefore, orchards that during many centuries were basic in feeding and economy of agrarian society, lost their function when modern irrigation systems appeared. The final use of many orchards has been the set-aside or residential use, as it has happened in other ancient Spanish irrigation systems.

Also the creation of new irrigation systems implied the movement of some crops from modern irrigation systems to new irrigation systems, implying the extensive use of the fields (nowadays basically devoted to winter cereals) while fruits and vegetables almost have disappeared.

We may wonder which advantages have new irrigation systems over modern irrigation systems at the Ebro Basin.

Several reasons may be suggested to highlight the advantages of new irrigation systems on older systems, taking also into account mechanical and manual resources that agriculture has had at the moment. These are the reasons:

1. New irrigation systems, like those of Bardenas and Monegros, at the centre of the Ebro Basin are located in areas with a short frozen period, but with enough number of cold climate hours and with the extension of the warm season through autumn. Once water is guaranteed, these reasons allow to extend the varieties of intensive

- crops, to increase outputs of extensive ones (alfalfa, winter cereals and corn), and to expand the ripening period, gaining access to market in high prices period.
2. The lay-out of plot distribution in new irrigation systems, corresponds to a highly mechanized agriculture with a scarce use of labour force, so it perfectly suits with a very heavy agricultural machinery use, needing great land extensions to its management. Modern systems, on the contrary, set out some difficulties to gain access to farms and manoeuvrability inside the field. Besides, the implementation of high expensive technologies (sprinkling and drip irrigation), is only possible in large plots and without any charge from the past (plantation framework, pruning) that make difficult building infrastructures or increase their cost.
 3. They allow incorporating more efficient systems in management and working cultivation, for example drip irrigation implemented at many plots of new irrigation systems, consumes less water and uses more efficiently the labour force than traditional ones, which are irrigated by flood irrigation. New systems look similar to rain, including their good effects in washing up plants and higher assimilation index of water, nutrients and phytosanitary products, because these could be applied at the same time of irrigation.
 4. Soils at modern irrigation systems may have signs of exhaustion because they suffered a very intensive use during decades and problems of contamination due to the constant application of chemical products. The necessity of obtaining crops demands high costs to fight against weeds and crop illnesses. The number of treatments required the use of more concentrate and expensive products. They were effective during a short period of time but ineffective two years later. New irrigation systems, on the other hand, have soils with better sanitary state and they are less exposed to illnesses.
 5. The size of the farms, always bigger in new irrigation systems than in modern ones, confront great mechanized agriculture (with high necessities of money), with descending prices and supported by Common Agriculture Policy subsidies. This policy uses size as one of the elements to establish the amount of money that farmers could receive.

One question that may cause surprise is the small amount of surface occupied by intensive crops in new irrigation systems. Garden products, fruits and vegetables are present but with little landscape impact and little economic effect. The very big size of farms and the lack of manpower are key factors that imply highly mechanized crops. Besides, and in a much highlighted point of view, we have to take into account the absence of food companies and the weakness of marketing channels against some other areas of Levante (East) and Southeaster Spain. We could not forget either, the difficulties of some products to compete in national and international markets against those produced in countries with less expensive labour force.

Nevertheless, it could happen that in the future more profitable crops for surface unit, or more efficient in water consume, were introduced, step by step, in Monegros and Bardenas, while these new irrigation systems reach progressively a greater maturity level.

As far as we know, irrigation systems need time to develop their potential, farmers need time to learn about water management with more efficient techniques, soils need time to improve their structure and fertility and also time is needed to create a diversified landscape with diversified land-uses and time is also necessary to set up a marketing net to distribute fresh and transformed goods. All these may be achieved in irrigated areas but are quite difficult in drylands.