Updates on the project

The project 'Measuring, monitoring, and managing sustainability: the coastal dimension' entered its second phase with the identification of the districts that best represent the drivers that have an impact on the coastal resources of India—Thane for industrial activity, East Godavari for agriculture/aquaculture, and North Goa for tourism.

Specific study sites chosen include 12 villages in Bardez *taluka* in North Goa; Kajuluru and Tallarevu *mandals* in East Godavari; and parts of Thane, Kalyan, and Ulhasnagar *talukas* in Thane District.

All the project partners worked individually as well as together towards the fulfilment of project objectives. The work includes

- visits to the three study sites and data collection and analysis by different teams
- questionnaire formulation and pilot survey for socio-economic analysis
- interviews with aquaculture experts and other stakeholders of aquaculture.

The preparation of village-level database and the socio-economic analysis of secondary data for all three study sites are in progress.

An integrated methodology of biophysical and socio-economic dimensions to understand land-use change processes in coastal areas

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The study of land-use changes (in coastal or non-coastal areas) is an essential contributing factor to the understanding of global change. While the problems caused by these changes are diverse, all of them can put the sustainable development of a region at risk. In developing countries that have high population growth rates, land has competing uses: while it is necessary to increase and intensify agricultural production, the demand for land to meet urban and industrial needs increases, causing serious problems in terms of arboreal vegetation and soil degradation (by erosion and pollution). In industrialized countries (particularly in Europe) that have low population growth rates, the problems resulting from land-use change have a different nature. Under the Common Agricultural Policy adopted by the European Union, agricultural areas tend to decrease, but this is accompanied by the expansion of land-use stimulated by urban growth and tourism activities. In certain regions, such expansion has taken place rapidly and, as it was not preceded by thorough territorial planning, it has contributed to the degradation of natural resources and the landscape itself. It is thus important to measure, monitor, and manage land-use changes in such a way that land-use is balanced and has minimum negative impacts.

The fundamental objective of the study 'Land-use change: a methodological approach to understanding the nature/society interactions in coastal areas'[1] (1999), was the development of an integrated methodology for analysing land-use changes in coastal areas. This methodology focuses on understanding land-use changes and the influence of the various agents of change present in the region, whether of a biophysical (climate, soil, land forms, vegetation), socio-economic, or institutional nature.

Figure 1 illustrates the methodology developed in this study, outlining the theoretical framework of integration of biophysical and socio-economic data at different levels of analysis. It also shows the various phases of operationalization of the research. In the initial phase, the patterns of land-cover changes and the socio-economic dynamics are identified at the regional level, which in the case of this study is the Alentejo coastal band. The integrated study of biophysical and socio-economic data conducted at various levels of

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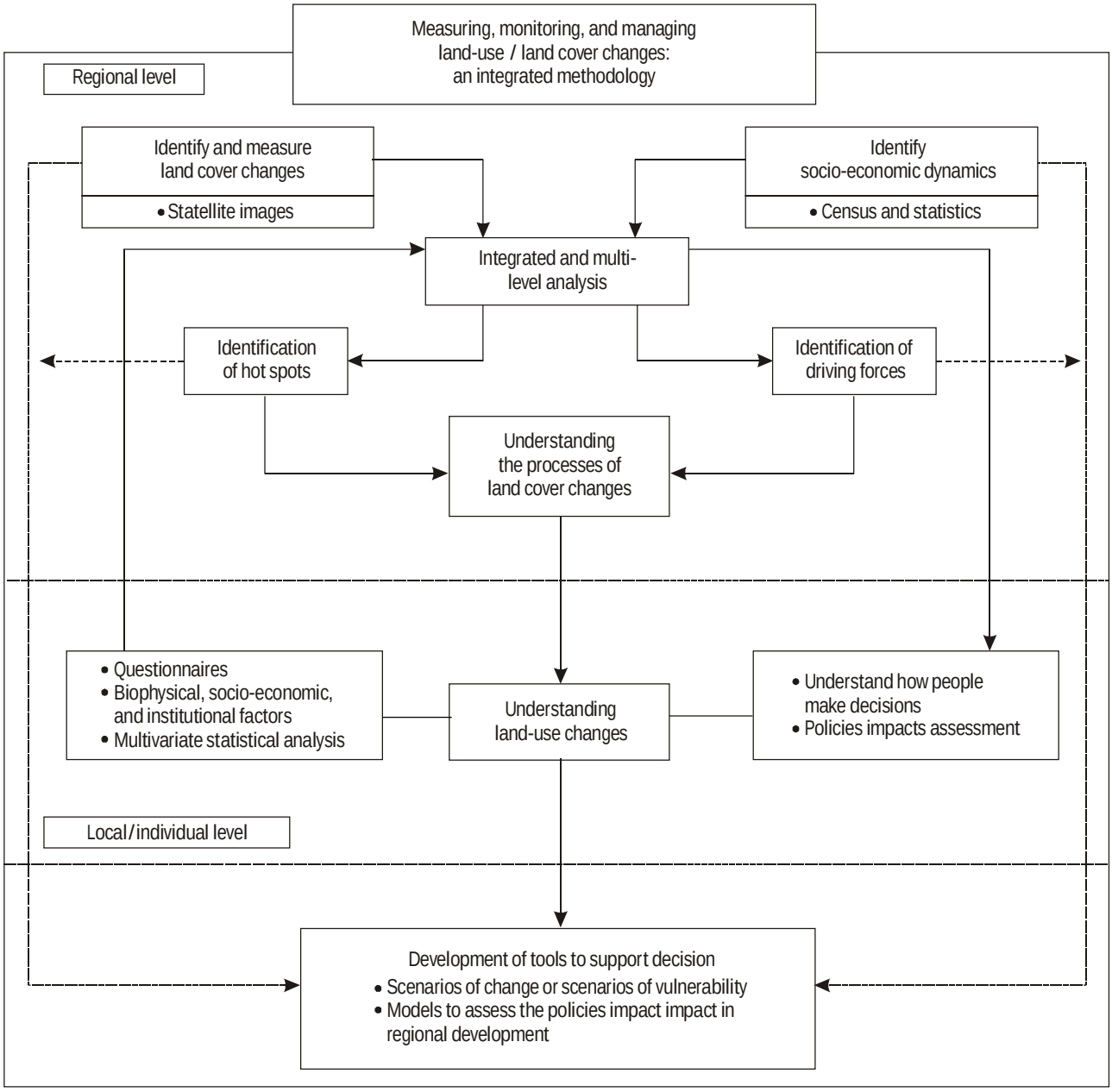

Figure 1 Schematic representation of the integrated methodology

spatial analysis was developed using GIS (geographic information system) tools. In this phase of regional analysis, this type of integrated analysis permitted the identification of the main driving forces and hot spots,[2] thus contributing to the understanding of the processes of land-cover change.

Nevertheless, land-use changes can only be understood in depth through the understanding of the decision-making processes of the various agents of change present in a given territory. Thus, the next level of analysis unfolds at the local or individual level and attempts to find out how people make decisions.

As stated earlier, the relation between land cover and land-use and the socio-economic data is rarely direct. Nevertheless, any methodology of study of land-use changes has to club together such data as it enables a first reading supported by the processes of change at a given regional scale. The social aspect of the GIS, however, is only fully developed with the creation of a local-level analysis, where it may serve as a support for structuring enquiries regarding agents of change, thereby putting forward more detailed and documented explanations of land-use changes.

[2] Hot spots are defined as areas where the greatest land-use changes are observed or where their occurrence is predictable.

It is in the phase of local/individual analysis that we may understand the way in which people adapt their land-use strategies to the biophysical and the institutional frameworks, thus contributing to the measurement of the real impact of national or European planning policies and ordinance.

This methodology is useful to the various agents of change in that it contributes to the construction of tools to support the decision-making process. Thus, in a regional context such as in the EU, where strong pressures that lead to accelerated changes that demand adequate and equally rapid answers are registered, the need for such a tool that supports decision-making processes at the national, regional, local, and even individual level is indeed great.

The usefulness of this methodology lies in the construction of scenarios of change or vulnerability by attempting to identify the critical areas of land-use change (present or future) and understanding and evaluating the vulnerabilities of those areas relative to those changes. In addition, it helps construct models for the evaluation of the impacts of national and supranational policies, thereby contributing to the evaluation of the real effects of these policies on land-use change and on the sustainable development of a region.

On legislation and concepts concerning geographical zoning for groundwater protection

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This paper addresses the (1) legislation on methods of groundwater geographical protection zoning from select EU (European Union) member states and the USA and (2) contribution for the revision of Portuguese legislation on groundwater geographical protection zoning.

Groundwater aquifers represent a strategic resource whose management and protection, from both the quantitative and the qualitative points of view, should be appropriately considered at national and local authorities levels.

The development of a groundwater protection programme in the context of the latest land-use control policies has the objective of avoiding problems concerning groundwater pollution. It makes possible the achievement of two fundamental goals: ensuring the availability of a high-quality water supply source and saving large amounts of financial resources (which can then be used in other areas of public utility), by avoiding the need for groundwater rehabilitation.

In the framework of the EU, most of the member states have specific legislation that establishes protection zones around wells, defining the polluting activities that should be banned in each zone, and whose main objective is the preservation of groundwater quality. However, the application of such legislation is difficult.

In Portugal, recent legislation (DL 84/90, 86/90, and 90/90 of 16 March 1990; DL 45/94 and 46/94 of 22 February 1994; and DL 236/98, monitoring the quality of groundwater resources) has reiterated the importance of defining protection zones as an instrument of groundwater protection. The new Portuguese Legislation of Groundwater Protection, DL 382/99, of September 1999, replaced Norma Portuguesa Definitiva NP836, established in 1971. The NP836 defined two zones, 'near protection zone' and 'far protection zone', with extensions depending on the aquifer type and on its filtration capacity. In this norm, the size of protection zones was defined in a simplified way. Moreover, its application was not complete all over the country. The new legislation considers three protection zones, including a zone related to the concept of 50 days travel time. Ciabatti and Lobo-Ferreira (1994) had previously suggested the use of similar concepts in Portugal.

Groundwater geographical protection zoning criteria used in the EU and in USA

In most of the EU member states, legislation concerning the limitation of hazardous activities endangering groundwater was established in the early 1970s. Legislation concerning groundwater pumping systems protection was also set up.

According to Margat (1992), groundwater protection in the EU member states is provided by two kinds of measures.