Land Use Policy 54 (2016) 534–548

Contents lists available at ScienceDirect

Land Use Policy

journal homepage: www.elsevier.com/locate/landusepol

Impacts of land use change on ecosystem services and implications for human well-being in Spanish drylands

Cristina Quintas-Soriano[a,b], Antonio J. Castro[c,a], Hermelindo Castro[a], Marina García-Llorente[d,b,*]

[a] Andalusian Center for the Assessment and Monitoring of Global Change (CAESCG), Department of Biology and Geology, Ctra. Sacramento s/n, La Cañada de San Urbano, Universidad de Almería, 04120 Almería, Spain
[b] Social-Ecological Systems Laboratory, Department of Ecology, Universidad Autónoma de Madrid, 28049 Madrid, Spain
[c] Department of Biological Sciences, Idaho State University, Pocatello, ID 83209, USA
[d] Madrid Institute for Rural, Agricultural and Food Research and Development (IMIDRA), Department of Applied Research and Agricultural Extension, Ctra. N-II, Km 38,200 CP 28802 Alcalá de Henares, Madrid, Spain

ARTICLE INFO

Article history:
Received 18 March 2015
Received in revised form 12 February 2016
Accepted 4 March 2016

Keywords:
Argument analysis
Arid
Conservation
Greenhouse
Rural abandonment
Urbanization

ABSTRACT

The arid southeastern Iberian Peninsula is a unique region in which conservation and human development have coexisted and coevolved over many decades. However, conflicts between economic development and conservation have generated increasing concern due to the rapid expansion of greenhouse horticulture and the abandonment of rural and mountainous areas. Human decisions regarding land use management have affected the status of ecosystems and therefore the ecosystem services supply. We identified four land use-land cover changes that summarize the most common management decisions. These include greenhouse horticulture expansion, urban intensification, rural abandonment, and conservation actions, which occur through protected area declarations. This study aims to explore the social relevance of land use-land cover changes on the delivery of eight key services provided by Spanish arid ecosystems as follows: provisioning services related to intensive and traditional agriculture, regulating services associated with water regulation, climate regulation, air quality and erosion control, and cultural services linked to local identity and tourism. Through 402 face-to-face questionnaires, we analyzed the arguments for and against these four land use-land cover types. We also assessed their impact on ecosystem services and the social importance and vulnerability of ecosystem services. We found significant differences in the social perception of the positive and negative impacts of land use types on ecosystem services. The sample population recognized the negative impacts of greenhouse horticulture on regulating services that are, in terms of water regulation, essential for the sustained delivery of final provisioning services related to agricultural activities. Overall, traditional agriculture and tourism are recognized as the most important services. A controversy between the two opposite models of territorial development – urban development and nature conservation – highlights the need to promote new strategies of land management. Finally, we discuss the usefulness of this approach to understand the arguments affecting the promotion of land use-land cover changes and to visualize the ecosystem service trade-offs under different management strategies.

1. Introduction

Land use-land cover (LULC) changes are a driver of global change that directly affects the status and integrity of ecosystems, and in last term its capacity to supply ecosystem services. LULC changes thus merit special attention for land management and planning due to their potentially negative consequences, creating trade-offs between some ecosystem services (Nelson et al., 2010; Pereira et al., 2012). For instance, the urban intensification that has occurred in recent decades has been accompanied by large increases in

* Corresponding author at: Social-Ecological Systems Laboratory, Department of Ecology, Universidad Autónoma de Madrid, 28049 Madrid, Spain. Fax: +34 91 4978001.
E-mail addresses: cqs572@ual.es (C. Quintas-Soriano), castanto@isu.edu (A.J. Castro), hcn068@ual.es (H. Castro), marina.garcia.llorente@madrid.org (M. García-Llorente).

http://dx.doi.org/10.1016/j.landusepol.2016.03.011
0264-8377/

resource consumption, habitat fragmentation and biodiversity loss (Foley et al., 2005; Lawler et al., 2014). In other situations, LULC decisions have preserved ecological values and ecosystem services through conservation strategies, including the designation of protected areas (Abram et al., 2014). In this sense, LULC changes affect both habitat characteristics linked to biodiversity and ecosystem services that are vital to the maintenance of human well-being (Foley et al., 2005; Schröter et al., 2005). Often, these decisions create compromises or trade-offs when a given land management strategy enhances the delivery of particular ecosystem services while limiting others (Mouchet et al., 2014). For example, Butler et al. (2011) identified a direct trade-off between food and fiber production versus water quality regulation, and Rodríguez et al. (2006) demonstrated how actions to enhance the supply of food and timber have led to declines in nutrient cycling and flood regulation services. Other authors have identified trade-offs between economic development and the provision of landscape aesthetic value and water supply for human use (Vidal-Legaz et al., 2013).

In this context, management decisions should promote sustainable landscape strategies in which human needs are satisfied while maintaining the capacity of the ecosystem to preserve key ecosystem services (McShane et al., 2011). In fact, several studies have stated the importance of exploring how land management influences the delivery of ecosystem services as different management strategies can change the relationships among ecosystem services, often creating opportunities to promote or deteriorate services simultaneously (Bennet et al., 2009; Mouchet et al., 2014). In this way, the aim of this study was to explore the arguments that support and oppose the promotion of LULC changes, as well as to assess their impact on a variety of ecosystem services provided by arid Spanish ecosystems. The selected ecosystem services included food production from traditional agricultural methods, food production from intensive agricultural methods, air quality, climate regulation, water regulation, erosion control, tourism and local identity.

In the arid ecosystems of the Mediterranean region of southeastern Spain, the consequences of LULC changes on the capacity of ecosystems to provide services are especially important due to the ecological vulnerability and high biodiversity of these ecosystems (Palutikof et al., 1996; Sala et al., 2000; Lázaro et al., 2001; Spanish NEA, 2014). This area is the driest region in continental Europe (García-Latorre et al., 2001; Armas et al., 2011) and has experienced one of the most dramatic and significant LULC transformations in all Europe, with enormous economic and sociocultural consequences (Aznar-Sánchez et al., 2011; Muñoz-Rojas et al., 2011). It has one of the highest population growth rates in Spain, where immigrants account for 22% of the total population. It also has a birth rate above the Spanish average (Wolosin, 2008; INE, 2011). Since 1960, land-planning strategies to promote socioeconomic development in this area caused four policy-based main LULC changes: (1) a rapid transition toward intensive greenhouse horticulture in coastal areas (representing 3.15% of the study area surface) (UNEP, 2005; Aznar-Sánchez et al., 2011) promoted by the National Institute of Rural Development and Colonization (Royal Legislative Decree 24/06/41); (2) urban expansion associated with population growth produced by agriculture intensification and massive tourism along the coastline (2.65% of the study area surface) promoted by the Andalusian Law 7/2002 in Urban Planning; (3) rural abandonment produced by the exodus of people toward urban areas along the coast (44.52% of the study area surface), which is currently combated by the Spanish Law 45/2007 on Rural Development; and (4) the declaration of the protected area networks with the aim of conserving the unique ecological value of this territory (20% of the study area surface), as for example *Sierra Nevada National Park* (Spanish Law 3/1999) or the *Cabo de Gata Natural Park* (Andalusian Legislative decree 314/1987) (Fig. 1). Based on these land transformations, particularly related to agriculture intensification, this period was described as "the Almería miracle" in response to the conversion of the driest regions in Europe into one of the most economically prosperous areas in the country due to the proliferation of greenhouse horticulture (Mota et al., 1996).

In the face of these land use transformation, this study explores the arguments supporting and against these LULC changes, their links with components of human well-being and the drivers of change, and their impacts on ecosystem services supply. More specifically, to understand the factors behind the promotion of LULC changes in the study area, we (1) identified the arguments for and against the promotion of each LULC type, (2) analyzed the social perception of the impacts of LULC on eight ecosystem services provided by the region, and (3) explored the social importance and perceived vulnerability of ecosystem services. Our research contributes to an improved understanding of the relationships between LULC transformation and human well-being and the interaction between LULC changes and ecosystem services. Finally, we discuss how the results support specific targets of existing European policies in terms of the legal framework and strategies to enhance biodiversity (Spanish Law 42/2007 on Natural Heritage and Biodiversity) and rural development (Law 45/2007 on Rural Development), and how they can contribute to promote new sustainable land management strategies.

2. Study area: arid ecosystems of the Iberian Peninsula and the occurring LULC changes

The study area is located predominantly in the Almería province and, to a lesser extent, in the Granada province, covering approximately 1,220.711 ha (Fig. 1). The mean annual temperature in the region varies from 12 to 18 °C, and the annual precipitation is below 350 mm/year in most of this territory (Armas et al., 2011). This region is distinguished by the presence of arid landscapes and diverse land use types.

Over the last 50 years, this arid region has experienced one of the largest LULC changes in the territory, which has been driven by the introduction of intensive greenhouse agricultural practices. Before 1960, this area was described as one of the poorest provinces in Spain (Sánchez-Picón et al., 2011). Historically, the conditions for human occupancy have been unfavorable, marked by scarce rainfall, rough land and frequent strong winds (Wolosin, 2008). The development model was fundamentally limited by water scarcity, and it was dedicated to subsistence agriculture characterized by dry farming with low yields. It was not until 1970 that this socio-economic model changed, led by the development of intensive agriculture, the tourism sector and the construction industry (CAMP, 2013). From 1982 to 2003, this region developed into the major producer of vegetables for Spain and other European Union countries. The region now holds the largest concentration of greenhouses in the world (approx. 26,750 ha) and is known as *El Poniente* (UNEP, 2005) and *The Plastic Sea* of Almería (Aznar-Sánchez et al., 2011) (Fig. 2A and B). The rapid development of this sector was fueled through the use of groundwater (and later desalinized sea water), the introduction of innovative technologies (such as biological control), the high number of sunny hours and the absence of a true thermal winter (CAMP, 2013).

As a result of the promotion of agricultural intensification, the area experienced a population boom coupled with the development of urban areas. On the one hand, the increasing population led to a rise in urban intensification in littoral areas and converted the Almería province into one of Spain's most transformed provinces. On the other hand, this urban intensification, coupled with the lack of employment in rural areas and the low profits from the traditional agriculture, provoked the migration of people from rural areas to urban areas in search for better opportunities.