



Spatial explicit assessment of rural land abandonment in the Mediterranean area

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ABSTRACT

This study adopts the “syndrome approach”, originally defined by the Potsdam Institute for Climate Impact Research (PIK), (Downing et al., 2002) to assess and map rural land abandonment (RLA), that occurred during the period 1990–2005 within the wider Mediterranean area. The basic idea behind the syndrome approach is to describe change processes by archetypical, dynamic, and co-evolutionary patterns of civilization–nature interactions. In the frame of the Rural Exodus Syndrome the RLA can be interpreted as the occurrence of environmental degradation through the abandonment of traditional agricultural practices. Multi-source spatial data, including biophysical-related variables mainly derived from Earth Observation as well as socio-economical GIS-based data, were used to define proxies for expected underlying processes and drivers of the mentioned syndrome. The analysis of data is rooted in the fuzzy set theory and approximate reasoning techniques which allows for the handling of uncertain and imprecise knowledge of environmental systems. Generalized Conjunction/Disjunction operators (GCD) were applied to compute intermediate indicator score maps representing the conditions that may affect the RLA, and a bipolar operator was used to combine mandatory and favouring conditions with the aim of generating a RLA indicator. The indicator expresses the detailed location and severity, or degree, of the syndrome. The Northern Mediterranean was generally found to suffer from RLA to a distinctly higher degree than the Southern Mediterranean. Reported abandonment studies from the existing literature, the European CORINE land cover map, and the Less Favoured Areas (LFA) map all supported the findings by confirming plausibility through convergence of evidence from comparisons with different types of independent information. This spatially highly-detailed results obtained may be of particular interest to policy and decision makers involved in rural development planning in the conceived areas.

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1. Introduction

1.1. Framework: syndrome approach to assess land degradation

In the past, different concepts to assess desertification or land degradation have been developed and discussed and, over time, definitions of desertification and land degradation have changed. Today, several definitions are in use, leading to confusion and sometimes to strong contradictions. The need for a more pragmatic view on desertification and land degradation becomes evident, when discussions regarding desertification are held for the mere purpose of defining the term itself, meanwhile the phenomenon continues to evolve and represents an alarming threat for vulnerable areas of large extent. As a consequence, a completely new concept was developed with the idea not

to define the phenomena explicitly but to describe and characterise them by a typical pattern of notable symptoms, forming a “syndrome” when grouped together. The problem is approached through the developed paradigm of Global Change Syndromes actively pursued by the Potsdam Institute for Climate Impact Research (PIK), providing a conceptual methodology as well as applied examples of global degradation syndromes (Schellnhuber et al., 1997; Cassel-Gintz and Petschel-Held, 2000; Petschel-Held and Lüdeke, 2001; Downing et al., 2002; Lüdeke et al., 2004).

In particular, Downing et al. (2002) suggested the following “syndrome” definition: “The basic idea behind syndromes is not to describe Global Change by regions or sectors, but by archetypical, dynamic, co-evolutionary patterns of civilization–nature interactions, which are called syndromes.” When applying the syndrome concept, observable and perceived characteristics or symptoms of a phenomenon are first captured and assessed as single measurable contributing indicators, and then combined to create an overall indicator as a measure for the occurrence of the syndrome.

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Schellnhuber et al. (1997) and Cassel-Gintz and Petschel-Held (2000) describe the main Global Change Syndromes (e.g. Sahel Syndrome, Overexploitation Syndrome, Rural Exodus Syndrome, etc.) and provide a detailed description of the related observable symptoms. In our approach, symptoms are expressed or approximated using multi-source, spatially explicit real world data both from Earth Observation and from official statistics, which are combined in order to map the spatial extent and the degree of occurrence of a phenomenon. Moreover we adopted a regional perspective, as our area of interest is not global but is restricted to the wider Mediterranean area.

Vogt et al. (2011) identify the lack of integrated monitoring and assessment as a major constraint for combating land degradation and stress the need for better integration of bio-physical and socio-economic aspects of desertification. Reynolds et al. (2011) recommend syndrome analysis as defined by the PIK (e.g. Schellnhuber et al., 1997) to be used to perform integrated assessment models, composed of linked submodels that represent different socio-economic and environmental disciplines.

We follow the above suggestions, applying an integrated assessment model in our approach.

1.2. Rural land abandonment in the Mediterranean

The rural land abandonment (RLA) is conceived in the framework of the Rural Exodus Syndrome which is defined as an environmental degradation through abandonment of agricultural practices (Downing et al., 2002). Within the existing literature, rural land abandonment is also reported with the terms ‘abandonment’, ‘land abandonment’ or ‘farmland abandonment’, the latter two terms clearly focusing on the abandonment of agricultural areas. (Land) abandonment is defined as the total termination of the use and management of soil including a change towards a less intensive pattern in land use: i.e. soils are left to their own spontaneous dynamics (Baudry, 1991).

Rural land abandonment and the associated depopulation are severe threats for agriculture-dominated areas in the Mediterranean region and this phenomenon represents a serious problem of high political interest. The abandonment of farmland is addressed at a political level within the European Union (EU) by the Common Agricultural Policy (CAP) 2003. Environmental indicators are continuously being developed to monitor the integration of environmental concerns into CAP; one indicator currently being developed is called the ‘identification of the risk of farmland abandonment’ (COM2006 (508final)).¹ In addition to CAP, the Council Regulation (Reg. 1698/2005, art. 50, 3)² on Less Favoured Areas (LFA) aims specifically at avoiding the abandonment of the land.

In line with the PIK definition (Downing et al., 2002), RLA is associated with a general impoverishment within the rural areas (with respective consequences for economic power, labour force and infrastructure) and a decrease of rural populations, whilst there is a relative increase in number of the local ageing population. Such abandonment generally leads to an increase in fire risk and typically, on pastures or meadows, more permanent vegetation such as shrubs and trees begin to dominate. Also related to RLA are the reduced attraction for mass tourism, abandonment of agricultural land and traditional methods of cultivation and the exodus of people with higher levels of education. The migration flow is mainly towards bigger cities or more developed regions, such as coastal zones which offer better employment opportunities. The general perception is that

agriculture offers only poor prospects. Additional part-time farm work is frequently carried out by local farmers as they often rely on an outside income. The RLA is characterised by a number of de-populated ghost towns or villages. Recently, an in-migration of cheap farm workers has taken place locally, such as the influx of migrants from foreign countries. In some rural areas, farmland has been conserved and the development of agro-tourism has occurred. Often, this is related to foreign private investors from more affluent, industrialised countries. However, the effect of this counteracting development is not yet large enough to invert the phenomenon.

RLA can occur on both shores of the Mediterranean and its consequences are vast, affecting both nature and society. The underlying causes are complex and diverse, ranging from socio-economic to biophysical causes, so that this analysis at regional scale requires an integrated modelling approach, including remote sensing data, GIS layers and/or statistical data (Reynolds et al., 2011). Recently, both Udelhoven et al. (2008) and Hill et al. (2008) have demonstrated a promising approach to map land degradation by exploiting the syndrome approach, using biophysical remote sensing data only. However, given the complexity of the syndrome itself and of the underlying causes, we believe that a modelling approach should also include a socio-economic component; in fact vegetation trends alone might not be sufficient to capture the concerned areas.

Next to Udelhoven et al. (2008) and Hill et al. (2008) a number of studies exist which focus on land abandonment. Whilst the investigations of the above cited authors cover an extensive area, i.e. the Iberian Peninsula, other authors have worked at a very local level. Bielsa et al. (2005), for example, describe agricultural abandonment in some study sites within the North Eastern Iberian Peninsula only. Sluiter and de Jong (2007) report land abandonment for an area within Mediterranean France. Other studies focus more specifically on land use changes, without any in-depth investigation of the related abandonment phenomenon (e.g. Symeonakis et al., 2007; Van Doorn and Bakker, 2007). Poyatos et al. (2003), however, investigate the consequences of abandonment in terms of land use change for a Mediterranean Mountain area. In addition to the above studies, a number of investigations do not model or map land abandonment at a particular spatial level, but rather work out its reasons on a general or more regional basis (MacDonald et al., 2000; Koulouri and Giourga, 2007).

A study conducted for the European Commission (Pointereau et al., 2008) investigates, in three different countries (Spain, France and Poland), the particular phenomenon of “Farmland abandonment”, which means the abandonment of utilised agricultural areas. Farmland abandonment represents a special form of abandonment; it is highly correlated with the phenomenon RLA but the focus, as the name suggests, is specifically directed towards the abandonment of agricultural areas.

The study differs considerably from the previously reported approaches: for the general definition and identification of RLA it relies on the syndrome approach and it combines two pieces of information having heterogeneous role, a set of contextual conditions constraining the flourishing of the syndrome and a typical pattern of notable symptoms that are proxies of observations of the syndrome occurrence. It considers and integrates a wide range of multi-source data (socio-economic and biophysical factors) which are handled and fused by exploiting fuzzy set theory and soft aggregation techniques in order to cope with both uncertainty and incompleteness of knowledge and data. The area of interest is the largest considered, comprising the whole Mediterranean basin. Finally, the study results in the creation of an aggregated indicator which takes highly detailed values of varying degree.

1.3. Objectives

The objective of this work is the modelling and spatial mapping of the RLA in the time period from 1990 to 2005. The assessment is

¹ Communication from the Commission to the Council and the European Parliament – Development of agri-environmental indicators for monitoring the integration of environmental concerns into the common agricultural policy [SEC(2006) 1136]/* COM/2006/0508 final */.

² Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD).

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