Habitat International 51 (2016) 70–78

Contents lists available at ScienceDirect

Habitat International

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

The future of landscapes and habitats: The regional science contribution to the understanding of geographical space

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ARTICLE INFO

Article history:
Received 11 April 2015
Received in revised form
22 September 2015
Accepted 15 October 2015
Available online 29 October 2015

Keywords:
Habitat fragmentation
Land use change
Regional science
Spatial analysis
Geographic information science
Regional intelligence

ABSTRACT

Recent decades have witnessed unprecedented landscape change. Most of these changes have been brought by human impact on the environment, and excessive exploitation of resources. While economic growth has brought prosperity and better living conditions, much of the human impact has had irreversible consequences on environmental systems and destroyed fragile ecosystems and biodiversity. One of the dimensions that most suffered from excessive pressure, and is albeit all very little assessed, is the regional spatial change in line with historical and archaeological heritage. Monitoring of these transitions is of utmost importance to guide best the directions of regional planning in future. I advance with explaining the crucial role that Geographic Information Systems can play for regional science in line with heritage, and define techniques for sounder interactions of urban areas and regions in line with complex representation of space. I conclude further, that we are witnessing different types of dynamics in the landscape settings, that can be defined as (i) the coherent landscape, (ii) the dominant landscape and (iii) the vertical landscape lagging under a concept defined as spatial memory of rapid changing regions. All together, a new paradigm where geodesign, spatial analysis and geocomputational advances are linked, regional science must consider a new paradigm which I designate as regional intelligence for a more sustainable future.

1. Introduction

Advances in complex spatial modelling when linked to regional science (Nijkamp & Reggiani, 1998) have allowed juxtaposing traditional quantitative thinking to decision making through computational methods. One of the main advantages of has become the possibility to explore possible future ecological challenges on the landscape at a spatial level (Lathrop & Bognar, 1998). The right, as well as the duty, of protecting and maintaining integrity of landscapes is a social responsibility and a commitment to transmit our heritage to future generations by keeping sustainable development (European Council, 2000). In recent years we have perfected the possibilities of mixing quantitative and qualitative analysis, integrating data abundance in triangulation frameworks (Jick, 1979). One of the abridging tools of both these scientific realities have become Geographic Information Systems (GIS), boosted by the availability of spatial information that permits an integration of research in the social sciences which are intrinsically spatially-explicit (Sohl et al., 2012). In this sense, understanding emergent behaviours in a context of spatial sciences has aided the development of fuzzy set theory (Altman, 1994), which incorporated with multiple variables of different origin, allow interpreting the underlying dynamics of anthropogenic behaviour on land use, landscape and ecosystems in what are defined as complex spatial systems (Batty, Crooks, See, & Heppenstall, 2012; Vaz, Cusimano, & Hernandez, 2015). This is further enabled by the already present interest in maintaining diversity at the regional level (Noss, 1983) where diversity depends on a fine balance of interactions of space, land use, human behaviour. The non-linear dimension of changes in the equilibrium of changing landscapes for instance, may benefit greatly from the interaction with Geographic Information Systems (GIS) that by offering a set of distinct spatial techniques permit a better understanding of the dynamics of complex system patterns at regional level (Fischer & Getis, 2009). This may have a direct application to finding elegant solutions for matching quantitative and stochastic models to understanding of regional change (Zander & Kächele, 1999). These regional changes are largely resulting from anthropogenic actions that are taken over time and space, and at the different levels (social, natural and economic) within the anthroposphere, leading to negative consequences on the natural environment and jeopardizing sustainable development (Goudie,

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http://dx.doi.org/10.1016/j.habitatint.2015.10.004
0197-3975/

2006; Vaz, Walczynska, & Nijkamp, 2013). These different levels have a distinct understanding of space, and make it particularly difficult to draw a combined effort to use spatial information from an ontological perspective. This is largely a result brought by human interpretation of space: from a social perspective, space is linked to place, that is, to the subjective description of memory of the region, and the narrative importance of these regions given a set of emotional values. From an economic perspective, space is the territorial definition of proximities to markets, and may much better be understood when adapted as location and efficiency of location for economic growth. From a natural environment perspective, space is the subset of the environment as a whole, without considering the anthroposphere. Spatial modelling as such, becomes at the interface of data availability and a subjective interpretation between the fringe of information and knowledge (Fig. 1). The designation of environmental change comes precisely as a result from social, economic and natural impacts human being has exerted on the environment, taking form in the limits of carrying capacity and the possible outcomes of loss of spatially explicit landscapes and human environments (Roughgarden, 1974).

In detriment of economic growth, land use diversity of non-artificial land is decreasing. This is having a negative impact on the landscape leading to permanent loss of diversified landscapes (Holtorf & Ortman, 2008) and increasing fragmentation of land use. Regional intelligence is thus a product of the interaction of local, global and regional knowledge, allowing the creation of spatial modelling approaches to deal within the framework of better decisions. A clear way to test regional intelligence is by means of assessing human impact on the landscape and on heritage is by measuring the variations of land use change focusing in particular on the registered changes of urban land use. In this sense, urban regions represent drivers of social and economic change, offering a clearer understanding on the impacts on the structure on the

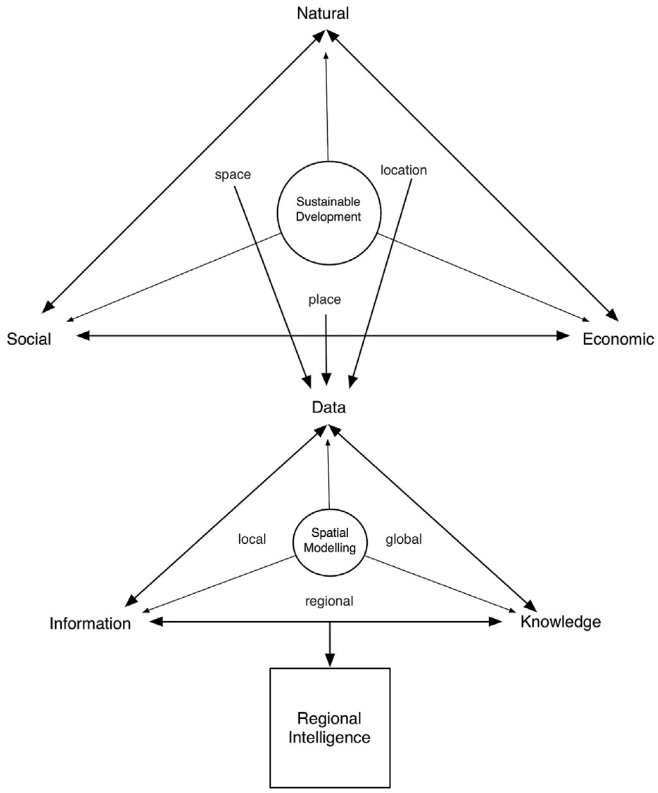

Fig. 1. The spatial dimension of sustainable development.

ecosystem services (Bolund & Hunhammar, 1999) and diversity in urban ecosystems as a whole (Francis, Lorimer, & Raco, 2012). The complexity of these urban regions (Batty, 2007) calls for a holistic perspective where urban regions should be intrinsically diverse and presence of archaeological heritage and historical landscapes catered. The consequences of anthropogenic behaviour over space, in particular population growth (Meyer & Turner, 1992) has led to excessive urban sprawl and severe impacts on land use, leading to irremediable loss of heritage (Vaz, Cabral, Caetano, Nijkamp, & Painho, 2012). Spatial models can thus capitalize on the carrying capacity of heritage, to test whether regional intelligence is present. This is further registered by the fact that population increase and the urban concentration is not only creating additional pressure on the natural environment, but also jeopardizing our historical ancestry, by depleting our own heritage. These landscapes, as pointed out by Antrop (2005), share a unique and irreplaceable value that may be directly experienced, with a higher level of symbolic and cognitive value. Landscapes of the past are as such a vital part of monitoring and sustaining the landscapes of the future. The role of spatial information and geovisualization is thus to foster the role of assessing, quantifying and identifying their risks, pressures and shape at present. Also, the scenic values of these landscapes are important properties for sustainable tourism, permitting a diverse understanding of humankind as well as their origins and traditions. This participatory role of sustainable tourism and heritage preservation, leads to a local and regional territorial identity (Vaz, Nainggolan, Nijkamp, & Painho, 2011), eventually generating a better quality of life and enhancing social responsibility for the environment in general. To evaluate and research these boundaries of spatial, economic, and social values is a fundamental role of applied regional science. Regional science combines the economic aspect of the preservation of the local, and foments the existence of functional urban and rural regions, merging from sociology, economy with regional decision analysis. Recent years have promoted the addition of spatial complexity and complexity science, where landscapes are having a key role as determinants of understanding and dealing with change. A good example is given by Vaz and others (2011): Cairo, one of the biggest megacities in the world, is witnessing an excessive urban growth brought by population growth, and creation of new infrastructures to support tourism, economic growth and population increase.

More than half of the world's population can be found nowadays in urban areas (Nijkamp & Kourtit, 2013). The increasing growth of urban regions is leading to polycentric urban agglomerations forming a new phenomenon of urbanisation throughout the world. These new geographical patterns require new planning solution to deal with the large scale consequences of land use transitions expanding over entire regions. Within the scope of geodesign, where planning of our cities may support smarter urban areas, regional land use change should be measured to avoid strain on the carrying capacity of the environment (Lambin et al., 2001). This is particularly true in urban and suburban regions, where population increase has been witnessed over the last thirty years (Krakover, 1985). Quantifiable and analytical models may support a systemic overview of the transitions of spatial distribution, allowing foresight of changing regions (Verburg, 2002). In this sense, spatial models do not offer only an integrative solution for regional analysis, but a regional spatial framework which may be adopted by legislators and planners, as well as to state and local governmental entities (Vaz & Jokar Arsanjani, 2015) permitting to (i) determine better land use policies and improving transportation and utility demand, (ii) identify future development pressure points and areas, and (iii) implement effective plans for regional development (Anderson et al., 1976). The medium-term effect of these actions may support sustainable development at regional level, with the