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INVARIANTS IN THE EVOLUTION AND TERRITORIAL IDENTITY OF TRADITIONAL *HUERTA* LANDSCAPE AT VEGA BAJA OF SEGURA RIVER: 1929-2010

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I. INTRODUCTION

The *Huerta* landscape at Vega Baja of the Segura River is a clearly delimited area, resulting from man-made secular organization and adaptation of territory, with formal coherence and evident spatial structure. Historically, the population has accommodated their needs to the natural features of the environment, developing from experience specific rules for the sharing of water or measurement of land, among others. This system has supported a balanced dynamic between extreme climate and environmental conditions and has provided the opportunity to expand agricultural production along the alluvial plain (Canales, 1995). For these reasons, it is considered a cultural landscape with an outstanding value thanks to its unique qualities, different from other similar areas.

This area is a well-known *Huerta* landscape for experts from many different disciplines. Its territorial unit represents a clear extended system, from Murcia to Alicante, belonging to the same river basin system, from "la Contraparada" or Major Dam, in Murcia, to its mouth in Guardamar del Segura, in the south of Alicante Province. This study covers the last stretch of the river, some 35 kilometers known as "Vega Baja" ("Low fertile floodplain") because this fertile strip of land is at the lowest part of the river's course. Local people often struggle with extreme weather conditions resulting in prolonged droughts and flash floods

Floods are paradoxically a destructive force but at the same time the provider of essential nutrients to fertilize fields (Andrés, 2011; Canales, 1993; Calvo García-Tornel, 1972). Therefore, from time immemorial, the decision-making process for territorial organization was set by seeking solutions to minimize the destructive force of floods and enable a balanced water distribution during drought periods. Due to its unpredictable and extreme nature, the Segura River gained the reputation for being the most monitored European river for many decades (Gómez y Grindlay, 2008).

From its inception, marshland transformation in cultivated plots has been built up along ten centuries of documented history (De Gea, 1995), thanks to soil's high fertility in addition to the implementation of a unique network system of irrigation-drainage canals. The existence of multiscale relationships between plot distribution patterns, settlements occupation and land uses, add complexity to landscape comprehension, determining the way it is perceived.

Even though a landscape system should not be constrained by the administrative boundaries, the existence of a limit between provinces has had an effect on the way land is managed. There are clear differences in territorial heritage management, strategic planning or investment criteria; factors which determine not only spatial perception, but also aspirations of local people.

This paper outlines the main findings in *Huerta* landscape evolution during the last century. Additionally, it determines which elements of this agricultural scenery remain unchanged as distinguishing features; as well as the evolution of those factors that change place identity. Thanks to the results obtained from the historical sequence of aerial photography, it has been possible to identify the most relevant turning points of this area's territorial dynamics between 1929 and 2010.

II. TIMELINE AND TERRITORIAL EVOLUTION

The Segura River Basin Authority (*Confederación Hidrográfica del Segura -CHS-*) was created in the very early twentieth century and from the outset the main concern was to seek for solutions and to develop a program of public investment to minimize the damage caused by floods. The use of aerial photography was an essential instrument for giving guidance to decision-making by engineers (Grindlay y Hernández, 2007).

Figure 1, on the left, shows a schematic timeline linking some historical events to the most relevant flood episodes in the Vega Baja area. On the right the photogrammetric flights and satellite photographs taken in this region are indicated and were the basis for subsequent policy decision making.

During the last century, territorial changes have occurred but at different paces. . Graphic documentation has provided accurate information: starting with the first planned flight in 1929, known as "*Ruiz de Alda*" flight –scale precision equivalent to 1:10000-–, an important document due to the quality and date of the images; followed by other flights that enable us to provide an insight on land transformations, as well as facilitating connections and associations between correlated historical facts and their corresponding changing patterns.

As a matter of fact, the *Huerta* remained a balanced situation between agriculture, population, settlements and infrastructures until the 1990s. Changes took place gradually and were naturally assumed by the population. Ten centuries of age-old tradition in the way of developing new plots of farming land and its consolidation as the main local economic activity were ruptured in the last ten years of the twentieth century. Changing Socio-economic circumstances, along with new legislation on land management, resulted in the introduction of different land uses and alternative forms of occupation (Martí y Moreno, 2014). In addition, technology applied to different elements: irrigation, crops, roads, among others, accelerated transformation of the traditional agricultural context; a trend which continues today. This process reveals variations on the population's land uses and practices and, therefore, a new *Huerta* landscape character is under construction.

III. LAND TRANSFORMATION METRICS: INVARIANTS ASSESSMENT

Key factors and invariants in the *Huerta*'s landscape identity shaping are: firstly, the irrigation-drainage canals network, which originally transformed the marshland into highly productive farming plots; secondly, a complex path network built following water lines, intertwined with the water mesh; thirdly, the overall agricultural image of short-cycle crop plantations versus orchards which have been gradually enlarged at the expense of decreasing of short rotation productive system; and lastly, strategically placed settlements. These four components are the essential landscape structure of *Huerta*.

In order to assess the evolution of territorial changes and quantify the variations observed, the study's geographical area involved monitoring a 400 meter x 400-meter grid pattern over the existing time-sequenced aerial photos ranging 1929 to 2010. More than a simple comparison, the study investigates the relationship between the spatial shifts detected, the impact on landscape perception, and community aspirations concerning sense of place.

III.1. Case Study "*Buena Vida*" path. Orihuela

The "Buena Vida" path is an historical trail (fig. 3), situated in one of the first cultivated areas. It is one of the hundred or so paths of an extensive network. This linear settlement is directly connected to productive plots as well as well communicated to Orihuela, the principal village of the county. Its strategic location together with its specific features, make it a representative sample that illustrates the processes and changes that have been taking place in this valley.

Examination of the first aerial images taken during the 1929 *Ruiz de Alda* flight (fig. 4 and fig. 5) show that this linear hamlet was originally distributed along one side of the historical route. The original settlement comprised the substandard housing of agricultural labourers. These modest buildings had small yards between houses where daily home routines were done under leafy fruit laden trees. The quality and scale of the photography permit a clear definition of each element: water and path networks, buildings, plots and crops, tree alignments, as well as the odd mulberry tree, carob tree among others. This landscape remained the same until the 1980s, as validated by the historical series for aerial images –USAF 1956, IRYDA 1978, IGN 1985–.

The 2010 graphic documentation shows a completely transformed panorama, with both sides of the trail occupied by buildings, not only dwellings, but also with small-sized industrial warehouses. Interstitial open spaces with trees between primitive houses have been invaded by house extensions; which means that the small gaps for neighbours' community life has disappeared. As a result, these new residential typologies adapted to contemporary lifestyle have increased density at the expense of losing agricultural land in favour of urbanization. New buildings have also introduced new uses: detached vacation houses with a swimming pool, warehouses, utility sheds or abandoned plots used as improvised parking or outdoor storage spaces. All these human activities have disrupted the original balance that existed between people and place, which in turn has affected the perception of the landscape by hiding views from the paths.

The shape of the agricultural plots has been developed during centuries of interaction between people and the environment. The plots are relatively small as a consequence of two factors: first of all, the watering and draining system canals is balanced according to topography, timing regulations related to water management, canal sections and crops; secondly, the high fertility which provided several harvests per year depending on shifting cultivation techniques. Patchwork and plot organization are some invariables of the *Huerta*'s characteristics, in contrast with the new uses introduced or vegetation changes.

Following the diagram of the evolution of a stretch of *Buena Vida Path* (fig.6) we can check how the sense of place along this trail has clearly changed from the spatial and visual point of view. In Figure 6, we observe the introduction of new buildings which resulted in a significant reduction of the visual permeability from 53% to 14% between 1929 and 2010 respectively. The change in typology means a different way of reading and understanding this landscape. The need to provide adequate space for vehicle access resulted in widening the road by extending it into the canal space area. For this reason, many canals have been covered which hides the water lines, changing the sensorial experience of place with the disappearance of the sound of water running; the passage of time marked by the irrigation shifts; a good hygrothermal regulation; and the typical cloak of fog.

III.2. Metrics on landscape transformation: quantifying changes and assessment of invariables

The aforementioned structural elements of this landscape -buildings occupation, crops and water and path networks- are measured and analysed in two aerial flight stages: 1929 and 2010. To measure the *Huerta*'s landscape changes, four tiles of the monitoring grid pattern along *Buena Vida* path were selected (fig. 7) for sampling, in order to compare the aerial photography taken during the 1929 Ruiz de Alda and the 2010 IGN flights. The information is represented in a bar graph (fig. 8), where each parallel bar represents the total surface of one of the four grid tiles studied.

The most relevant findings related to each main landscape element are as follows: in 2010 land occupation by buildings increased threefold in most cases. The measurement of unproductive plots and large infrastructure space appear as a specific segment in the 2010 graphic label, and accounted for between 2% and 9% of additional loss of cropland. The increase of both building and artificial areas is at the expense of fertile farming lands.

Focusing on crops, we find two different findings: firstly, as previously mentioned, is the loss of land due to the growth of other activities not related to agriculture; and, secondly, changes on crop variety, from vegetable species to orchards of mainly citrus groves, which grow occupying almost 90% of the tile in some cases. On the one side, trees provide a permanent green canopy favouring a permanent visual panorama of the valley, mainly from a distant observation point. On the other side, the system of vegetable crop rotation provides more biodiversity, shows a changing and interactive landscape where community and agricultural media have a more dependent relationships with regard to workload and diversity of tasks.

Despite all the variations described, the proportion of space belonging to irrigation-drainage canals, together with the path network, remains a constant, between 15% and 19% of the surface of each tile. This result quantifies the balance among *Huerta* landscape structural

networks –water and paths– in relation to the other identity elements. These data also proove the existence of landscape integral parts that bear the original territorial structure and maintain spatial organization.

IV. CONCLUSIONS

The *Huerta* represents a *continuous evolving landscape* that reflects the traditional lifestyle of a community in a century long battle against adverse natural conditions. Moreover, this landscape has a crucial role in this community's territorial identity, confirming that it is alive. This is, in fact, also evident in artistic works of painters, writers and poets of the twentieth century -Joaquín Agrasot, Miguel Hernández or Gabriel Miró, among others. Their artwork, inspired by this landscape and its people, remains in the collective imagery. According to some authors, it can be described as an *associative cultural landscape*; while others define it as a *linear landscape* because the water culture is inherited and further developed along the water network infrastructure. This alluvial plain is a monumental engineering work, a huge and complex canals network linked to significant social, economic and technological factors, which have triggered principles of authenticity, integrity and sound management practices (Rössler, 2002).

Landscape identity is conditioned by the readability and coherence of the key basic elements that shaped it; hence, loss of shape integrity and pattern determines the appearance of a new identity (Martínez de Pisón, 2010; Ponce, 2011). Each landscape is an expression of the existing dynamic interrelation between natural and cultural flows, in the same way a community follows a natural process of adaptation to evolutionary changes. For this reason, environmental assessment or people's perceptions vary depending on land uses, lifestyle and spatial changes. These changes in perception have a direct impact on which issues will become the research, protection or management goals, which in turn influences new trends in the landscape's character (Antrop, 2005). In this sense, it can be affirmed that the population belonging to the *Huerta* area has evolved and new generations have relied on alternative economic options, introducing new businesses that are not in harmony with traditional land uses. This represents a break with the original cultural base that shaped the *Huerta* landscape manifested by the way the territory is presently being developed which has resulted in widespread alienation from ancestral cultural values. The specific spatial features of the *Huerta* are being lost and along with that the collective memory of its origins.