



## **Interrogating sustainable productivism: lessons from the ‘Almerían miracle’**

### **Abstract**

Many have suggested that a new form of sustainable agricultural productivism is needed in response to the challenges to food security posed by climate change and population growth. We interrogate the potential of the intensive horticultural industry located in the Spanish province of Almería, to represent sustainable productivism. The Almerían horticultural industry has been lauded as an example of neo-endogenous growth and manifests a range of sustainable technologies addressing environmental impacts. This paper employs elements of ecological modernisation theory and emerging theorisations of sustainable productivism to analyse the sustainability of production, including farmers’ decision-making rationale and knowledge networks. We argue that Almerían horticulture represents ‘weak ecological modernisation’ and its main sustainability challenges are posed by water use, a demand led production rationale and the precarious situation of family farms that at present provide a degree of economic embeddedness in this highly industrialised production model. The competitive imperative yields marketing organisations huge sway in production decision-making, and while a cost-price squeeze has driven efficiency in the use of farm inputs and product innovation, it has paradoxically made further advances in sustainable water management very difficult to achieve. Transforming the Almerían horticultural industry into a truly sustainable model of productivism would require the concerted efforts of not only individual farmers and marketing organisations but also regional and local water governance institutions and land use planning. The main obstacle to this remains the dominant normative perception that justifies groundwater over-abstraction on the grounds of its high economic returns and the perceived inability of small farmers to invest in desalinated water or further technological solutions.

### Highlights:

Ecological modernisation theory is applied to assess the Almerían horticultural sector.

Despite many environmental measures, resource use and production methods do not yet measure up to sustainable productivism.

While water poses the main sustainability challenge, concerted effort of farmers, marketing organisations, land use planning and energy and water governance institutions is required to realise the sustainability potential.

Deliberative governance institutions are not able to overcome deep seated normative perceptions about legitimate water use, but a decisive governance push is required for change to emerge.

Key words: Sustainable productivism, ecological modernisation, horticulture.

## **1. Introduction**

The combined pressures of climate change and population growth have raised questions regarding the ability of global agri-food production to maintain sufficient levels of food security and many have suggested that what is needed and perhaps emerging is an era of new agricultural productivism (HLPE 2012). Wilson and Burton (2015) outline different models of what they term neo-productivism, for example to describe changes taking place in the European context where a renewed focus on productivity is driven by policy changes that despite a persistent multifunctional agenda render production increasingly exposed to market signals. In traditionally more liberal contexts such as New Zealand or Australia characterised by ‘light touch’ environmental management requirements, neo-productivist models of agriculture have emerged particularly where sustainable production methods are adopted in order to add value to products (Wilson and Burton 2015: 58). While biotechnological responses are purported by many as necessary to enable ‘green’ productivity increases, there is also a more cautious school of thought highlighting the potential impacts of a reliance on corporate technology solutions and high quality standards on small farmers (McDonagh 2015a). Horlings and Marsden (2011) for instance put forward evidence of a model of regionally embedded sustainable but production oriented forms of agriculture that appear to avoid the ecological problems associated with the disembedded ‘old school’ productivist agriculture (e.g. Van der Ploeg 2006) and depend on bottom-up innovation (see also Firbank et al. 2015; McDonagh 2015b). Indeed, proponents of ecological modernisation theory suggest that with attention to inclusivity in innovation processes and reflexive engagement with a broad knowledge base, productivity increases and environmental sustainability can be combined in a socially sustainable manner (Mol et al. 2014).

In this paper, we employ elements of ‘strong ecological modernisation’ and the emerging theorisations of locally embedded sustainable productivism (Mol and Spaargarten 2000; Horlings and Marsden 2009; Kitchen and Marsden 2011; McDonagh 2015b) to analyse the sustainability challenges and solutions, as well as the knowledge networks and rationale of production decision-making in the intensive horticultural industry located in the Spanish province of Almería in Andalusia (Figure 1). We engage both primary qualitative and secondary data to assess the sustainability of the sector and to access farm level decision-making to understand the networks which condition how market forces and policy influence production practice at farm level and in the sector more broadly (see e.g. Wilson and Burton 2015). We conclude that despite significant examples of environmental innovation, Almería represents a weak form of ecological modernisation where a demand led productivist agenda dominates and particularly sustainable

water management remains at an impasse. Our findings pinpoint the tensions between market oriented knowledge networks and sustainable resource management imperatives played out in local governance deliberations. We highlight the institutional weaknesses that enable this and outline the potential for transforming the large scale intensive production system into sustainable productivism.

## **2. Methodology**

The province of Almería is situated in southeast Spain, in the autonomous region of Andalusia. The province is characterised by a series of mountain chains, tectonic basins and coastal plains adjacent to the Mediterranean (Figure 1). The Almerían climate is described as semi-arid thermo-Mediterranean (Cantón et al. 2001) resulting in typically low annual precipitation (García Latorre et al. 2001; Lázaro et al. 2001; Solé Benet et al. 1997). Provincial soils are typically poor with low natural fertility (Mota et al. 1996). It is not surprising then that early agricultural practices were limited by these conditions (Horden and Purcell 2000) and at face value, the provincial situation does not favour mass horticultural production. The birth of large scale intensive horticulture encompassing 30 000 ha of plastic greenhouses (Valera et al. 2016) can be attributed to the convergence of a number of factors that represented a paradigm shift in the province's agricultural fortunes, turning what many Almeríans considered abandoned wasteland into highly productive areas concentrated mainly in the Campo de Níjar and Campo de Dalías indicated in Figure 1. In 1990, David Tout presented a detailed account of the horticulture industry in Almería Province, southeast Spain from its conception in the early 1960s to end of the 1980s. This 'Almerían miracle', Tout observed, could be explained by the conjunction of technologically driven plastic greenhouse production, favourable environmental resources (approximately 3000 hours of sunlight p/a and despite low rainfall, abundant groundwater resources), availability of labour and the sustained market demand for winter vegetables, especially in northern Europe. Mota et al. (1996: 1600) later note, " 'The Almerían economic miracle' well justifies its name, since the living standards have risen so dramatically in the region that the isolated and hand-to-mouth economy of the 1950s has given way to one of the highest incomes per capita in the country".



Figure 1: Location map for the Province of Almería in southern Spain. The principle horticultural regions are centered to the west and the east of the city of Almería, in the Campo de Dalias and the Campo de Nijar, respectively.

Our analysis of the sustainability of the Almerian horticultural sector synthesises past research findings and recent secondary and primary data. We have undertaken 13 semi-structured interviews conducted face to face (11) and over email (2). The interviewed stakeholders represent the most central institutions and actors governing the decision-making in the horticultural sector. These consist of marketing organisations bringing together fruit and vegetable exporters and producers (Mkt1-2); regional environmental governance (Env1); local and regional agricultural governance and planning (Ag1-2); local and regional water governance institutions responsible

for the Andalusian water law and its implementation as well as water infrastructure and monitoring of use (Water1-3); and growers (Grower1-5). The confidential and anonymous stakeholder interviews centred on the following themes:

Factors contributing to the competitiveness of the Almerian horticultural industry

Product quality and its constituents

How is the Almerian horticultural sector changing

Farmer decision making and sources of information

New aspects of water governance: enforcement of quotas; water banks; water pricing

Any other thoughts that respondent would like to share

Interviews were analysed according to the themes arising from the theorisations of sustainable productivism and the secondary data indicating the significant issues in Almería: local socio-economic embeddedness; environmental sustainability; production rationale; innovation and technology; and governance institutions. The analytical approach therefore represents a generic approach to thematic qualitative analysis (Bryman 2016).

Empirical papers focussing on the Almerian horticultural sector were sought via Summon using the key words of Almería AND horticulture, and the former complemented with AND water or AND biodiversity from the past 10 years as several comprehensive analysis of the sector have been conducted within this timeframe. The aim was to find publications on the social, economic and environmental sustainability of the horticultural production sector and of the relevant policy and governance context. Finally, the following organisations have been consulted in the form of personal communication during field visits<sup>1</sup>: two medium sized co-operative supplying produce from the Campo de Dalías and Campo de Níjar respectively; a multi-national seed producing company serving the greenhouse industry in Almería and Murcia; and two of the four water desalination plants in the province. We acknowledge that personal communication does not constitute systematically collected interview data and in order to avoid bias, no conclusions are based solely on this personal communication.

### **3. Ecological Modernisation and intensive agriculture**

#### *3.1 Different drivers and models of sustainable productivism*

---

<sup>1</sup> The authors visit the Province of Almería annually for geographical and environmental fieldwork and have regular access to stakeholders in the water management, horticultural, nature conservation and tourism sectors.

Sustainable productivism is a term increasingly used to combine the need to maintain food security whilst addressing the adverse consequences of 'post war productivism' (McDonagh 2015b; Wilson and Burton 2015). The post-war era has in literature been cast as that of agricultural intensification, commercialisation and specialisation at farm level, led either by state support or unabated processes of resource capitalism (e.g. Woods 2011). This has seen a disembeddedness from the three pillars on which traditional regional farming styles were based (a reciprocal relationship with the local physical environment, local economy and the agrarian community) and the emergence of what some term socio-technical, industrialised farming regimes driven by the processes of capital accumulation, often accelerated by policy (van der Ploeg 2006). There is a consensus that this kind of productivism and associated mechanisation was environmentally detrimental and underpinned the steep decline of agriculture as a source of rural employment and indeed prosperity rendering it either subsidy dependent or frog-leaping the local economy altogether (Woods 2011). Euro-centric literature identifies a post-productivist (or multifunctional e.g. Wilson 2008) tendency, most strongly manifest in policy, that attempts to respond to the ills of agriculture of the industrial kind by incentivising the production of non-market values such as biodiversity and recreational amenities (Evans et al. 2002). Many see this as a temporal continuum that is now beginning to give way to instances of neo or sustainable productivism (Wilson 2008; McDonagh 2015a). Wilson and Burton (2015) have used case studies of developments in Australia and New Zealand to illustrate that in some regions, thanks to early market liberalisation, productivism never ceased but is continuing to evolve, subject to structural drivers and market signals. These neo-productivist models display varying degrees of greening. For example, Wilson and Burton (2015) outline a form of market led co-operative based neo-productivism where greening has happened to a significant extent but in order to add value to products and in response to emerging more stringent regulatory compliance needs.

Nevertheless, Tilzey and Potter (2008) demonstrate with case studies from the UK, Australia and the US, that policy driven multifunctional as well as neo-productivist forms of greening are associated with persisting negative environmental and socio-cultural impacts, as any implicit green agendas remain subverted and transmuted by the imperative of economic growth. Many suggest therefore that the policy and in some cases retail sector led greening of agricultural practices in the recent decades represent, at best, what literature terms weak ecological modernisation (Mol and Spaargarten 2000). In weak ecological modernisation productivity remains the focus of orientation, but market demands and policies have begun to change and the industry is grappling with options to adjust methods of production to new health and

environmental demands while continuing to operate according to the logic of profit growth via intensification (Evans et al. 2002; Marsden 2004; McDonagh 2015b). Thus, institutions and power relations don't change and green technologies are added to the existing configurations of accumulation. This departs from what McDonagh (2015b) and Horlings and Marsden (2011) term sustainable productivism (or sustainable intensification) stemming from small farmers' own initiatives closely attuned to local environmental socio-economic needs and opportunities. This latter model that remains spatially limited, ostensibly avoids the weaknesses of the kind of greening where practices and technologies are driven by policy and corporate research and development.

### *3.2 Distinguishing between strong and weak sustainability - criteria*

In the ecological modernisation literature that examines the potential for co-locating economic growth, productivity and environmental sustainability, the problems associated with 'weak greening' have to do with insufficient or piecemeal increases in environmental sustainability and persistent lack of local environmental and economic embeddedness (Mol et al. 2014; Jokinen 2000). This latter refers to sustainability solutions such as commercial biotechnology inventions being predominantly 'engineered' by policy and commercial incentives rather than developed with existing farming context in mind and therefore often out of kilter with everyday logic and knowledge basis of farm-level decision-making (e.g. Kaljonen 2006). This, together with inability to commit to large investments limits the ability of smaller farms to increase environmental sustainability. Weak greening can thus favour takeover of land by large farmers and corporate land owners. Ecological modernisation scholars such as Spaargarten and Cohen (2009) and Mol et al. (2014) have highlighted the importance of a more reflexive approach to the role of science and technology and inclusivity and deliberation in devising sustainability solutions in the various sectors of the economy. A deliberative and open governance approach would ensure that certain production methods, communities or factions of communities are less likely to become subverted due to lack of capacity to comply with standardised requirements by integrating place oriented knowledges and framings of sustainability into decision-making and innovation processes (e.g. Kaljonen 2006; Jokinen 2000). Ideally, in strong ecological modernisation, and locally embedded sustainable productivism, sustainable practices are practitioner led and policy and knowledge networks encourage and facilitate this; environmental sustainability is perceived as value added in farm gate prices; priorities in research and development activities and investment patterns are focussed on achieving and encouraging environmentally sustainable outcomes as well as resource efficiency; and land-use planning is also guided by environmental sustainability (Jokinen 2000:

36). In short, farmer agency and place specific sustainability solutions should be central to locally embedded sustainable productivism (Horlings and Marsden 2011; McDonagh 2015b).

#### **4. Sustainable productivism and the case of the ‘Almerian miracle’**

##### *4.1 Local socio-economic embeddedness*

At face value at least, the ‘Almerian miracle’ resembles the kind of resource capitalism that transformed the landscape and established industrialised agriculture in California in the early 20<sup>th</sup> century (e.g. Woods 2011). A 1,7 billion Euro per year export industry (Valera Martinez et al. 2016), Almería is the most dominant horticultural region in Europe and the province that accounts for 79% of Spanish horticultural and fruit exports (Aznar Sanchez et al. 2013). Nevertheless, in contrast to what the technology and demand led production model might imply, the Almerian case displays a high level of local embeddedness (Galdeano Gomez et al. 2010). An early example of this is the local ownership of the financial resources that enabled the small scale private ownership structure of greenhouse production. Cajamar, a significant source of credit, derives from a provincial credit co-operative where instead of urban entrepreneurs or corporations, capital was initially invested by growers themselves. Many of the co-operative based marketing organisations continue to offer credit for technical innovations and new greenhouses to great benefit of small growers (Giagnocavo et al. 2013). Moreover, according to Ferraro Garcia and Aznar Sanchez (2008), together with auxiliary industries and services, horticultural production contributes approximately 22% of VAT income and 31% of employment in the province. While in Spain unemployment rate has soared in the last decade, Almerian agriculture remains one of the very few sectors where production area and employment opportunities have increased, even if jobs are mainly in unskilled farm labour (OOSPEEA 2012). The owners often work on the farm and derive their main income from this labour, but the industry depends to a significant extent on seasonal migrant labour, which has until recently consisted largely of undocumented workers with questionable labour rights (Aznar Sanchez et al. 2011). Aznar Sahcnes et al. (2013) point out that in 2012 there were 141 marketing organisations sharing the nearly 3 million tonnes per year production in Almería. In the agri-food sector, this makes for an ‘atomised’ marketing structure (farmer’s co-operative personal communication 2012). Since most of these ‘middle men’ are local co-operatives and auction houses (Aznar Sahcnes et al. 2013), quite unlike the resource capitalism of the early 20<sup>th</sup> century in California, this production enables a significant amount of the value added to directly benefit the local economy (Aznar Sanchez et al. 2013).

Indeed, Galdeano Gomez et al. (2010) have attributed the later stages of the ‘Almerian miracle’ to a form of neo-endogenous growth where the burgeoning horticultural industry has attracted auxiliary enterprises in the field of input goods and research. This local agro-industrial cluster ensures that there is a hub of innovative activity focussed on adding value to Almerian produce. Many of the local businesses have emerged solely in response to the needs of the horticultural producers and can be seen to facilitate the access into the industry by small scale entrepreneurs.

*“The auxiliary industry ... , is the second economic engine behind agriculture. So, a farmer who wants to put up a greenhouse tomorrow has a lot of companies that build greenhouses, lay irrigation systems, sell seeds, any supplies you need. Go to the street, pick up the phone...”*  
(Mkt1)

The cluster encompasses international but also local research and development enterprises, closely attuned to local circumstances, catering to local growers’ needs to produce vegetables that thrive in the specific Almerian conditions and meet the demands of the consumers of the established markets (Galdeano Gomez et al. 2010; Aznar Sanches et al. 2011; seed company personal communication 2012).

*“The areas where water is poor quality, you produce a kilo less but also the fruit is of a higher quality, ... more flavour. In the province of Almería, ... what we are working on is taste, quality and taste.”* (Water3)

#### *4.2 Access to knowledge and innovation at farm level*

The majority of producers belong to a co-operative that provides stable economic arrangements and ensures access to technological development and training by small farmers (Galdeano Gomez et al. 2016). The proximity between growers, co-operatives and supply companies has been central to the emergence of a number of technological solutions that increase sustainability without compromising the productivity of the sector. This *“Almerian capillary system”* (Mkt1) enabling quick diffusion of locally tailored innovations to farm level also means that the sector is highly adaptable to demands from wholesalers. The rapid adoption of Integrated Pest Management (IPM) practices since 2008 is an example (Galdeano Gomez et al. 2010; van der Blom et al. 2010). IPM that can also act to increase crop yields has been adopted by the majority of growers, many of whom have acquired the UNE155.400 certification pertaining to biological control (Informe Frutihortícola 2012; van der Blom et al. 2010). Therefore, the Almerian

knowledge and innovation network has simultaneously acted to increase farm level economic stability and to incentivise and enable the adoption of new technology. This certainly appears to shield the economy from the price instability that tends to endanger small farms that remain integrated into global supply chains but are not in receipt of state subsidies (Galdeano Gomez et al. 2016).

Nevertheless, there is evidence of a cost – price squeeze that stems not only from falling prices (Valera Matinez et al 2016) but also from the emergence of ever more competitive alternative production locations such as Morocco. The rise of globalised retailers is widely seen to underpin the unfavourable price development of recent years (Instituto Cajamar 2004; Valera Martinez 2016: 15). The competitive advantage of Almerían horticulture lies in high resource efficiency, productivity and marketability of produce. The latter hinges on product quality and the local knowledge and innovation networks are harnessed to maintain this.

*“... with CASI we have technicians and they come round every two weeks. I think the maximum time they’re allowed not to visit a farm. Because we’ve got a system where our tomatoes can be traced.” (Grower2)*

These ‘feedback-loops’ (Sundqvist et al. 2005) are focussed on compliance with existing public and private quality standards such as freedom from chemical residues and visual criteria. As is common to export oriented industrialised agri-food networks, horizontal networks play a significant role in filtering consumer preferences as well as legislative and technological standards and inventions to producers (Bush and Oosterveer 2007; Salazar Mato and Navarro del Aguila 2000; Valera Martinez et al. 2016).

However, there are tensions within this neo-endogenous model. The attention to marketability brings pressure for ‘base concentration’ which is perceived as key to ‘absolute quality’ and a standardised and reliable production output (personal communication with marketing co-operative 2010). There is a trend of mergers among marketing co-operative and auction houses which is mirrored by similar consolidation among producers. In 2006, the top 10 horticultural companies accounted for 64% of all billed income, in 2012 this had risen to 75% (Valra Martinez et al. 2016). These developments may be about to compromise the dimension of economic embeddedness based on the small scale production structure. Our data also suggests that the marketing chain may be undergoing more than just structural adjustment:

*“...the average [greenhouse] is one hectare or half a hectare, per owner. Now the trend is changing, there are entrepreneurs who are investing, buying land for greenhouses and then produce to different markets, with different lines of production. And they themselves handle the product, they do not take the product to a co-operative.” (Ag2)*

While some of the prospective large scale investors propose leasing land out to small farmers (La Voz de Almería 19.4.2016) this would nevertheless substantially alter the basis of production and the position of the small farmer.

#### *4.4 Resource use and its sustainability*

The industry is regularly lauded as very sustainable and Valera Martinez et al. (2016) have collated data on the main environmental emissions from greenhouses which compare favourably with those from main competitors in Eastern and Northern Europe. In terms of energy consumption, Almería’s climate renders it at a natural advantage in greenhouse production particularly in relation to European competitors in terms of low energy consumption and potentially ample access to solar energy (Perez Garcia and Sanchez Molina 2012). Moreover, the greenhouse production has transformed an area of sparse natural vegetation into a significant carbon sink (Campra et al. 2008). Many cite the emergence of locally based plastic recycling plants as another sustainability dividend from the industrial cluster and waste management is now subject to detailed regulation (Valera Martinez et al. 2016).

Nevertheless, some highly politicised environmental problems remain. Water is a limiting factor in this semi-arid region (Downward and Taylor 2007). Water efficiency measures (such as the greenhouse structures themselves and drip irrigation) have become wide spread since their introduction in the 1980s, when there began to appear symptoms of progressive salinisation in the aquifers (Galdeano Gomez et al 2010; Downward and Taylor 2007; Consejería de Agricultura y Medio Ambiente 1991). At national scale, the highly contentious large scale water transfers of the late 1990s have given way to what Swyngedouw (2013) terms a conciliatory market-environmentalist paradigm. Water scarcity is to be addressed through desalination technology and increased attention to water efficiency in irrigation inscribed in the Programa AGUA (Galdeano Gomez 2010; Downward and Taylor 2007; Valera Martinez et al. 2016), which sets out plans for the installation of large scale desalination plants through a state-industry partnership model. However, despite four provincial desalination plants, the vast majority of aquifers in Almería

remain overexploited (Tolon et al. 2013). Even with improvements in irrigation techniques that have contributed to water efficiency, aquifer data from the Instituto de Geología y Minero de España (IGME 2005) illustrates that the most intensively irrigated areas show a clear association with falling water tables and diminishing quality (e.g. increasing salinisation).

While groundwater salinisation limits both crop productivity and the range of crops that can be grown, there are also vulnerable surface waters particularly in Campo de Dalías that are experiencing biodiversity decline (e.g. Paracuellos 2006; Grindlay et al. 2011). The natural ‘albuferas’ or shallow freshwater lakes at Adra constitute a vulnerable nature reserve (Reserva natural Albufera de Adra; Law 2/89) and with the nearby coastal protected zone (Paraje natural Punta Entinas-Sabinar) form a significant habitat for rare species of migrating birds amidst the ‘the sea of plastic’ (Personal communication MMA, 2010). There is evidence of Nitrate leaching into nearby surface waters (Thompson et al. 2007; Torellas et al. 2012) which is particularly detrimental to biodiversity as findings on water quality suggest eutrophication and changes in salinity in protected wetland areas (Abellán et al. 2007; Casas et al. 2011). The relationship between bird populations, water resources and irrigated greenhouse agriculture is complex and whereas organic production is gaining popularity, practices such as fertigation (adding nutrients to irrigation water) and the emptying of grow bags continue to contribute to harmful emissions of nutrients in the vicinity of greenhouses (Env1).

*“Although environmental denominations such as the organic standards and the IRM have led to great improvements in what is happening inside the greenhouses, what are most detrimental are the actions outside” (Env1)*

Like Ripoll et al. (2011), we suggest that the central sustainability challenges in the Almerian horticultural production sector pertain to persistent incompatibility between the rationale underpinning production decisions and actual availability of resources – mainly water – in the region. Another not entirely unrelated concern is the erosion of the family farm basis of the industry and the potential consequences that this will have on economic embeddedness. The Almerian horticultural sector therefore represents a case of weak ecological modernisation where environmental sustainability remains subverted by an overarching productivist rationale (Tilzey and Potter 2008). There is little evidence that environmental quality is seen as a means to add value, and greening in the sector can be attributed to attempts at profit maximisation mainly through resource efficiency gains as with drip irrigation technology, energy conservation and also

IPM which is encouraged partly due to its positive impact on the quality and quantity of harvestable crop (van der Blom et al. 2010). Below, we demonstrate that where sustainability requirements counter profit maximisation, they have been exceedingly difficult to apply consistently.

## **5. The barriers to sustainable productivity in Almería: water governance and the agrarian question**

### *5.1 Water governance and sustainability in Almería*

Tolon et al. (2013: 64) who have used various methods to calculate water footprints for Spanish agricultural production, note that the use of water in Almería is highly efficient producing a small water footprint per volume of produce and unit of income. While Tolon et al. (2013) suggest that this justifies the overexploitation of aquifers, they concede that the absolute flows of water in the province can be termed to demonstrate an ‘irresponsible approach’ to water use (Madrid 2007 cited in Tolon et al. 2013). Therefore, despite the ostensible reconciliation presented by desalination, there is an unresolved normative debate to be had concerning the extent of the water scarcity problem in Almería. Below, we discuss how this impinges on water governance and farm decision-making.

First of all, scarcity is not reflected in water pricing in the region (Hernandez Mora et al. 2008). Groundwater price is mostly based on its pumping and potential distribution costs alone. This renders it much cheaper than desalinated water (in Almería, 0.22 Euros/m<sup>3</sup> to 0.52 Euros/m<sup>3</sup> according to our data - Water3). Fundación Cajamar offers a calculation of the percentage costs (both running and capital) of greenhouse production for a typical Almerían style greenhouse (Cabrera Sánchez and Uclés Aguilera 2012: 30), where water represents approximately 2.5% of the annual costs whereas the biggest costs are labour and seeds and seedlings at 40% and 8.4% respectively. Surface water is even cheaper than groundwater, but it is a limited resource that in most areas cannot compensate for the overuse of ground water (Hernandez Mora et al. 2008).

The potential for technological innovation in water efficiency at farm level is far from exhausted and could be engaged much more rigorously to address water use (Marte et al. 2011; Alcon et al. 2014). Closed circuit hydroponic production for example, could help combine the present or even increasing productivity levels with significantly limited environmental impact (Torellas et al. 2012). But while groundwater remains cheap and accessible, there appears to be little incentive to adopt this type of innovations.

*“... taking into account that the impact of the cost on total production is somewhat laughable ... [Water] constitutes 2, 4, 5 or 6% [of all production costs]... with these percentages, so what?”*  
(Water2)

Effective implementation of governance mechanisms, such as water pricing, for sustainable water use at a regional or local level is politically extremely challenging and this certainly seems to be the case in Almería (see e.g. Oñate and Peco 2005; Grindlay et al. 2011). Spain has a history of a deliberative rather than coercive approach in water governance, and the past couple of decades have seen the devolution of water governance to the regional level (Hernandez Mora et al. 2008). The Andalusian Water Agency was established in 2005 and presides over water distribution and pricing. In 2010 the Andalusian Water Law (Act 9/2010) rendered ground water as public property and transformed previously private water rights into public concessions also stipulating for the first time the obligation to register all existing wells (Paneque and Beltran 2015). But limiting users to those with existing rights has for long been a pressing issue (Garrido and Llamas 2009) and WWF España (2006) goes as far as to suggest that most of the growth of the greenhouse area in Campo de Dalías since 1986 has been based on illegal wells. Monitoring of the capacity and evolution of the aquifers with the aim of establishing a suitable framework to regulate demand was initiated only in the 1990s and attitudes to water use are clearly still influenced by the historically relaxed approach to water (Downward and Taylor 2007; Garrido and Llamas 2009).

Despite the ‘conciliatory’ solution of desalinated water, normative ambivalence about the legitimacy of continued reliance on aquifer water also appears to hamper the functioning of the deliberative governance mechanisms devised to achieve sustainable water consumption. In the south east of Spain, producers are organised into irrigation communities that share costs of water distribution and the required infrastructure, and, in compliance with the 1985 national Water Act, central associations of irrigation communities and other users have been formed where an aquifer is in overdraft. These central associations are tasked with drawing up a plan for the recovery of the aquifer (Hernandez Mora et al. 2008). The execution of these plans is what the future of the overdrawn aquifers in Almería hinges on. For example:

*“The city and the irrigators, all the users, [the association of user communities] are committed to cut [annual] extraction of water [from the local aquifer] by 50 hm<sup>3</sup> ... so that the quality will recover.”* (Water3)

The plan involves reducing the use of aquifer water to sustainable levels that allow recovery and substituting with water from the desalination plants. However, in practice, the notion that present levels of use are justified continues to block progress:

*“What is happening now is that one community of irrigators has a sensor in a zone with very good water quality and another situated closer to the coast with seawater intrusion has water of much worse quality. Both need to work towards recovery [of aquifer], this is what [the Association of User Communities] are working on. There are a few that do not want to collaborate. We can only hope that the majority wants to collaborate, and that the administration allocates the Association of User Communities sufficient powers to oblige everybody to collaborate.”* (Water3)

While *“Everyone is waiting for is the neighbour to pay for the desalinated water”* (Water1), there is very little beyond an unprecedented regulatory imperative or the eventual spread of the problem within the aquifer that, despite the deliberative governance arrangements, appears likely to resolve the present impasse. This may well be a realistic expectation as a further measure prescribed by the European Water Framework Directive is the requirement that all EU member states charge for water use at a cost approaching the true cost of its abstraction. So called ‘full-cost recovery’ would mean growers could have to pay significantly more for their water than the 0.12-0.25 Euros/m<sup>3</sup> price range at present (farmers’ co-operative, personal communication 2010). The price increase would likely be instrumental in promoting the adoption of further technological solutions such as closed circuit hydroponics or at least the use of desalinated water. However, some suggest that the present price of desalinated water would also increase substantially on implementation of the full cost recovery principle (Ripoll et al 2011). Moreover, the sustainability of desalinated water is often questioned on the basis that its production consumes a lot of energy (e.g. Lopez Gunn et al. 2012). There is of course ample opportunity for renewable, perhaps totally solar powered desalination plants in the south of Spain and the fluctuations in government incentives for a transfer to renewable energy sources are seen by many as the main obstacle to sustainable desalinated water.

*“My question is, if what we have is here in Almería is ... sun and wind, does it make sense to build a desalination plant with conventional energy? ... we are in a country that has for the last*

*four years stalled with all renewable energy policies. ... It bothers me that we are not on the street every day manifesting and vindicating those things.” (Grower3)*

There is a third, perhaps the most sustainable source of irrigation water in Almería, namely recycled water. A prominent example of this latter is the Cuatro Vegas recycling plant which recycles the waste water from the city of Almería. The Cuatro Vegas water recycling plant run by a Community of Irrigators based on a co-operative business format although a not-for-profit one, demonstrates perfectly the potential for bottom-up innovation:

*“...in the mid-80s a group of people ... realized that water ... was an element that was limiting us, and we also saw that the city of Almería was "a river" that was pouring into the sea without profit. Then we began to have meetings with farmers... now we are about +1100 farmers who form an entity, and ... we have the aim of reaching 2000 ha, we cover now, [almost] 1900 ha” (Grower1)*

But, water recycling is a localised solution dependent on a source of good quality recyclable water and again a sufficient incentive remains absent. Nevertheless, there appears to be an emerging push for smaller scale innovations at farm level.

*“To recycle water? Yes, ... in the region of Nijar it is being done. Why? Because there they had poorer water quality. We here, as our water quality has been or is quite good compared to them, so far it has not been done or at a very small scale. But we are beginning to recommend to farmers, that when they reform their holdings or establish a new greenhouse, they take into account that water is collected, in order to mix rain water ... from the upper aquifer, which [would] make optimum quality water for irrigation.” (Water3)*

### *5.2 The locus of power and the rationale underpinning water use at farm level*

Our data affords some examination of farm level decision-making to better understand this impasse in water conservation. As discussed, local auction houses, agricultural development organisations (SAT, Sociedad Agrícola de Transformación) in addition to growers’ co-operatives occupy a very influential position in farm level decision-making. Nevertheless, the water issue has not traditionally been on these organisations’ agenda. Grower2 who uses hydroponics but without the more demanding closed circuit technology for example had to seek advice and support directly from the wholesaler.

*“I got on the internet at the beginning. ... It was hard to find a company ... You can ask them and they send a technician and he explained a few things. And also [my neighbour] ... has hydroponics as well and he gave me some little advice.” (Grower2)*

Close circuit production does have added risks to do with spread of disease as well as requirements for water quality. Without support of the knowledge networks, many farmers fear the adoption of closed circuit systems would lead to problems. Both the administration and some growers acknowledge that a stronger push for water efficiency measures is required.

*“... I think [desalinated water] is a cost that the farmer has to bear, because otherwise we will not have water.*

*- And that's why you have decided to grow with hydroponics, because it is better?*

*For me it's better because I save water ... I'm not contaminating aquifers. It is zero pollution of aquifers, because I am recirculating.” (Grower3)*

*“Yes there are plans, there is even financial help to change hydroponics greenhouses ... But ... in these cases the need to implement arises from the farmers themselves. Because of the cost, the price of water...” (Water1)*

Research suggests that additional investment and even the higher cost of desalinated water could be sustained by the majority of producers and would contribute to increase profit (Grindlay et al. 2011; Torellas et al. 2012). But this water official refers to the precarious position of many small farmers that suffer disproportionately from the price squeeze:

*“[Small farmers] have very high water consumption, higher than modern farms ... this year has been warm, it has favoured winter production [in northern Europe], and this year ... everyone can compete with Almería, and with cheaper water prices.” (Water1)*

One large producer's co-operative suggests that consumer demands will direct attention to sustainability challenges that must be faced (personal communication 2010) but there is little evidence that the localised problem of water quality has gained much traction as a quality concern. Grower3 is a large farmer using closed circuit hydroponic production which is highly

water efficient and has identified a niche market for water efficient products which some cooperatives have the capacity to access.

*“What [your cooperative] say when you decided to produce with hydroponics, especially with the closed cycle?”*

*For them it is very positive. What happened, the cooperative now, there are some markets, for example Scandinavian markets, Norway, Denmark, Sweden ... there are specific markets that pay very well, but they demand [specific quality criteria].” (Grower3)*

It appears that significant change to water management will not happen unless the impending ground water price increase is realised, inevitably at a relatively higher cost to smaller farms. But even within the water administration, there are some, perhaps tacit, doubts as to the legitimacy of this move. Moreover, the water problem appears as much that of the scale of production as of farm level practices (Ripoll et al. 2011). Existing planning legislation appears poorly equipped to address this problem via controlling the spread of greenhouses with the sector still slowly expanding (Valera Martinez 2016: 25-26). Excavation for developments greater than 10ha on slopes greater than 15 degrees requires an environmental impact assessment and the permission of the provincial branch of the Ministry of Environment, but the licences required to establish a smaller greenhouse do not pay attention to water beyond requiring a legitimate source to be named (Ag2; Env1).

Our findings suggest that the marketing organisations at the centre of the knowledge and innovation network pay a large role in what Ripoll et al. (2011) term a demand led rationale governing water management in Almería. Therefore, “the starting point is not ‘how much water do we have’, but the opposite: ‘In order for our agricultural output to expand as expected, where do we get the water from?’” Ibidem: 16). To all intents, so far the deliberative governance arrangements afforded by legislation appear unable to elicit a shift to the use of desalinated water at farm level. Moreover, the irrigators’ federation Feragua has alleged that if anything, the new water governance instruments such as water banks enabling the sale of water quotas by individual farmers will further encourage overexploitation by reassigning resources saved by irrigation modernisation to new users (Global Water Intelligence 2010).

Finally, there is a widely acknowledged conflict between water security via desalination and environmental security (Lopez Gunn et al. 2012). And while environmental officials maintain that

at present environmental values are losing out to the needs of the horticultural sector, there are further opportunity costs to consider. The economic and employment opportunities offered by the horticultural sector are not to be frowned on, but the majority of jobs (about two thirds; 18% of total employment) are as unskilled and seasonal agricultural hands often occupied by migrants with as yet poorly established rights (OOSPEEA 2012; Aznar Sanches et al. 2011). Conversely, irrigated agriculture represents 86% of the total amount of water used in Almerían economic activity (Tolon et al. 2013). There is a hierarchy of uses that prioritises urban over agricultural (and agricultural over touristic) uses of water in the national law, but in Almería at least, this prioritisation is not observed (Paneque and Beltran 2015; Global Water Intelligence 2010). Viewing the opportunity costs of this water use in economic terms, for example Auernheimer and González (2002) state that for identical expenditure on water investment returns from tourism can be 60 times higher than those of agriculture. These arguments, if voiced more prominently, could help destabilise the predominant albeit often tacit interpretation that the extraction of water from overexploited aquifers is justified to maintain the levels of production. Put together, all this suggest that to ensure the long term viability and legitimacy of horticulture in the province, an explicit agreement needs to be reached on legitimate levels of water use. Moreover, to maintain the locally embedded small farm structure of the sector, especially on small farms, innovation and extension activities need to be re-focused to support farm level water efficiency (Alcon et al. 2014; Marte 2011).

## **6. Conclusions**

The main conclusion from this analysis of the Almerían horticultural sector through the theoretical lens of sustainable productivism is that while several environmental innovations have been implemented, the underpinning rationale is that of maintaining and enhancing market competitiveness and cost efficiency. Innovations such as IPM and water efficient irrigation systems have been advanced through the remarkable ‘capillary system’ formed by marketing organisations and agronomists working closely with auxiliary enterprises and small farmers. However, environmental technologies and farming practices that do not explicitly coincide with the goal of market competitiveness do not receive the support of the knowledge network and farmers are left to their own devices in adopting them. While the sector is exemplary in that scarce resources are efficiently used with good access to technological innovation that benefits productivity and efficiency gains even on the smallest farms, its overall environmental impact on water resources and vulnerable habitats that depend on them is detrimental. This is partly because broader principles marking sustainable productivism such as the existence of land use planning

controls that are guided by sustainable resource use criteria are also lacking. Although we found evidence of policy networks that facilitate producer led environmental sustainability solutions, they suffer from an impasse where persistent disagreements over legitimate water use practices block the necessary progress in cutting water abstraction from aquifers.

We concur with many writers that, despite the establishment of four desalination plants in the province, water scarcity and more specifically aquifer depletion remain the main environmental problem in Almeria. The main problem is the persistent perception, based on historic notions of water rights (as private, untrammelled by policy intervention) and the high productivity per water unit, that present level of water usage is justifiable. This relative notion of the scale of the water problem also makes it next to impossible to implement governance measures such as increased enforcement of water abstraction quotas and higher pricing of aquifer water that would convince farmers to actually use desalinated water, especially because some of the smaller greenhouses would likely suffer disproportionality from the increased costs.

Our findings also afford some commentary on theorisations of sustainable productivism and specifically the role of policy in facilitating the adoption of sustainable solutions (van de Ploeg 2006; Jokinen 2000). While the knowledge and innovation network in Almeria ensures that small farmers have good access to latest technologies, the bias towards competitiveness that dominates the network also renders small farmers vulnerable. Despite the buffer of the co-operative arrangements, farmers' economic fortunes remain open to fluctuations resulting from weather and market developments. This hinders their capacity (whether perceived or actual) to adopt technologies that are not supported by the marketing organisations. If and when water price rises, the smallest farmers will be prepared. At the scale of the industry, the emerging trend for larger production units and ones that sell directly to retailers (without co-operatives or auction houses) may provide a solution to this path dependency. These larger units operating independently of the horizontal networks of marketing organisations and ASTs may be more agile in identifying market niches for sustainable produce and are also likely to have more capacity to invest in water efficiency beyond small farmers. It remains to be seen whether this is the case and what this trend means in terms of socio-economic embeddedness – will profits from the sector start frog-leaping the local economy like all too often is the case with big rural enterprises (Woods 2011) or will a new model of tenanted farming help maintain the locally embedded small scale structure of most of the production. Nevertheless, there is no evidence in our data that the existing deliberative aquifer management policy arrangements or new flexible water governance instrument introduced

by the Andalusian Water Law, such as water banks and small scale water transfers are capable of addressing the depletion of the aquifers in either Campo de Dalias or Campo de Nijar. Use simply needs to be curbed whether by water pricing or a stricter regulatory intervention, and both will require enforcement mechanisms that will be challenging to implement in the context of the strong economic interest that will be affected and also the prevalent water management culture that appears to date back to times when water was an abundant and cheap private resource (Garrido and Llamas 2009).

Finally, while it appears that despite the above barriers, a transition into sustainable productivism with the Almerían horticultural sector would be feasible, it is justified to question whether any production sector that dominates resource use in a locality to this extent can be termed truly sustainable. In Almeria, it is still the logic of quantity that dominates production whereas added value could be achieved through combining both quality and quantity as in sustainable productivism (Horlings and Marsden 2011). Almerían tomatoes are vulnerable to competition as they can easily be replaced by for example Moroccan ones in the market without consumers necessarily having a sense of any great loss of value. A more sustainable production strategy might be based on a deeper engagement of the unique Almerían features such as the vicinity to valuable natural resources, their sustainable nurturing and the specific characteristics of the production materials that contribute to special taste attributes in production and branding. This together with more stringent controls on water use and the greenhouse area might help consolidate the kind of resource use rationale where legitimate levels of use are defined according to the ability of water resources to sustain these valuable ecological functions and not just the sea of plastic.

#### **References:**

**Abellán P.N., Sánchez Fernández D., Velasco J. and Milán A.** (2007) Effectiveness of protected area networks in representing freshwater biodiversity: the case of a Mediterranean river basin (south-eastern Spain). *Journal of Aquatic Conservation: Marine Freshwater Ecosystems* 17: 361–374.

**Alcon F., Tapsuwan S., Martínez Paz J.M., Brouwer R., de Miguel M.D.** (2014) Forecasting deficit irrigation adoption using a mixed stakeholder assessment methodology, *Technol. Forecast. Soc. Change* 83: 183-193.

**Aznar Sánchez J.A., Galdeano Gómez E., Álvarez Ramos J., Tapia León J.J., Godoy Durán A.** (2013) Caracterización y desafíos del sector de la comercialización. In (same eds.) El sector de la comercialización hortícola en Almería: Concentración, prospective y logística. Pp: 17-46. Cajamar Caja Rural: Almería.

**Aznar Sánchez J.A., Galdeano Gómez E. and Pérez-Mesa J.C.** (2011) Intensive Horticulture in Almería (Spain): A Counterpoint to Current European Rural Policy Strategies. *Journal of Agrarian Change*, 11(2): 241–26.1

**Auernheimer C and González G** 2002 Repercussions of the national hydrological plan on the Spanish Mediterranean coast (water versus tourism and agriculture) Presented *Agriculture and Urbanisation in the Mediterranean Region: Enabling Policies for Sustainable Development – Local Resources and Global Trends: Environments and Agriculture in the Mediterranean Region* Rabat, Morocco, 25-30<sup>th</sup> April 2002

**Blom Van der, A., Robledo A., Torres S. and Sánchez J.A.** (2010) Control biológico en horticultura en Almería: un cambio radical, pero racional y rentable. *Cuadrenos de estudios agroalimentarios CEA01*: 45-60.

**Bryman A.** (2016) *Social research methods*. Oxford: OUP.

**Bush S.R., and Oosterveer F.** (2007) The Missing Link: Intersecting Governance and Trade in the Space of Place and the Space of Flows. *Sociologia Ruralis* 47(4): 384-399.

**Cabrera Sánchez A. and Uclés Aguilera D.** (2012) Análisis de la campaña hortofrutícola de Almería. Campaña 2011/2012. Fundación Cajamar: Almería.

**Campra, P. García, M., Canton, Y. And Palacios-Orueta, A.** (2008): Surface temperature cooling trends and negative radiative forcing due to land use change toward greenhouse farming in southeastern Spain. *Journal of geophysical research atmospheres*, 113, D18109.

**Casas J.J., Sanchez-Oliver J.S., Sanz A. Furné M., Trenzado C., Juan M., Paracuellos M., Suárez M.D., Fuentes F., Gallego I. Gil C. and Ramos-Miras J.J.** (2011) The paradox of the

conservation of an endangered fish species in a Mediterranean region under agricultural intensification. *Biological Conservation* 144: 253–262.

**Dowdard S. and Taylor R. (2007)** An assessment of Spain's Programa AGUA and its implications for sustainable water management in the province of Almería, southeast Spain. *Journal of Environmental Management* 82: 277-289.

**Evans, N., Morris, C. and Winter, M. (2002)** Conceptualizing agriculture: A critique of post-productivism as the new orthodoxy, in *Progress in Human Geography* 26, 3, pp. 313-332

**Ferraro García F.J., and Aznar Sánchez, J.A. (2008)** El distrito agroindustrial de Almería: un caso atípico. Paperpublished in *La Colección Mediterráneo Económico* (13): "Los distritos industriales" ISBN: 978-84-95531-40-7 CAJAMAR Caja Rural, Sociedad Cooperativa de Crédito - Producido por: Fundación Cajamar

**Galdeano Gómez E., Pérez Mesa J.C. and Godoy-Durán A. (2016)** The social dimension as a driver of sustainable development: the case of family farms in southeast Spain. *Sustainability Science* 11(2): 349-362.

**Galdeano Gómez, E., Aznar-Sánchez J.A. and Pérez-Mesa J.C. (2010)** The complexity of Theories on Rural Development in Europe: An Analysis of the Paradigmatic Case of Almería (South-east Spain). *Sociologia Ruralis*, 51(1): 54-78.

**Garrido A. and Llamas M.R. (2009)** Water Management in Spain: An Example of Changing Paradigms. In Dinar A. and Albiac J. (eds.) *Policy and Strategic Behaviour in Water Resource Management*. Earthscan.

**Global Water Intelligence** 201 European News in Brief. 11(8). Available online at: <http://www.globalwaterintel.com/archive/11/8/brief/europe-news-brief.html#sthash.t0IhdZ1X.dpuf>

**Grindlay A.L., Lizárraga C., Rodríguez M.I. and Molero E. (2011)** Irrigation and territory in the southeast of Spain: Evolution and future perspectives within new hydrological planning. *WIT Transactions on Ecology and the Environment* 150: 623-638.

**Hernandez Mora N., Martinez Cortina L., Llamas Madruga M.R. and Custodio Gimena E.** (2008) Groundwater issues in southern EU member states – Spain country report. European Academies. Science Advisory Council.

**HLPE** (2012) Food security and climate change. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2012.

**Horden P and Purcell N** (2000) *The Corrupting Sea: Study of Mediterranean History* Blackwell Publishers Ltd, Oxford.

**Horlings L.G. and Marsden T.K.** (2011) Towards the real green revolution? Exploring the conceptual dimensions of a new ecological modernisation of agriculture that could ‘feed the world’. *Global Environmental Change* 21: 441-452.

**IGME** 2005 Instituto de Geología y Minero de España ([www.igme.es](http://www.igme.es))

**INFORME FRUTIHORTICOLA** (1st of March 2012) Almería Prosigue su Revolucion Verde [http://infofrut.com.ar/index.php?option=com\\_content&view=article&id=1515:almeria-prosigue-su-revolucion-verde&catid=93:general](http://infofrut.com.ar/index.php?option=com_content&view=article&id=1515:almeria-prosigue-su-revolucion-verde&catid=93:general)

**Instituto Cajamar** 2004 *El modelo económico Almería basada en la agricultura intensiva* Instituto de Estudios Cajamar, Almería

**Jokinen P.** (2000) Europeanisation and ecological modernisation: agri-environmental policy and practices in Finland. *Environmental Politics* 9(1): 138-167.

**Kaljonen M.** (2006) Co-construction of agency and environmental management. The case of agri-environmental policy implementation at Finnish farms. *Journal of Rural Studies* 22: 205–216

**Kitchen, L. and Marsden, T.** (2009) Creating Sustainable Rural Development through Stimulating the Eco-economy: Beyond the Eco-economic Paradox? In *Sociologia Ruralis*, 49, 3, pp. 274-294

**La Voz de Almería** (19.4.2016) El dueño de embutidos El Pozo proyecta nuevos invernaderos junto al PITA. Pp. 6-7.

**Lopez Gunn E., Dumont A., Vilaarts B., Niemeyer I. and Martinez Santos P.** (2012) The concept of water and food security in Spain. In: De Stefano L. and Llamas R.M. (eds.) *Water, Agriculture and the Environment in Spain: can we square the circle?* CRC Press.

**Marsden T.** (2004) The Quest for Ecological Modernisation: Re-Spacing Rural Development and Agri-Food Studies. *Sociologia Ruralis* 44(2):129-146.

**Marte W.E., Nanseki T. and Bienvenido F.** (2011) The role of education, institutional settings and ICT on the Integrated Production Development in Almería, Spain. *Agricultural information research* 20(2): 66-73.

**McDonagh J.** (2015a) Rural Geography II: discourses of food and sustainable rural futures. *Progress in Human Geography* 38(6): 838-844

**McDonagh J.** (2015b) Rural geography III: Do we really have a choice? The bio-economy and future rural pathways. *Progress in Human Geography* 39(5): 658–665

**MMA** 2005 Programa AGUA: Actuaciones para la Gestión y la Utilización del Agua Ministerio de Medio Ambiente ([www.mma.es](http://www.mma.es))

**Mol A.P.J. and Spaargarten G.** (2000) Ecological Modernisation Theory in Debate: a review. *Environmental Politics* 9(1): 17-49

**Mol A.P.J. Spaargaren G. and Sonnenfeld D.A.** (2014) Ecological Modernisation Theory: where do we stand? In: M. Bemann, B. Metzger, R. von Detten (Eds) *Ökologische Modernisierung. Zur Geschichte und Gegenwart eines Konzepts in Umweltpolitik und Sozialwissenschaften*, Frankfurt: Campus Verlag, 35-66

**Mota H F, Penas J, Castro H, Cabello J and Guirado J S** 1996 Agricultural development vs biodiversity conservation: the Mediterranean semiarid vegetation in El Ejido (Almería, southeastern Spain) *Biodiversity and Conservation* 5 1597-1617

**OOSPPEEA:** Observatorio de las Ocupaciones del Servicio Público de Empleo Estatal de Almería (2012) Informe de Mercado de Trabajo en Almería: Datos 2011.

**Oñate J. and B. Peco** (2005) Policy impact on desertification: stakeholders' perceptions in southeast Spain. *Land Use Policy* 22: 103-114.

**Paneque P. and Beltrán M.J.** (2015) Towards a more flexible water concession system in Spain: public water banks in Andalusia, *International Journal of Water Resources Development*, 31:4, 657-668.

**Paracuellos M** (2006) Las albuferas de Adra (Almería, sudeste ibérico) y su relación histórica con el hombre *Farua. (Miscelanea Abderitana)*.

**Pérez García, M., Sánchez Molina, J. A.** (2012): Energías renovables en los invernaderos. *Cuadernos de Estudios Agroalimentarios*, 3: 181-210.

**Ploeg, J. van der** (2006) Agricultural production in crisis, in Cloke, P., Marsden, T. and Mooney, P. (Eds.) *The Handbook of Rural Studies*, Sage: London, pp. 258-277

**Ripoll S., T. MacMillan, M. J. B. Muños, E. Velázquez, C. M. López and L. Levidov** (2011) WP3: Water Scarcity and its Virtual Export from Spain to the UK. Final Report of the Co-operative Research on Environmental problems in Europe Project.

**Salazar Mato J. F. and Navarro del Aquila C.** (2000) Impacto económico-ambiental de los grupos de productores en los cultivos intensivos de Almería. Trabajo 8-9 (2000). Presented in 'Relaciones Laboradas en la Universidad de Sevilla' 28-29<sup>th</sup> of September 2000.

**Spaargarten G. and Cohen M.J.** (2009) Greening lifecycles and lifestyles: sociotechnical innovations in consumption and production as core concerns of ecological modernisation theory

The Ecological Modernisation Reader. Environmental reform in theory and practice. / Mol, A.P.J., Sonnenfeld, D.A., Spaargaren, G., London/New York : Routledge - ISBN 9780415453707 - p. 257 - 274.

**Sundkvist, A., Milestad, R., Jansson, A.,** 2005. On the importance of tightening feedback loops for sustainable development of food systems. *Food Policy* 30 (2): 224–239.

**Thompson R.B, Martínez Gaitan C., Gallardo M., Giménez C. and Fernández M.D.** (2007) Identification of irrigation and N management practices that contribute to nitrate leaching loss from an intensive vegetable production system by use of a comprehensive survey. *Agricultural Water Management* 89: 261 – 274.

**Tilzey, M. and Potter, C.** (2008) Productivism versus post-productivism: modes of agri-environmental governance in post-Fordist agricultural transitions, in Robinson, G. (Ed.) *Sustainable Rural Systems: sustainable agriculture and rural communities*, Ashgate: London, pp: 41-65

**Tolón, A., Lastra, X. y Fernández, V.J.** (2013). Huella hídrica y sostenibilidad del uso de los recursos hídricos. Aplicación al Poniente Almeriense. Estudios previos y medidas de eficiencia. *M+A, Revista Electrónica@ de Medio Ambiente* 14(1): 56-86.

**Torrellas, M., Assumpció A., López, J.C., Baeza, E. J., Parra, J. P., Muños P. and Montero J.I.** (2012) LCA of a tomato crop in a multi-tunnel greenhouse in Almería. *International Journal of Life Cycle Assessment* 17:863–875.

**Tout D.** 1990 The horticulture industry of Almería province, Spain *The Geographical Journal* 156 304-312

**Valera Martínez D.L., Belmonte Ureña L.J., Domingo Molina Aiz F., López Martínez A.** (2016) Greenhouse agriculture in Almería. A comprehensive techno-economic analysis. Serie Economía. Caja Rural.

**Wilson G. and Burton R.J.F.** (2015) ‘Neo-productivist’ agriculture: Spatio-temporal versus structuralist perspectives. *Journal of Rural Studies* 38: 52-64.

**Wilson G.** (2008) From 'weak' to 'strong' multi-functionality: Conceptualising farm-level multifunctional transitional pathways, in **Journal of Rural Studies** 24, pp. 367-383

**Woods M.** (2011) Rural. Routledge: London.

**WWF España** (2006) Uso ilegal del agua en España: Causas, efectos y soluciones. WWF/Adena: Madrid. Available online at:

[http://awsassets.wwf.es/downloads/uso\\_ilegal\\_del\\_agua\\_mayo06.pdf](http://awsassets.wwf.es/downloads/uso_ilegal_del_agua_mayo06.pdf)