Environment and Social Sciences: land-use dynamics studies

Nelson Lourenço[*]
Universidade Nova de Lisboa, Portugal

Maria do Rosário Jorge[**]**; Carlos Russo Machado**[**]**; Luís Rodrigues**[**]
Universidade Atlântica, Portugal

The importance of Global Change research and Land-Use and Land-Cover Change (LUCC) studies reflects concerns about the need to understand the influence of human activities on the biogeochemical foundation of the biosphere as well as their impacts on climate change.

Nowadays, since 1995, it is assumed the importance of LUCC as a substantial agent of change with great significance in climate change, loss of biodiversity, use of natural resources, human health and quality of life.

Therefore we must perceive the influences of land-use and land-cover changes as a significant driving-force for Global Change.

LUCC is an interdisciplinary project designed to improve the understanding and projections of the dynamics of land-use and land-cover change as inputs to and consequences of global environmental change and sustainable development. The scientific framework of this core project of IGBP (International Geosphere-Biosphere Programme), and also sponsored by IHDP (International Human Dimensions Programme on Global Environmental Change) is defined by major strategies reflected in three interlocking research foci (Table 1):

Table 1 - Research Foci of LUCC

Focus 1 **Land Use Dynamics** **Comparative Analysis**	**Focus 2** **Land Cover Changes** **Direct Observations and diagnostic models**	**Focus 3** **Integrated Models** **Regional and Global Models**
Activities	**Activities**	**Activities**
1. Land use decision making 2. Local land use and regional-global levels 3. Sustainability and vulnerability scenarios	1. Hot-spots and critical areas 2. Socialising the pixel 3. Patterns to processes	1. Modelling review 2. Scale issues 3. Urban / Rural and water issues 4. Scenario development

Adapted from: IGBP-IHDP, 1999. Land-use and Land-cover change. Implementation Strategy

[*] Universidade Nova de Lisboa, Av. de Berna, 26, 1050 Lisbon, E-mail: nelson@eunet.mail.pt

[**] Universidade Atlântica, Antiga Fábrica da Pólvora de Barcarena, 2745-615 Barcarena. Phone 351-214 398 227 - Fax. 351-214 302 573, E-mails: rosarioj@uatla.pt; cmachado@uatla.pt; lrodrigues@uatla.pt

These three foci reflect the need to articulate the study of the patterns of land cover changes (Focus 2) with the analysis of land-use dynamics comparing local case studies (Focus 1), and also the need to elaborate regional and global models (Focus 3) for estimating future land-use and land-cover changes.

Each group of Focus activities is trying to answer the same science questions but from a different perspective and at different scales. Each research focus also incorporates activities that create the linkage with other perspectives and other scales of analysis. The importance of this scales issue is related to the need for searching answers at local level integrating the external driving forces in other levels of intervention, i.e. the regional and the global framework that influence the local or the individual level.

Land-use change studies (FOCUS 1)

Land-use change is a key research and policy issue, which provides the theme for significant amounts of cross-disciplinary research in Europe. Despite the existence of a large number of national and Trans-European research programmes aimed at assessing the sustainability of land-use systems, there are few programmes with the explicit task of developing integrated methodologies. Thus, the need to provide a forum for the debate and assessment of research methodologies as a means of developing convergence between disciplines. Given the growing and often conflicting pressures on land use systems, this area of research has been identified as a major point of focus for national and international policies.

Generally speaking, the effects of the change in land use on global change are still little known in much the same way as the factors, which are behind those processes, are not fully understood. There are difficulties in defining methods of intervention in the regions and in obtaining support instruments for decision making which are fundamental to managing, understanding, monitoring and assessing the (environmental and social) changes resulting from modifications in land use.

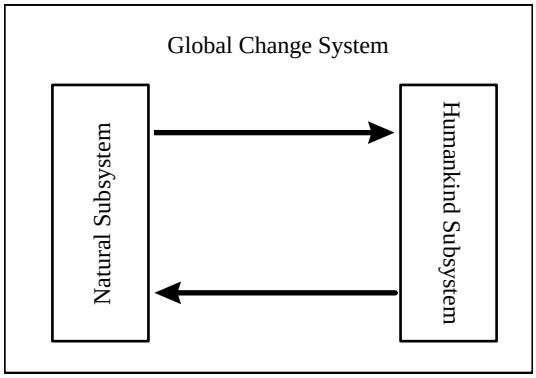
As mentioned by Mesarovic, McGinnis and West (1996), studies on the role which humanity plays in global change are often carried out within the concept of an *analysis of the human dimension*; thus, they loose the systemic perspective which considers society as a sub-system interacting with the natural sub-system within the far-reaching and integrated framework which is the global change system.

The use of this systemic perspective allows the complexity of the interactions defined by the social systems / natural systems to be incorporated in the analysis and obliges the development of a different view on the relationship of these two systems.

This view shows that they interact through a logic of reflexivity, in other words, the social systems are changed at the same time as they modify the natural system, that is to say, the impact of human activity on the environment and the consequences of the latter's deterioration on human activity cannot be considered separately since they are related in real time (these two views are graphically represented in Fig. 1).

Therefore, the land use study involves both the manner in which the biophysical attributes of the land are manipulated and the purpose for which the land is used: forestry, parks, livestock herding, urban areas, suburbia, and farmlands (IGBP Report No. 35: 20). The chosen classes denote intent or purpose of use, so knowing this purpose and intent is a manner to understand the trends of change.

Fig. 1 – The Reflexivity view of Global Change



Adapted from: Mesarovic; McGinnis; West, 1996

The demands for improved knowledge of environmental processes and the impacts of policy on their dynamics must increase, as population pressures on food supplies and natural resources mount and the publicly held perception of preserving environmental diversity and amenity strengthens.

Some of the most profound changes in the landscape have arisen from direct decisions by man concerning land use, and these have affected both the quality of environmental resources, such as soils and water, and the sustainability of food production. Land use decisions are based on opportunities and constraints affected by both biophysical and socio-economic drivers.

Predicting future land use change requires methodologies that integrate understanding of the processes affected by these drivers. Because the dynamics of land use and land cover can have biophysical, social, economic or ecological drivers, we must use a cross-disciplinary approach to analyse the different problems. Nevertheless the work depart from the disciplinary perspective of traditional land use studies it must maintain the specificity of each science.

Aside from a more integrative approaches for human / environmental syntheses, which must put for a better understanding of the biophysical and social driving forces, we need to push further from land cover to land use in a way that we must understand the processes more then the patterns of occupation of a territory.

Another issue is related to the importance of developing coastal – hinterland integrative models to the land use change analysis. These kinds of models are very important to support land use change scenarios and therefore of great usefulness to rapid policy responses that inter-link socio-economic and environmental changes.

The coastal areas

The importance of coastal areas as a study object has emerged in recent times. This rising of importance is due to the increasing complexity of the activities that are present in those regions, that is to say the complexity of the processes of change present in those areas. Moreover different scientific research domains contemplate this complexity. Therefore it is of great importance to fix the limits of what is considered as *Coastal Areas*.

For the physical researchers the coastal areas are related to the influence of the presence of the sea. This conception of coastal areas frames a region, with variations in large of its limits, that includes the coastal plain, the coastal cliff and the coastal plateau. In the immerse area

the limits could also comprehend the continental shelves. Therefore, it is a demarcation very related to the influence (present or past) of the sea in the shaping of these areas.

In the frame of this study the coastal areas are considered as the regions, located near the sea, where he can notice **rapid** and **intense** socio-economic and environmental changes. These kinds of changes are demanding for **fast** and **appropriate** policy responses as well as they act as important driving forces over hinterland regions.

They can be considered as "*Hot Spot*" areas in the sense that they are one of the most dynamic and intricate areas of the planet. This complexity involves significant process of population dynamics, which are expressed in population growth, demographic stress and in rapid and intense migrations (hinterland-coast, rural areas-coastal areas).

Also the importance of these areas involves complex Land Use and Land Cover dynamics. These dynamics are shaped by different factors, where we can see the importance of physical drivers (such as geomorphologic, extreme events and natural hazards) and social drivers (population dynamics, industrialisation, external market forces, cultural and life style patterns and policies regulations) and are reflected by:

- Changes in spatial distribution of forests, agricultural and urban areas;
- Changes in environmental functions;
- Changes in performance and management expressed by intensive/extensive use of land that reflects also the land tenure / ownership structures.

This kind of approach to the coastal areas reflects a distinctive way of understanding these areas. In articulation to the relations studied by physical researchers, which give more importance to the land-ocean interactions, these kinds of studies are emerging related to the coast-hinterland interactions.

So this studies are emerging as a quite new topic of research inside the Land Use and Land Cover Change scientific network. The approach should be the analysis of different case studies that should provide methodological tools to the divers users of the land. Therefore it is very important to develop methodological approaches to the study of land use change in coastal areas.

These methodological approaches must apply to the capacity of the remote sensing and geographical information systems techniques in order to develop and support the research in those areas.

The multiple uses of coastal areas constitute excessive and competing demands on limited resources. There are basically two types of conflicts that can be observed:

a) Those between the natural and socio-economic systems operating, or in other words between natural environment and human activities. For example, it is very important to study the impact of the introduction of new activities, such the tourism, over the environment. The increasing pressure to urbanise the coastal areas could transform, in a first stage, a natural region in a chaotic area. Likewise the increasing construction of new highways in those regions has an impact, locally and regionally, and not only over the natural environment, that is far from totally known. However, in a second stage, the disturbance, or even degradation, of the environmental conditions will be a significant constrain to the development of the introduced socio-economic activities.

b) Those within the socio-economic system it self, in terms of conflicts between the divers users for the limited natural resources available. For example, a new activity such the tourism will have an impact over the population in terms of changing the structure of labour force, introducing elements of conflict or competitiveness between the divers agents of change.

Nowadays, the coastal areas are under a demographic pressure due the population concentration trends verified in these areas. The observation that the demand of coastal resources are limited in supply, and their continued "healthy" existence is crucial to the functioning of coastal areas, suggest three research questions:

- How do societal driving forces impact coastal resources? Which are the key drivers that will generate or foreclose actions in the future?
- What are the policies, economic and environmental, which are supportive of, and which constrain the sustainable development?
- How might changes under alternative scenarios of economic development and urbanisation affect coastal landforms, land use and land cover?

Another important issue is related to the diversity of coastal areas. Besides the geographical diversity (the tropical mangrove and its dynamics and problems are clearly distinct from the problems and dynamics of the coastal or sandy shores of temperate zones) it is important to take in to account the diversity introduced by the human activities. In the same geographical frame, the pressure generated by a major urban centre is quite different from the pressures associated to the tourism settlements. Also the industry has an impact diverse from activities such as agriculture, fisheries or quarrying. The combination of these diversities leads to different types of coastal areas.

The study of land use changes (in coastal or inland areas) thus appears to be an essential contributing factor to the understanding of Global Change. In fact, while the problems that these changes cause are diverse, they have one aspect in common: they can put the sustainable development of a region at risk.

Thus, in developing countries those have high population growth rates, there is a need to increase and intensify agricultural production, in competition with urban and industrial occupation of the territory, causing serious problems in terms of arboreal vegetation and soil degradation (by erosion and pollution).

On the other hand, in industrialised countries (and in Europe, in particular) where there are low population growth rates, the problems resulting from land use change have a diverse nature.

The tendency in the European Union for agricultural areas to decrease, brought about by the Common Agricultural Policy, has been accompanied by the expansion of land use stimulated by urban growth and tourist activities. In certain regions, this type of land occupation has had a very rapid growth, and without thorough territorial planning, has contributed to the degradation of natural resources and the landscape, putting at risk the economic development model itself.

In this sense, it is fundamental measuring, monitoring and managing the land use changes in such a way that the occupation of the territory is balanced and does not create negative impact on the landscape and natural resources.

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