



KEYNOTE  
PAPER

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## Some Observations on Human-Landscape interactions in Almería

### Preamble

I met Juan Puigdefábregas in the early 1990s when working with Adrian Harvey on the relationship between ecological and geomorphological processes in the Tabernas Badlands. Juan was generous in sharing his knowledge and experience and has influenced my ideas and approach since that time. I recall in particular, a field conference in 1994 when Juan gave an overview of human-environment relationships in Almería. This raised my awareness of the impact of human activity over many centuries; something that continues on an increasing scale. In the succeeding 25 years I have made regular visits to Almería to conduct research into landscape processes and to lead student field trips focusing on geoecology and sustainability. What follows is essentially a reflection on my learning and observations set into the context of future environmental and social challenges that the province is likely to face.

### Introduction

As we enter the Anthropocene, the impacts of human activities upon landscape and climate are givens. Equally, landscapes affect the human experience; culturally, aesthetically and emotionally, as well as physically and economically. Climate projections for Almería (Aemet, 2018) indicate an increase in maximum temperature by the end of the century of between 2 and 5°C depending on Representative Concentration Pathway. They also indicate a 10 to 20+% decrease in precipitation with fewer rain days, longer dry periods and limited but variable change in precipitation intensity. Water

is therefore likely to represent a significant challenge going forward. Regarding human drivers, ecological footprint figures for the whole of Spain (Global Footprint Network, 2018) show that an ecological deficit first appeared in the mid 1960s and grew steadily until 2007, when it went into a sharp decline, probably related to the financial crisis. Since 2012, it has stabilised, and despite significant progress in decarbonisation of electricity supply, stands at around 2.3 planet Earths. I have been unable to find specific figures for Almería but the general picture is not sustainable and no doubt this also applies locally. Thus, unless dramatic changes are made to production and consumption systems, we can anticipate increasing scarcity of environmental resources in the context of a socio-economic system that is over-exploitative. Clearly this is unsustainable and appropriate methods for mitigation and adaptation must be explored. This is a complex area but we can explore aspects of it through examination of some case studies in order to highlight some key issues.

### Sustainable Landscapes

In addressing the question, 'What is a sustainable landscape?', Wu (2013, p1013) defines landscape sustainability as the capacity of a landscape to consistently provide long-term, landscape-specific ecosystem services essential for maintaining and improving human well-being in a regional context and despite environmental and socio-cultural changes. He suggests a need to address basic questions

concerning what is to be sustained and what developed, how these aspects relate to each other and on what scales this should be considered. These questions are context-dependent and multi-faceted but for spatial scale in general, Forman (1995) suggests a kilometres-wide area in which the mix of local ecosystems and land-uses is repeated in similar form. Where time is concerned, clearly nothing lasts forever, but larger systems tend to have greater longevity than smaller ones and Wu (2013, p1009) proposes that a scale domain of a few decades to a century is sensible based on the characteristic scales of key processes supporting ecosystem services and human well-being. This seems inherently reasonable and provides a basis for examining the local situation and asking questions about what we know and do not know.

Juan suggested that the history of human impact on the Almería landscape has been episodic with related fluctuations in population numbers. Economic concerns have seemingly dominated over the environmental and social and the resulting changes have left clear signals in contemporary landscapes. Both the scale and speed of change have accelerated in recent times and major developments are clearly visible from space, yet parts of the province seem little altered, retaining an air of the wild and remote. Several protected areas have been established and there are indications of change in the way that landscapes are perceived and exploited. Whether these can be nurtured and developed to produce a lighter human impact remains in question.

### **Scale and speed of change**

The broad landscape appearance of parts of the Tabernas basin endures and continues to attract film and television producers with related economic benefits through tourism. Parts of the Tabernas Badlands receive some environmental protection through designation as a Paraje Natural and, aside from construction of the A92 motorway, change has been limited at the gross scale during the past three decades. More rapid change/turnover can be observed at finer scales however. In contrast, the

development of intensive olive farming has led to dramatic change in the landscape between Tabernas and Sorbas. Large volumes of groundwater are exploited for irrigation and this appears to be linked to depletion of flow from the spring at Los Molinos del Rio de Aguas, where, ironically, a small community is attempting to demonstrate the potential for sustainable living. If the large olive groves are effectively mining fossil groundwater, then clearly the reduced spring flow is but a symptom of a larger sustainability issue with potentially dire consequences. Nearby however, there is an enterprise producing sustainable, organic olive oil where use of agrichemicals is minimised and irrigation managed sustainably using a replenishable source, buried pipes and pumps powered by renewable energy. Waste materials are recycled and the oil produced is of a very high quality, facilitating premium pricing, but raising questions of scalability. Production of olive oil in Almería is small compared to other parts of Andalusia, but, in a situation where annual EU production (with Spain dominating) exceeds consumption and export by almost half a million tonnes (DG Agri Dashboard, 2018), the balance between the economic and environmental costs of less sustainable production techniques can be questioned. Social and cultural factors are also involved in terms of enterprise structure, employment opportunities and the values that underpin different approaches.

Modern agriculture often involves the re-engineering of traditional farming landscapes, sometimes unsustainably. This is not a new phenomenon, but now takes place on an altogether larger scale. An example SW of Sorbas provides an illustration. The adjacent Infierno and Mocatán catchments exhibit very different patterns of vegetation cover and erosion (Willshaw, 2001). Both have been exploited for terrace agriculture in the past and both subsequently abandoned; they also have different histories of fluvial incision. In order to understand the contemporary landscapes we need to examine change over a range of time scales. The Barranco Infierno drains into the Rio Aguas a few kilometres downstream of Sorbas and was affected at an early stage by the major river capture near to Los

Molinos (Harvey and Wells, 1987), leading to significant incision followed by stabilisation as slope vegetation adjusted to a new equilibrium. Headwater channels were exploited for terrace agriculture and later abandonment of these has led to collapse and localised slope erosion. In contrast, the Barranco del Mocatán is some 7 km further upstream of the capture point, so the wave of incision reached this catchment considerably later than that of the Infierno. This has led to a more recent period of rapid erosion (Mather, 2000) in an area of dispersive soils (Faulkner et al, 2008). Vegetation is sparse in much of the upper Mocatán catchment and traditional agricultural terraces are eroded by piping. Recent attempts to develop agriculture in the area have involved re-engineering of slopes, creation of an access track and sinking of a well. These did not go well.

The track was cut directly across a suite of steep gullies and required regular maintenance to prevent re-establishment of channel profiles. Since maintenance was abandoned the track has deteriorated into a series of very deep pipes. The well reached 260 metres before water was found and then produced such a rapid flow that it could not be managed and, for a short time, the gullies below the well became a large lake. The well is now capped but the disturbance has caused significant erosion in the surrounding area.

While this is but one local example it clearly illustrates the perils of short-term economic exploitation with limited regard to the environmental constraints that such a sensitive area presents. It also perhaps provides an example of limited communication between researchers, farmers and policy makers.

Growth of tourism has had a significant impact on coastal areas. International visitor numbers to Andalusia as a whole have increased in recent years following a downturn in 2007. Most international visitors to Almería arrive by air and come for the climate and beaches. They may be oblivious to the landscape changes illustrated above and most seem undeterred by the more obvious presence of plastic greenhouses.

Ecotourism opportunities, for example, in natural and industrial heritage and long-distance trails, have increased, but a recent survey of tourists to Andalusia found just 5% citing 'nature' as the reason for their visit (Andalusia.com), indicating considerable scope for further development. Some 266,000 passengers arrived at Almería airport on low cost flights in 2017 (Junta de Andalusia, 2019). Clearly, they come from a variety of countries, but if just one in four flew from the UK, then their flights alone would account for emissions of some 18,000 tonnes of CO<sub>2</sub>.

### Summary and discussion points

Climate change is likely to pose significant challenges in Almería, increasing competition between sectors and impacting on both residents and visitors. Much current activity in the province is unsustainable in the medium-term, raising questions concerning the direction of future development to maintain ecosystem services and human wellbeing.

Current models of production and consumption are unsustainable. Examples of new models exist but these will require knowledge, innovation and cultural change if they are to be scaled appropriately, and their adoption will have an inevitable impact on lifestyles.

How should decisions on what is to be sustained and what developed be made? What evidence is required, who should contribute it and how?

While decades to a century may be appropriate periods to consider future landscape sustainability, understanding the sensitivities of contemporary landscapes requires a much longer view of the past.

Are the landscapes of Almería as resilient as they can sometimes appear?

Short term, small scale changes can be indicative of more significant underlying problems.

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