Measuring Sustainability: Theory and Experience from the Mediterranean

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Preface

The rhetoric of sustainable development has become a prominent feature of political discourses in recent times, both in the Mediterranean Basin and elsewhere. However, there is much skepticism over actual implementation of sustainable development. Several decision-making tools have been developed to provide a yardstick of the practice of sustainable development. Sustainability indicators are increasingly recognized as an important tool in this regard. The use of indicators to measure the environmental, economic and social facets of sustainable development has fostered an intense debate on what actually constitutes sustainability, and concerning the scales of analysis that we should adopt. Moreover, the use of such indicators highlights the methodological difficulties of measuring quality of life. Quantitative approaches have traditionally been valued for their rigor and amenability to statistical analysis, but several aspects of sustainability are not easily rendered in numerical terms, and hence the development of sustainability indicators often brings together a variety of scientific techniques from both the physical and social sciences.

This book brings together a collection of essays recounting experiences with sustainability indicators in a variety of conceptual and geographical contexts. Sustainability indicators can be applied in various ways for different themes, and as is evident from the readings in this book, practices vary widely. Whilst the views of the individual authors may not necessarily find agreement with all readers, this collection is intended to foster critical thinking of the ways in which sustainability indicators have been developed and applied. Such an exercise enables a judicious evaluation of the success of strategies and techniques to date, and the formulation of guidance for desired future developments.

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Contents

Introduction

Louis F. Cassar

Over the past three decades, the concept of sustainability has become widely known and understood (UNEP, 1972; UN, 1992a; UN, 1992b; World Commission on Environment and Development, 1987). During the years that followed the Second World War, more and more people realized that with so much environmental degradation one cannot envisage a healthy global society, nor can one anticipate a flourishing and well-balanced world economy. Milestone events include the Stockholm Conference on the Human Environment, organized by the United Nations (UN) in 1972, the publication of *Our Common Future* (known also as the Brundtland Report) in 1987 by the World Commission on Environment & Development, the UNCED Earth Summit in Rio de Janeiro in 1992, and the World Summit in Johannesburg in 2002.

It was as early as the 1960s when Rachel Carson, the author of *Silent Spring* (1962), alarmed the westernized world when she wrote about the deterioration of environmental quality and the potential far-reaching consequences, as a result of nature's inter-connectedness. Ten years on, at the UN Conference in Stockholm, it became apparent that issues pertaining to environment and development could not be regarded as separate concerns any longer; moreover, nor could the two remain in conflict. It also became abundantly clear that although economic development couldn't be stopped, attitudes had to change in order to alter the then course of events. The Stockholm Human Environment Conference marked the start of worldwide environmental awareness that boosted the grassroots lobby. Hence, it set the stage for the adoption of suitable strategies to control waste, toxic emissions and environmental degradation (Lang, 1993). Consequently, sustainable development and sustainability became the guiding principles of environmental policy and resource management worldwide (UN, 1992b; UNSEC, 1998), which increase during the nineties.

Concurrently, the Club of Rome initiated a research based on the assumption that resources would not suffice to satisfy increasing needs of an ever-growing population. The resulting publication *Limits to Growth* (Meadows *et al*., 1972) predicted that pressures, as a result of population increase, would bring about various crises during the initial part of the 21st century.

The notion of linking environment and development was further developed by UNEP, in an effort spearheaded by Mustapha Tolba, its Executive Director. After years of trying to define a terminology that would encapsulate the implications of environment and development, UNEP, together with other international conservation-oriented organizations, integrated the two widely divergent themes into an umbrella concept of conservation through the First World Conservation Strategy in March of 1980 (IUCN *et al.,* 1980).

Lester R. Brown, a year later, published *Building a Sustainable Society*, which summarized views suggesting ways of harmonizing the material needs of society, population growth and the rational use of natural resources so as to minimize environmental degradation and pollution (Brown, 1981). In December 1983, the UN General Assembly established the World Commission on Environment and Development. The Brundtland Commission, as it was also known, was to develop a global strategy for harmonizing environmental protection and economic development for the decades that followed. *Our Common Future* was presented in February 1987 and, unlike *Limits to Growth*, it did not suggest that that economic growth should be restrained. On the contrary, it suggested that economic development should continue in countries of the Third World if people were expected to satisfy their basic needs (World Commission on Environment and Development, 1987). The Brundtland Report presented a concept of sustainable development that integrated economic and environmental policies, such that in cases of divergence between the two, ecological interests were given preference (Lang, 1993). It also emphasized that fundamental changes in society were needed before sustainability could be achieved. Subsequently, the challenge of the 1990s was to implement this understanding and ensure a transition to sustainable development and lifestyle. This was the message conveyed during the Earth Summit in Rio in 1992, when world leaders pledged to cooperate for our common future, adopting a global plan of action to confront the world's environmental ills. According to Gro Harlem Brundtland (1993):

"This action plan, called Agenda 21, is an investment in future generations based on the concept of sustainable development and inter-generational equity."

In Johannesburg, ten years later, little progress was registered however. It was noted that the journey from the Rio summit had taken ten years but a lot seemed to have been lost on the way. Moreover, it appeared that protecting environmental assets turned out to be a much tougher ten years later. The Secretary General recognized the need to discuss *(i)* the absence of progress in eradicating destitution; *(ii)* the long-term unsustainability of consumption and production models in many regions of the globe; *(iii)* the inability of institutional mechanisms to effectively integrate the social, economic and environmental dimensions of development; and, *(iv)* the absence of financial resources and effective technology transfer mechanisms (Sachs, 2002).

Linked to this broad call for a sustainable way of managing resources was the need to track progress towards goal attainment. It was the adoption of Agenda 21 that made sustainable development a universally accepted goal. As a result, a Commission on Sustainable Development (CSD) was set up to keep track of progress. This, however, necessitated the need to create a "measuring stick" by which to distinguish relativity and proximity, and which should encompass economic, social, environmental, cultural and institutional realms of human activities which, indeed, have an influence on sustainable development. Such means of measure should also be wide-ranging enough to take into account *(i)* stresses on economies, ecosystems and social aspects; *(ii)* impacts of stresses on the state of these complex systems; and, *(iii)* responses to these stresses (Moldan and Billharz, 1997). Consequently, there were numerous calls for the introduction of Sustainability Indicators (SIs) to attempt measure the state of sustainability, the pressures which influence that state and the responses of policy and decision-makers, planners, environmental managers and others towards a general improvement of the situation (Winograd, 1995). The use of such indicators would have had to be far-reaching, from one wishing to assess sustainability of a household to the policy-maker whose decisions influence long-term development, production and consumption patterns on a large or even nation-wide scale (Moldan and Billharz, 1997).

The increasing awareness about environmental issues, particularly in the last decades, led many to realize how development models relate to resource use (Winograd, 1995). It is acknowledged that the current global situation necessitated urgent change in development models, both in socio-economic terms as in environmental ones, and that this transformation would not come about with conventional solutions (WRI, 1992). Change must transcend the sustainable development rhetoric in order to become a reality, and for this to happen, the evolution of the process needs to be carefully quantified and monitored so as to understand the relationships between problems and to initiate the necessary responses (Winograd, 1995). Environmental indicators have emerged as indispensable tools for defining strategies leading to sustainable development.

Many definitions of sustainability indicators discount the possibility of qualitative indicators and restrict the concept to numerical variables, either explicitly or implicitly (Holling, 1978; OECD, 1993; Adriaanse, 1993; World Bank, 1995), since, it is maintained that an essential function of indicators is to quantify. In principle, however, indicators could be either a qualitative (nominal) variable, a rank (ordinal) variable, or a quantitative variable (Gallopín, 1997). In ecology, the classic qualitative indicator is the "indicator species" (Braun-Blanquet, 1932), whose association with a particular habitat is indicative of the existence of certain environmental conditions. Gallopín (1997) claims that qualitative indicators may be preferable to quantitative ones in at least three different cases, notably: when quantitative data is unavailable, when the attribute is inherently non-quantifiable, and when cost considerations become a determining factor. It is argued that indicators are a compromise and that their design needs to optimize between relevance to the user, scientific validity, and measurability. Hence, in view of the fact that processes differ within different situations, research on SIs cannot aim at universally applicable approaches (Bakkes, 1997).

In a dynamic and complex system like human society, sustainability is fundamentally a question of balance that needs to be maintained over time, and that cannot easily be scaled or measured; this is why most indicators are, indeed, measures of unsustainability (Dahl, 1996). The concept of sustainability is also inherently a value-laden concept since it implies an element of responsibility for present generations in respect of future ones. Different societies will interpret the concept in their own way and according to existing value systems (Dahl, 1997). Thus, there is an element of relationship between beliefs, ethics and values underlying a society and their approach to sustainability. Some cultural groups may not see the relevance in sustainable development because, for example, they adhere to the belief that the world will soon come to an end, while most religious groupings "have a sense of continuity with the past, solidarity with others in the present, and stewardship for the future" (Dahl, 1997).

The lack of a precise and universally accepted definition of the term "sustainable development" has both advantages and disadvantages. One advantage is that it permits a consensus to be reached supporting the morally and economically unsavoury idea that earth, its environment and its resources, should be treated as a business in liquidation (Holmberg *et al.*, 1991). Another advantage is that the very concept does away with the dichotomy between environmental protection and economic growth, while the vagueness of the term enables the incorporation of values such as equity, liberty and justice into the debate.

In general terms, indicators should perform the following functions: **simplify**, **quantify**, **analyze** and **communicate**: they should facilitate understanding by illustrating issues in a less complex manner and should make them quantifiable so that analysis could be conducted without difficulty and communicated to the different levels of society (Adriaanse, 1993). The notion is to make different aspects of environment and development stand out, as a result of which the level of uncertainty in the formulation of strategies is reduced, thus enabling decision-makers to better define their priorities. In addition, the use of SIs should be useful in predicting aspects of non-sustainable development, as well as the limitations and opportunities for applying a development that is indeed sustainable (Winograd, 1993). The selection of relevant indicators may, however, not always prove an easy task. Given the diversity of situations involving environmental management within a region as large and complex as the Mediterranean, and the great variation in available environmental data, it is often difficult to identify the most critical aspects of environment and development. Furthermore, statistical data crucial for monitoring SIs are frequently unavailable in a number of developing countries, and, more often than not, reliable when they are (Talay, 1996). In the case of the socio-economic dimension, the choice of indicators may vary from country to country in view of differences in perception of what constitutes good quality of life across geopolitical zones (Nath and Talay, 1996). This would be less problematic, however, in the case of environment indicators relating specifically to ecological assets. Therefore, the selection of indicators, even after the prioritization of environmental constraints and opportunities, will inevitably contain a certain degree of arbitrariness (Winograd, 1995).

Carpenter (1995), who wrote about the limitations in measuring ecosystem sustainability, argues that biophysical measurements by which to judge the sustainability of management practices and conservation are inadequate, except in cases of significant and obvious degradation. Carpenter claims that this unfortunate state of affairs is largely due to the lack of a basic understanding of ecosystems as well as to the practical difficulties of ecological research. Nobel laureate Robert Solow (1992) suggested:

"Talk without measurement is cheap. If we – the country, the government, the research community – are serious about doing the right thing for the resource endowment and the environment, then the proper measurement of stocks and flows ought to be high on the list of steps towards intelligent and foresighted decisions."

In a way, this statement represents widely held expectations that natural scientists can provide a quantitative basis for sustainability strategies. In terms of economic valuation, good progress has been made in monetizing environmental impacts and bringing non-market valuation of environmental externalities into financial accounts of the costs and benefits of development projects (Dixon *et al.*, 1988). Notwithstanding, Sheng (1995) argues that national economic indicators fail to even measure economic sustainability, which is an integral part of overall sustainability, let alone accurately reflect social and ecological aspects of sustainable development. Most economy-related decisions are based on a comparison of costs and benefits, and these indicators conceal the true costs of economic activities and encourage policies that are superficially contributory to the economy, but in reality destructive to the environment.

"... they lead to unsustainable use of natural resources, which in turn contributes to overall unsustainability in social, economic and ecological terms" (Sheng, 1995).

On the other hand, "ecology" is unlikely to develop a simplified single indicator of sustainability, such as an ecological equivalent of GNP, although various attempts have been made with this in mind. Analogies with the state of the human body were made over the years and terms such as "vital signs", "health check" and "ecosystem health" have been used in an attempt to measure the state of an ecosystem. The term *ecosystem health* was used by various (Schaeffer, 1988; Costanza, 1991), much in the same way of assessing human health, recommending the use of some datum which would describe the health of a given environment. However, this technique remained both qualitative and somewhat vague (Carpenter, 1995).

Sustainable development is both temporal, as implied by the term "development", and spatial since development takes place within a physical location and can be represented by x, y (and z) coordinates (Langaas, 1997). In this respect, *geographic information systems* (GIS) have an important role to play. Very often, the spatial dimension of sustainability has often been neglected by those working on environmental or sustainability indicators. Langaas (1997) attributes this to the often limited capability and skill to deal with geo-referenced data by those working on indicators, and to the fact that spatial heterogeneity for many indicators was considered irrelevant compared to the temporal dimension. A case in point is the fact that in the proposed indicators of sustainable development (ISDs) proposed by the UN Commission on Sustainable Development, the spatial domain of social, economic and institutional indicators has not been given adequate importance. With respect to environmental indicators, on the other hand, due attention has been paid to the spatial element, where the focus has been largely on the "state" indicators.

In recent years, as information technology (IT) became increasingly more central to decision-making processes, various spatial management tools became more accessible and, as a result, more widely used. Consequently, GIS became an increasingly valuable management and decision-making tool. As time progressed, it has become more integrated with other types of information systems and tools, such as Database Management Systems (DBMS), traditional spreadsheet packages and Internet and World Wide Web components (Langaas, 1996). Several benefits have been identified for the use of GIS in indicator work, notably in:

(i) **Sampling** – obtainng a spatially representative sample of an indicator for deduction of an average value for an overall area under study. GIS, in this case, can be useful in making spatially unbiased averages from geographically distributed sample measurements.
(ii) **Analysis** – a key feature in GIS is the range of tools offered for spatial analysis.
(iii) **Database management** – GIS, in connection with spreadsheet raw data and statistical data, can be a powerful tool for decision-taking.
(iv) **Visualization** – the production of cartographic images as a key feature of GIS can be useful in producing spatial indicator and reference maps, e.g. of different timelines for comparative purposes.
(v) **GIS-WWW Interlink** – the possibilities for interactive analysis are many and the potential use of GIS in sustainability indicator work should not be seen in technological isolation. These can be demonstrated by Internet users of on-line sustainability indicators databases that are managed by GIS software linked to Web servers, allowing users to define and visualize spatial indicators to better suit specific needs (adapted from Langaas, 1997).

In an effort to respond to European citizens' growing concern for the quality of their environment, the EU published, in 1999, the first edition of *Towards environmental pressure indicators for the EU*. This contained 60 indicators that presented an overview of pressures by human activities on the environment in ten policy fields (EU, 1999). This work represents on-going work and covers areas such as biodiversity and dispersion of toxic substances, along with air pollution and climate change. Furthermore, it provided an important contribution to the development of indicators for measuring effectiveness of the integration of environmental concerns into different sector policies. For example, the indicators that cater for terrestrial biodiversity total six in number, and although the number appears small, of the ten policy fields, loss of biodiversity is probably the most controversial and presents considerable complexity. The European continent only covers 7% of the earth's land surface but comprises substantial biodiversity due to natural fragmentation and scattered biotic distribution caused by rivers, mountains, seas, as well as the influence of glaciation (over time), among other factors. On the other hand, pressures on European biological diversity (particularly those responsible for habitat loss and fragmentation) are many and these largely stem from agricultural practice, an ever-growing urban footprint, forestry and transport. The selected pressure indicators include:

LB-1: Protected area loss, damage and fragmentation;
LB-2: Wetland loss through drainage;
LB-3: Agriculture intensity: area used for intensive arable agriculture;
LB-4: Fragmentation of forests & landscapes by roads/intersections;
LB-5: Clearance of natural & semi-natural forested areas;
LB-6: Change in traditional land-use practice.

In addition to these, a suite of other indicators was adopted through various programmes and agencies. Most indicators that were proposed essentially reflected early work and parallel initiatives. Foremost among those promoting the use of indicators were the Organization for Economic Cooperation and Development (OECD), the European Union with its list of indicators for Sustainable Development, the UN Convention on Biological Diversity, the UN Commission on Sustainable Development and UNEP's Mediterranean Commission on Sustainable Development (MCSD).

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1 The Need for Specific Indicators for Mediterranean Coastal Landscapes

Marko Prem

Abstract

The chapter first introduces the UNEP Mediterranean Action Plan (MAP), in order to familiarize readers with its legal and institutional structure, and with its main activities. An overview of the main landscape types and the richness of the Mediterranean region are followed by a description of the main pressures and trends as the driving forces. These include processes in coastal urbanization, tourism and agriculture, all responsible for landscape changes, which too often are detrimental. The main sustainability concepts and approaches involved in landscape management that deals with opportunities and limits are introduced in the second part, including landscape planning as a concept for an integrated planning procedure. The need for indicators and, in particular, for indicators related to landscape, is discussed in the third part. Differences between indicators and sustainability indices to evaluate whether changes are in line with sustainable development principles are outlined. In conclusion, thoughts on the use of sustainability indices based on landscape units or administrative boundaries are presented.

Diversity of Coastal Landscapes

The diversity of Mediterranean landscapes contributes to local and regional identity, reflecting the past and present relationship between man and his natural and built environment. Very rich cultural landscapes have evolved over many millennia, as different human populations, cultures and religions flourished around the Mediterranean, and developed particular coastal landscapes as a result of several land transformations related with the production of food, the construction of settlements and fortifications, etc. Nowadays, however, there are increasing threats to cultural identity, heritage and landscape diversity of the region due to external (e.g. globalization) and internal (e.g. rapid urbanization of coastal areas with consequent impacts on traditional socio-economic structures) factors. As a result, natural and cultural (man-made) landscapes have deteriorated significantly in several coastal places.

According to a recent study[1], cultural landscapes of Mediterranean coastal areas which are related primarily to agriculture were categorized into the following groups:

- landscapes of crop fields;
- cultivated sinkholes;
- grassland landscapes; gully landscapes; and
- terraced landscapes.

[1] Mediterranean Landscapes: A contribution to a better management; prepared in 2005 by Prof. D. Ogrin, University of Ljubljana. See Publications at www.pap-thecoastcentre.org

Forests, in addition to the above, play a very important visual, biological and climatic role in the Mediterranean landscape.

Figure 1.1: Mediterranean agricultural landscapes (Credit: M. Prem)

Figure 1.2: Mediterranean mountain landscape (Credit: M. Prem)

Pressures and Trends

Coastal areas, throughout the Mediterranean, face severe pressures and problems, which threaten coastal resources and undermine the viability of economic activities. The significance of coastal areas is widely recognized, as well as the need to act in the immediate future since pressures are becoming more and more intense, generating negative transformations of the landscapes. These include population growth in the southern and eastern shores, changing agricultural production systems towards more intensive and resource demanding uses in the north (but also lately in the south), industrial development and expanding transport infrastructure, and expanding tourism, leading to increasing concentration of population and economic activities in coastal areas. As a consequence, landscapes in coastal areas experience rapid transformations due to:

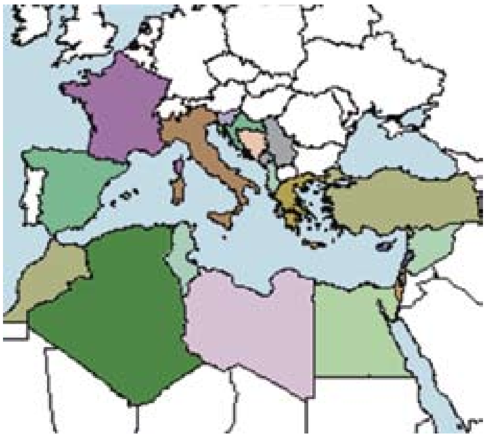
- **Coastal urbanization** mainly as a result of population concentration, uncontrolled tourism development and the proliferation of recreational activities (secondary houses). This is evident in most of the countries of the southern Mediterranean but also in countries of the northern shores. The uncontrolled and rapid land development, coupled with land speculation has detrimental effects on the coastal environment and landscape. Coastal urbanizations, has in recent decades entered a phase of rapid expansion, reaching a state of “hyper-development”, typified by high population densities, environmental degradation and decline of the quality of life, with activities concentrated in a few large urban centres and in coastal areas. The population is increasingly occupying coastal areas, exacerbating “littoralization” phenomena, which further attract population and economic activities. Coastal urbanization thus represents the bulk of consequences related to landscape, as vast coastal spaces (e.g. farmland, natural habitats) are inevitably reduced or there is increased spatial imbalance in development between strong coastal areas and the abandonment of weaker inland areas. In addition, the quality and the amount of open spaces within urban areas are too often poor and inadequate. Estimates for the southern and eastern countries of the Mediterranean indicate that 100 million additional people will live in these countries by 2025, of which, 31 million will live in coastal areas; 75% of the Mediterranean population, i.e. 380 million people, will live in urban areas by 2025. In 2000, the equivalent figure was 274 million (Plan Bleu, 2005).

- The development of **tourist activities** in most Mediterranean countries is a key element in coastal urbanization (both in new developments or in sites of “reconversion”), setting off processes of local economic growth and inflicting a heavy burden on local authorities who are faced with difficult choices of management (e.g. provision of facilities, services, municipal sewage and waste treatment, imbalance between seasons, etc.). Mass tourism, therefore, exacerbates many of the problems existing in urban areas, leading to diminished biological diversity and landscape values in coastal areas. The most attractive sites, and those with high landscape values, come under the strongest pressures. The tourist industry in the region represents 33% of international tourism. By the year 2025, about 637 million tourists are expected to visit the Mediterranean per annum, i.e. 273 million tourists more than in 2000 (Plan Bleu, 2005).
- Two main processes are evident in **agriculture**. On one hand, there is the modernization of agricultural areas through the introduction of new farming technologies and practices, resulting in the loss of existing cultural landscapes, but also in the introduction of new landscape patterns. By intensifying agricultural production, biological and landscape diversity is reduced tremendously (species, habitats), especially where wetlands are dried out. Wetlands have decreased from 3 million hectares in the Roman era to 200,000 hectares by 1994, representing a reduction of 93%. Additional impacts include losses of dunes, changes of water regimes etc. On the other hand, agricultural areas are also being set aside and trends towards renaturalization of cultural landscapes are under way due to abandonment of farming. In this case, many traditional landscape types are lost such as terraces, traditional soil retention structures and field boundaries.
- In addition, **soil erosion** and **desertification** present a persistently serious threat, particularly in agricultural areas and affecting landscapes extensively. The prevalence of such processes is often a result of bad agricultural practices. Climate change may also be a contributing factor.
- With respect to **forests**, forest fires are a serious phenomenon in Mediterranean coastal areas, reducing land cover and changing the overall landscape characteristics of certain areas. Often areas are close to urban and tourist districts, and their functions are therefore also affected. Reforestation that takes place after fires is not always successful from the landscape point of view as new tree species are introduced. Artificial landscape patterns may also be created (linear and inorganic forms).

Most of the above issues are interrelated, providing for a rather complex grid of relationships. However, coastal urbanization may be identified as a rather critical process, responsible to a great extent for the deterioration of coastal landscapes, both in terrestrial and marine parts of coastal areas. However, the exploitation of natural resources in open areas (mineral extraction, agriculture, recreation, etc.) can also create significant landscape changes.

Commitments of Mediterranean Countries

The Barcelona Convention[2] states that "*Contracting Parties shall commit themselves to promote the integrated management of coastal zones, taking into account the protection of areas of ecological and landscape interest and the rational use of natural resources*". Other implementation documents also have landscape management as an objective, such as Mediterranean Action Plan (MAP) Phase II Action Plan and Priority Fields of Activities (1995), where countries commit themselves "*to promote nature, and protect and enhance sites and landscapes of ecological or cultural values*".



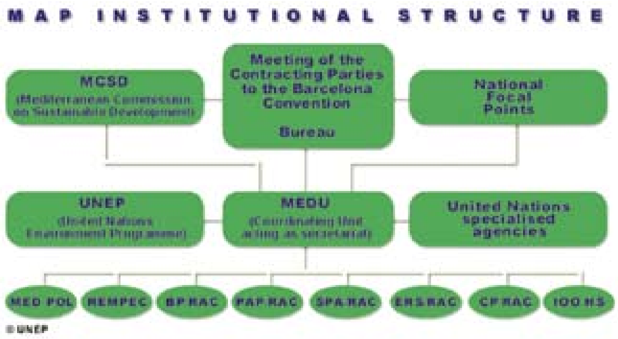


Figure 1.3: Contracting parties to the Barcelona Convention (left) and the institutional structure of MAP (right)

A plethora of other international organizations (in addition to national initiatives) have issued legal instruments having some bearing upon landscape, either directly or indirectly, such as UNESCO, the Council of Europe and the EU. The European Landscape Convention (Council of Europe, adopted in 2000) is the latest instrument devoted entirely to landscape, which has recently come into force.

In spite of the above-mentioned commitments, coastal landscapes of the Mediterranean have never been studied or elaborated in MAP projects *per se*. Landscape was taken into account only indirectly, through proposals of various documents (plans, strategies, programmes), in projects oriented to a local level, such as Coastal Area Management Programmes[3] (CAMP), by using Integrated Coastal Area Management[4] (ICAM) methodologies or by dealing with individual natural resources. However, existing landscape-specific methodologies and concepts (such as landscape planning, valuation, assessment, or vulnerability studies, and landscape characterization) have not been introduced or taken into account. Also, knowledge of the landscape typology (i.e. of the variety of landscapes) and awareness of landscape values is not adequate, nor is the understanding of the main processes and forces influencing their transformation.

On a positive note, Mediterranean populations are more and more aware of the importance of their landscapes for their quality of life and for the identity of their countries. They have

[2] Mediterranean Action Plan (MAP; http://www.unepmap.org) is the first Regional Seas Programme of UNEP, established in 1975. It brings together 21 coastal countries and the EU, all the Contracting Parties to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean, known as the Barcelona Convention, adopted in 1976 and revised in 1995.
[3] Coastal Area Management Programme (CAMP) is one of the main MAP programmes co-ordinated by PAP/RAC. It is oriented at the implementation of practical coastal management projects in selected Mediterranean coastal areas, applying Integrated Coastal Areas Management (ICAM) as a major tool.
[4] ICAM is a continuous, proactive and adaptive process of resource management for sustainable development in coastal areas. Two most frequently used acronyms are ICZM – Integrated Coastal Zone Management, and ICM – Integrated Coastal Management.

come to realize that the quality and diversity of many landscapes is deteriorating as a result of a wide variety of factors described above, and that this is having adverse environmental, social and economic effects on these societies. The quality of landscapes has an important bearing on the success of economic and social initiatives, whether public or private. Public authorities should, therefore, be encouraged to adopt policies and measures at local, regional, national and international levels for protecting, managing and planning landscapes. These measures and policies should be adaptable to particular types of landscape which, depending on their specific characteristics, would require various approaches at local level, ranging from conservation via protection to management and planning. These various treatments allow socio-economic development of the areas concerned.

The main objective of landscape management should be to establish principles, which would guide landscape transformations to a particular state, valued for its cultural significance and social values. In sum, cultural and natural values linked to landscapes are part of the common Mediterranean heritage, and Mediterranean countries therefore have a duty to implement collective actions for the protection, management and safeguarding of these values.

Landscape Management as a Response

In order to bridge the gap identified, i.e. lack of a more active role of MAP in the field of landscape management, the Contracting Parties to the Barcelona Convention, at their Ordinary Meeting in Catania in 2003, adopted the recommendation *"to undertake thematic studies with a view to developing relevant guidelines and action plans on the issue of coastal land and sea environment and the utilization of its resources"*, i.e. landscape management. The activity related to landscape management in the Mediterranean is co-ordinated by PAP/RAC in the framework of ICAM.

As a first step to meet the above request, an expert meeting was organized to formulate priorities and discuss the most appropriate methodologies and approaches to be applied. Prior to this meeting two position papers[5] were commissioned as background documents in order to propose activities related to landscape management in Mediterranean coastal areas, i.e. to prepare a sort of a policy paper to guide PAP/RAC in dealing with this topic, and to identify current landscape management practices in the Mediterranean, as well as the main landscape types, in order to get an overview of the situation of Mediterranean coastal landscapes.

Amongst the plethora of activities that could take place in this framework, the following ones were proposed:

- To develop and promote landscape planning methodologies and tools (landscape analysis, valuation, vulnerability, integration of landscape analysis into SEA and EIA);
- To prepare an inventory, a survey of landscapes at Mediterranean and national levels, to include identification, classification and evaluation of landscapes (landscape characterization/typology, map of endangered landscapes, map of outstanding landscapes) important for the preservation of Mediterranean identity;
- To make an effort for integrating landscape planning into planning documents at all levels (national, sub-national and local), particularly in the urban development, agriculture, water management and tourism sectors;
- To elaborate national strategies for landscape management in coastal areas;
- To cooperate with nature conservation initiatives, such as "Natura 2000" of the EU;

[5] Mediterranean Landscapes: A contribution to a better management; by Prof. D. Ogrin, 2005 University of Ljubljana, Slovenia, and Mediterranean Coastal Landscapes; Management Practices, Typology and Sustainability; by Mr. I. N. Vogiatzakis, G. H. Griffiths, L. F. Cassar and S. Morse, 2005, University of Reading, UK. Both available at www.pap-thecoastcentre.org, see Publications.

- To organize awareness campaigns, promotion actions, training courses and seminars on landscape perception, methods and management;
- To develop educational packages to improve knowledge about landscape values and publish materials in the form of brochures, atlases and posters;
- To organize workshops to demonstrate landscape management methods and to promote good practice;
- To implement pilot projects to demonstrate, in practice, the above items, with a view to preparing guidelines and good practice guides;
- To network with landscape practitioners in exchanging experiences and enhance contacts with related organizations (such as UNESCO and the Council of Europe).

Landscape Planning: An Opportunity for Integrated Approaches

Decisions about land use are usually made through instruments of spatial planning such as spatial policies, strategies or plans at various levels, namely, national, regional and local. All these decisions are needed in order to initiate any development, most commonly through the planning or building permit. Without such permits, no further legal action can be taken. This therefore represents the most crucial phase in any land development process, and this also applies to discussions about conservation, as this also constitutes land-use. The importance of these procedures is indicated by the fact that they always, implicitly or explicitly, include outcomes that carry a certain impact on the landscape.

Conflicting situations, inherent in any planning process, arise from confrontations between planned activities and the existing environment. They can be reconciled only in an interactive planning process, through dialogue between development and conservation interests. The traditional conservation approaches based on principles of reservation lack flexibility and are not able to generate alternatives. It is important to emphasize several features of such a planning method. The first is its integrated character, meaning that all relevant planning proposals are dealt with in one single procedure incorporating both development and conservation interests. Secondly, data for decision-making are acquired objectively, in an analytical way and are thus not a product of individual opinions. Furthermore, criteria used in analysis and evaluation are clear and, as a rule, tested through public inquires. No less important is transparency. All motivations, choices of data, decision criteria and any other aspects used as a basis for decision-making, are available in documents accessible to the public. This method also allows a return to any earlier stage of the process, if corrections turn out to be necessary. Most importantly, a number of alternatives are outlined, providing the public with a correct insight into the scope and nature of the anticipated development and its environmental impacts. Thus, thoroughly enlightened, the public has a more reliable basis for participation in the decision-making.

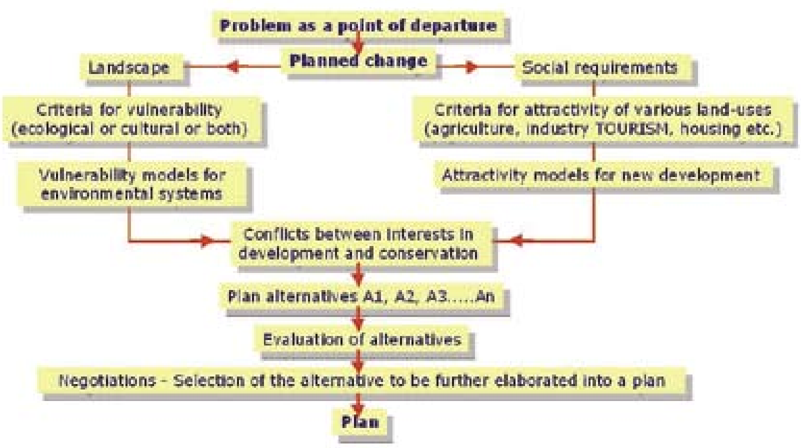


Figure 1.4: The planning scheme

The planning scheme shown in the diagram above exemplifies a landscape approach within general planning, although it can also be successfully applied in sectorial planning, such as coastal zone planning, reconstruction of rural areas, agricultural modernization, residential planning, etc. The scheme is about a dialectical concept, where two opposite entities are confronted in a search for knowledge that would help optimize the contradictory nature of development and protection. In this process, landscape is an excellent tool because it incorporates all important environmental systems, natural as well as cultural. An outcome of this working process is clear information about the *pro et contra* of the studied development idea. Although much information is required, especially for the processing of data, this is nowadays facilitated by computer technology.

Case Studies of Projects for Quality Landscapes

Currently PAP/RAC implements a number of thematic projects, selected as representative and complex examples, which allow problem solving through the use of methodologies and approaches relevant to landscape management, including involvement of the public in a participatory process. The complexity of the area, as an important criterion, refers to a representation of the main development problems and pressures typical of the Mediterranean, such as tourism, urban sprawl, infrastructure, forestry, agriculture etc. These projects therefore cover different situations and are pro-active, i.e. focused on problem-solving rather than merely on description and data-collection. These cases will be of use for the exchange of experience with other countries, and are to be used for the preparation of guidelines for landscape management at a later stage of this activity.

The three thematic projects are the following:

1) Characterization of landscapes of Tunisian coastal areas;
2) Revitalization of agricultural landscapes on the island of Korcula in Croatia; and
3) Vulnerability assessment for Levante de Almeria in Spain.

Specific Indicators for Coastal Landscapes

There is a need for specific indicators to monitor changes in the landscape, specifically whether changes are sustainable. These indicators, or sustainability indices, should capture and show trends related to the environment in its most general understanding, i.e. both physical aspects as well as the socio-economic context, including cultural concerns. This is not an easy exercise.

Currently, there already exist many lists of indicators established by the international community, and countries are obliged to report on the state of the environment on their basis. Indicator lists include those issued by the OECD, EU and World Bank, as well as the Mediterranean indicators. The latter were developed in the framework of the Barcelona Convention by the Blue Plan and include approximately 130 indicators. Not all of these are directly linked to coastal landscapes, but many of them are very relevant. It should be emphasized that landscape is not just the visual appearance of the territory but integrates environmental and socio-economic aspects as well. The concept of landscape brings together all spatial elements, such as natural areas, watercourses, forests, agricultural areas, settlements, and the way in which man uses those resources. There is a strong historical element and "layers" of human activities over time, and what we observe today is a result of the past and current uses of land resources. It is the socio-economic situation which determines the relationship between man and landscape. How can we judge whether this relationship is sustainable or leading to landscape degradation? Can indicators and sustainability indices respond to such questions?

Figure 1.5: Sustainable coastal landscape: Sv. Nedilja, Hvar, Croatia (Credit: M. Prem)

The scope of an individual indicator and of composite indicators is rather limited. First of all, each landscape unit, however defined, is unique in all its aspects, either environmental or socio-economic or both. Natural processes and ecosystems that frame the context change from place to place. Societal behavior is a reflection of these circumstances on the one hand, and a reflection of economic, political and cultural characteristics on the other. The relationship of society towards landscape is changing and consequently, attitudes towards the objectives of sustainable development are also changing. What sustainability means for one society is not necessarily valid for another, as sustainability reflects socio-economic and political situations, developmental levels and other circumstances specific to particular societies. For example, how could we judge the location of a hotel close to the beach as not sustainable, if all other alternatives would have had even worse effects on the environment? This is especially the case if the society in question followed democratic procedures in order to come to decisions such as participatory processes, involvement of all stakeholders, transparent methodologies, assessment of alternative sites, etc. It is complicated, when the issue is landscape, where some "unusual" criteria can play a very important role in defining the quality of the landscape, such as spatial order, territorial integrity, diversity, harmony, symbolic meaning, ratio between natural and cultural elements of the landscape and so on. How could we capture this in a sustainable index?

A general and homogeneous list of indicators is useful for a specific landscape unit; however, in order to make comparisons at a more global scale, much more information is needed on a specific landscape. An additional argument can be made to show that figures collected at various levels, mainly related to administrative borders such as countries, regions or local communities, can not satisfactorily respond to the question of whether a certain landscape unit is in line with sustainability objectives. Landscapes and ecosystems have their own geographical coverage that is not related to administrative ones. Further endeavors would therefore be necessary to capture all important details. Financial implications and resources needed to perform such exercises in the long run are substantial. However, it will only be through the development of such sustainability indices for landscape units, irrespective of administrative boundaries, that we can capture a better picture of the situation.

In conclusion, we can agree that specific indicators for coastal landscapes are undoubtedly needed. However, the use of existing indicators without taking into account the relationship with other individual indicators is not enough. Even when sustainability indices are calculated, they should be used with caution. If there is the need to come to better conclusions as regards landscape, then sustainability indices need to be based on coherent landscape units rather than on administrative boundaries.

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2 Linking Landscape Character Assessment with Sustainability Indicators for Mediterranean Coasts

Ioannis N. Vogiatzakis, Geoffrey H. Griffiths and Stephen Morse

Abstract

Landscape approaches have been adopted by international and national organizations to summarize pressures and threats and develop policies for sustainability.The chapter illustrates the potential of Landscape Character Assessment for the derivation of sustainability indicators in the Mediterranean area. It presents the overall approach, including a description of the available data sets and techniques to develop a typology of Mediterranean coastal landscapes. In addition, the proposed methodology is evaluated for providing the spatial context within which sustainability indicators (SIs) can be derived.

Introduction

The transformation of the Mediterranean environment into the varied landscapes of today, has been long and complex, involving both natural and human processes of change (Ogrin, 2005) After the Second World War, this transformation was not only driven by agriculture, fire and grazing but also by imperatives (national and/or global) that bear little relation to local and regional contexts, in which settlements and agriculture have developed over millennia. Further anthropogenic pressures have been described by Naveh and Lieberman (1984) as the cause of "neo-technological landscape degradation". The forces of population growth and industrialization have stimulated considerable land-use change, especially agriculture intensification, with associated impacts including soil erosion, eutrophication and various industrial developments. These processes now threaten the integrity and diversity of the Mediterranean, with a trend towards simplification of formerly diverse, fine-grained landscapes and a more homogeneous environment.

Despite the explicit reference of the Barcelona Convention to landscape management, the coastal landscapes of the Mediterranean have never been the subject of intensive and directed study under the aegis of UNEP (UNEP/MAP, 2005). Landscape was taken into account only indirectly within local level projects such as the Coastal Area Management Programme (CAMP) using the Integrated Coastal Area Management (ICAM) procedures or by dealing with discreet natural resources. Therefore, existing landscape-specific methodologies and concepts have not been introduced in the ICAM system. The idea for landscape conservation was initiated by the IUCN (IUCN, 1994). In Europe, over the last 10 years, landscapes have received increasing attention from policy-makers (Council of Europe, 1996; 2000) and researchers both at the national and international level (Makhzoumi and Pungetti, 1999). This reflects a new paradigm shift in natural resources management that recognizes the importance of landscape functions and values. The landscape is the fabric that integrates settlement, agriculture and ecology and offers a spatial unit for sustainable land management through the integration of sectoral activities (Naveh, 1995). During the 20th century, growing concern about the impact of change on the landscape led to an increased interest in the inventory of land-cover and land-use as well as mapping and understanding landscape structure and function. There is growing realization that a new holistic approach is necessary for the protection and management of all landscapes, rather than focusing on the most valuable or beautiful.

The physiognomy of the coastal landscape is created by geological, geomorphological and biological factors greatly modified by human activity over millennia. Many different kinds of classification have been applied to coasts in an attempt to characterize dominant features in terms of physical or biological properties, modes of evolution, or geographic occurrence (Fairbridge, 2004; Finkl, 2004; EUCC, 1998; LOICZ, 1998). The increased availability of spatial data in digital format, and the advances in geographical information science and other disciplines, have provided the opportunity for a more comprehensive study of the coastal environment in an integrated and systematic manner.

Landscape character is defined as a distinct, recognizable and consistent pattern of elements in the landscape. Landscape Character Assessment (LCA) is a set of techniques and procedures to map differences between landscapes, based on their historical evolution and physical characteristics (Griffiths *et al.*, 2004). Despite the wide use of Landscape Character Assessment (LCA) as a tool for landscape planning and management in NW Europe, there are few examples of its application in the Mediterranean as part of either a national mapping strategy or ICAM plans.

A powerful tool for measuring and monitoring sustainability and environmental quality is the use of indicators. Indicators are *"quantitative/qualitative statements or measured/observed parameters employed to describe existing situations and measure changes or trends over time"* (UNESCO, 2006). They are employed to quantify, simplify and further communicate complex phenomena, usually to policy-makers and the wider public. Increased interest in the development of indicators worldwide has led to a number of generalized indicator sets (OECD, 1993; EEA, 2005; Esty *et al.*, 2005) and also indicators for specific applications (EEA, 2005; Wascher, 2000; UNESCO, 2006). These indicators can be also adapted/modified according to scale from local, regional to national (Cedrero *et al.*, 2003). For example, within the broad area of sustainable development, various efforts have been made to develop Sustainability Indicators (SIs). However, there has been little consensus as to what the indicators should be, as well as to how they are to be derived and applied. Indeed, indicators are only one way of doing a sustainability assessment. The result has been a plethora of approaches ranging from participatory ("bottom-up") to expert-driven ("top-down"), quantitative to qualitative and implicit (subjective) to explicit (based on rigorous and replicable measurement) and a plethora of "indicator matrices" championed by global agencies, government, interest groups and others. While there have been initiatives to introduce some global and regional commonality in approach these have often been criticized for being too prescriptive and inflexible.

One of the problems with putting sustainability into practice using tools such as indicators is related to the meaning of "space", in which sustainability is being "done". In theory, this should be the largest scale of interaction where the need to meet needs and aspirations applies. If this applies to all people – and by definition it should – then this represents the space inhabited by humans and currently that is the globe. If humans ever ventured to other planets, then sustainability would apply there as well. Spatial equity should imply that a fundamental set of SIs would be applicable to everyone everywhere. However, in practice, sustainability has been perceived in the simplest sense of being a physical location – a place such as a country, region, urban centre – with associated boundaries of governance, politics, culture and economic influence that can all be crudely summarized as geo-politics. In other words, the boundary often tends to be a much more limited geo-political space than the globe although this is not to say that efforts to address global concerns are absent. But even here the debates are founded on nations talking to nations. In practice, what we experience as sustainability, or lack of it, is an outcome of geo-political discourse.

A further complication relates to time scale. The assumption is that sustainability should apply for as long as human beings exist. If the human race were to become extinct then so would the need for sustainability. Indeed, extinction would be the ultimate indicator of unsustainability! Temporal equity should imply that there should be a fundamental set of Sɪs, which ensure that each generation does not damage future ones. However, in practice, the time scales are often reduced from this theoretical extreme to what corresponds with a politician's term of office, or to what periods of time allow for a measurable (or presentable) impact following an intervention. Therefore, in practice, any intervention to help sustainability is expected to produce tangible benefits in 5 years or perhaps even less. Again, the way for engaging and experiencing efforts to achieve or fail to achieve sustainability is driven by geo-political concerns.

Thus while theory holds that sustainability, as a human construct, should apply to wherever humans exist and for the time that humans will exist, the practical reality is that these *continua* are quantized into "bits" of space and time. Hence, geo-political bounded space and time help to diversify the choice of Sis, as the focus is upon needs and aspirations of those within the space and "now", perhaps to the detriment of those "outside" the space and in the future. Hence SIs become spatially and temporally fixed to these *quanta* and the result is heterogeneity between the spaces and even within the same space as well as over time. Different indicator matrices would be created for the same space, with jostling between groups, each presenting their set as the "best" or "most applicable", perhaps with their own vested interests in mind, and with overlaps between conflicting views as to the "space" which is deemed important. National matrices would be applied at "local" scales, alongside more locally-derived matrices. From this reality, it logically follows that boundary permeability, where pressures are important for sustainability such as pollution readily cross geo-political boundaries, is a heterogeneous concern. The spaces, which feel the effects of the pollution, may understandably be more concerned than the places which pollute, and the SIs chosen by each space may well differ.

Of course such heterogeneity with the choice of SIs is not necessarily a bad thing. People are different across and within spatial scales, and their needs and aspirations change in time. Nevertheless, it is interesting how this inevitable heterogeneity with regard to SIs has been somewhat at odds with an evolving sense of "abstract space" in geography: a hypothetical space is characterized by complete homogeneity and is often applied to limit extraneous variables. There is a conflicting demand to "simplify to research and manage" within a context of diversity and complexity. The result can be the assessments of sustainability that stops at national borders and that can, at one extreme, effectively give a country a single value for sustainability. The Environmental Sustainability Index (ESI) is a classic example. Using the ESI, it is possible to generate a map of the Mediterranean with nation/states colour-coded with regard to their pressure-state-impact-response SIs (Figure 2.1) In Figure 2.1, the scale from red to green implies increasing sustainability, and it is clear that generally the south shore of the Mediterranean does well in terms of pressure (e.g. less emissions of pollutants) but poorly in terms of state, impact and response. However, it can be noticed how the assessments stop at national borders because the ESI is designed to assess sustainability at national level. Much manipulation is taking place here, especially by the creators of the ESI, and alternative assessments of the region are possible.

Is there an alternative spatial scale to the geo-political one represented in Figure 2.1? While a geo-political analysis has logic in terms of a clear set of decision-makers able to act, as well as a resonance in terms of familiarity, another approach would be to employ a landscape – land use *continuum*. While this approach may provide advantages, it also raises problems. For example, the sustainable management of the Mediterranean coastal zone is a multidisciplinary and cross-national problem that spans a wide range of spatial scales.

This complexity is probably the reason why the coastal landscapes of the Mediterranean have never been comprehensively studied and that landscape-specific methodologies and concepts have not been developed. Currently, there is inadequacy in our level of knowledge of the landscape typology, i.e. variety of landscapes, but also the main processes and forces influencing their transformation in the region. The development of a coastal typology is a necessary basis for coastal zone management and a pre-requisite for the evaluation and risk assessment of losses or changes to coastal related resources. The aim of this chapter is to discuss and examine the relationship between landscape character assessment and Sustainability Indicators.

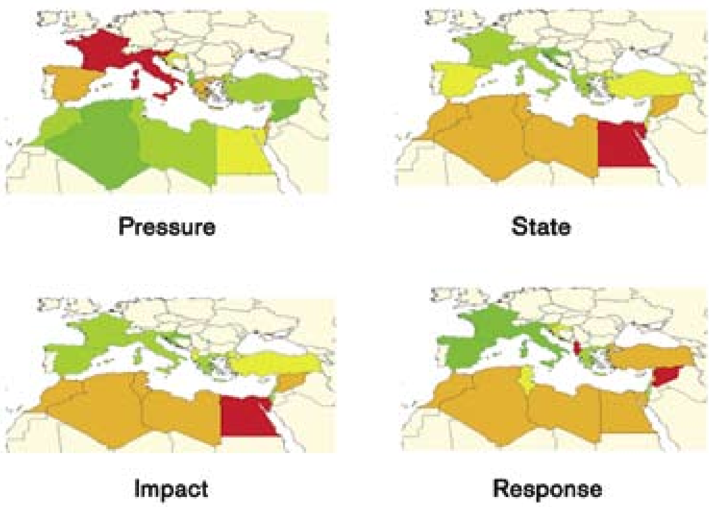

Figure 2.1: Values of the Environmental Sustainability Index for 2005 used to generate SIs of pressure-state-impact-response for Mediterranean countries

Landscape Classification – Developing a Spatial Framework

Landscape Typology

A landscape typology, and the subsequent classification into discrete landscape types, provides the **spatial framework** for the derivation of sustainability indicators. The typology is a recognition that past and future pressures vary enormously between landscape types and, therefore, the development of policies and measures to contain such threats and to restore ecosystem functioning and other landscape scale processes is directly related to the **character** of a landscape. In this context, spatial framework refers to distinct and mapped areas on the ground, encompassing a particular set of landscape attributes. The rationale for the development of the typology is based upon an understanding of the factors, both natural and cultural, that determine the intrinsic "character" of a landscape. For example, in a coastal context, differences in climate, slope, substrate, tidal range, etc., combine with cultural factors that have shaped the evolution of the landscape over millennia, to create a recognizably distinct landscape type.

There are many techniques for the classification of landscapes. An early attempt by FAO (1996) to establish agro-ecological zones is a good demonstration of a land classification technique at a global scale, based on spatial environmental data. Examples of European level classification include the European Landscapes Map (Meuus, 1995) and the work produced recently by Washer and Jongman (2003). Despite its wide use in NW Europe as a tool for landscape planning, the development of a landscape typology for Mediterranean countries has been limited, with few exceptions (Pinto-Correia *et al.*, 2002; Mata and Sanz, 2003; Marušič and Jančič, 1998).

Methodology

An important distinction is made between landscape **typology** (the nomenclature) and landscape **classification** (application of the typology in map form). The typology necessarily precedes the classification, requiring the sampling of the whole range of landscape units to identify the attributes that discriminate between the full complement of landscape types. This is a complex task and is influenced by a range of factors, including:

- The objectives and scale of the project;
- The scale, resolution and quality of data;
- The sampling scheme;
- The diversity and complexity of the landscape types; and
- The techniques to classify the samples into a consistent typology.

There is a close relationship between the scale and objectives of the project and the availability and quality of the input data. Quality issues relate to modernity and data availability in digital format, in addition to the level of detail – some individual countries, for example, will have soil maps at medium scales in digital format containing more detail than is available for all counties across the region. Thus, there are difficult decisions about which data to include, given probable differences in quality and level of detail.

The sampling scheme is a critically important consideration in the typology development. At Mediterranean region scale, even if data are available at an appropriate level of detail, it is unfeasible to sample every landscape type. A sample design needs to be developed based upon an initial stratification related, for example, to climate zones or to broad geological types. Based on this, a sample of points, at which more detailed information on variables such as soil type and land-cover can be collected, are selected. The level of sampling intensity is related to the complexity of landscape types, with more samples in areas of landscape diversity. Finally, the techniques used to classify the sample data into a robust and consistent classification that can be applied across the whole region of interest will determine the level of detail (number of divisions) in the typology and its applicability at a range of spatial scales.

Classification involves the translation of the typology into mapped form – essentially the labelling of every landscape unit. GIS increasingly provides the tools to accomplish this, enabling the different layers of spatial data to be overlain, combined and classified according to specific rules and thresholds identified in the typology. The development of landscape typologies has been facilitated by the use of GIS, enabling data-sets of different scales and, frequently, varying projections, to be integrated into a single digital database of geographic and attribute data. This technology provides significantly increased opportunities for more detailed environmental resource inventory, and analysis in space and time, and shows considerable promise for extensive use in nature conservation. Statistical procedures are employed for determining the rules to decide between classes, in order to produce repeatable results with minimal personal bias. Clustering techniques have been also applied at global level for developing coastal typologies (LOICZ, 1998).

Data Sources - Availability

Although it is commonly accepted that a scientifically sound typology should be based on detailed information on the distribution, quality and quantity of biophysical variables, in many cases such information may only be derived from heterogeneous data sets of differing quality (Table 2.1). Quality can be, for example, compromized by modernity, spatial scale and area coverage.

Before the process of mapping can begin, all the relevant, readily available information for the study area needs to be collated as a series of digital map layers within the GIS. Since the Mediterranean area extends over three continents, there is a need to use complementary data sources in order to obtain information for the whole region. These include:

Table 2.1: The most common variables employed in landscape classification

Variables	Description	Example datasets
Climate	Physical - Abiotic	CRU, Univ. East Anglia
Soils	Physical - Abiotic	FAO UNESCO Soil Map European Soils Database
Geomorphology*	Physical - Abiotic	USGS TOPO30
Hydrology*	Physical - Abiotic	Not available
Vegetation	Physical - Biotic	Potential Nature Vegetation
Land use and Land cover	Cultural	CORINE, PELCOM
Landscape History	Cultural	Not available

Apart from the international datasets presented in Table 2.1, it should be noted that there are also national datasets for some of these variables, both for the countries that have carried out a landscape character assessment and for the countries with no landscape character assessment (such as Greece). These datasets differ in terms of their geographic projection and collection standards and there are frequently problems related to copyright.

Coastal Landscape Typology Development: A Case Study

The methodology described in the previous section will be exemplified with a case study from the island of Sardinia, Italy (Figure 2.2). Sardinia, the second largest island in the Mediterranean, has a variety of landscapes strongly linked to its geological history but also to human influence. The coastal zone of the island is characterized by a wide variety of habitats such as dunes, estuaries, salt marshes, sea cliffs and coastal garrigues. Although the landward limit of the coastal zone should be defined by the limit of the local coastal administrative units, these were not available in digital form for this case study. Therefore, a 7 km buffer from the coast was used as a “proxy” to delineate the coastal zone. This distance is an approximate average of the extent of the administrative community units along the coast of Sardinia and, in some cases, coincides with catchment areas.

For the derivation of the typology, climate, landform, geology and land-cover were employed (Table 2.2). **Climate** data were taken from the European Environmental Stratification (Metzger *et al.*, 2005). The framework divides Europe into 84 classes based on topographic and climatic variables at 1 km^2 resolution. This dataset was employed to provide surrogate information on climate. Although five classes are found in Sardinia, only three of them characterize the coastal zone (Table 2.2). **Landform**, the relative relief and shape of the land surface, was derived from interpretation of a DEM of Sardinia (USGS - STRM) with a pixel size of 90 x 90m. **Geology** was simplified into meaningful categories for landscape character assessment using the 1:200,000 geological map of Sardinia. **Land-cover** was taken from the CORINE land-cover map of Sardinia (Marini *et al.*, 1993). The land-cover classes in the study area were amalgamated in order to reflect the broad pattern of primary land-use at the landscape scale: agricultural areas, forested and semi-natural vegetation, humid zones and water bodies. All the maps used in this study form a co-registered spatial database.

Figure 2.2: Location of the island of Sardinia, Italy

The data were stored in ArcGIS, a GIS (Geographical Information System) developed by ESRI (Environmental Systems Research Institute). The climate zones were first divided into physiographic units from contour and geological data. The resulting units were then further sub-divided by land use patterns to derive the building blocks of the system, the Landscape Description Unit (LDU). These units were subsequently amalgamated into Landscape Types with similar attributes using TWINSPAN analysis (Hill, 1979). The classification was stopped at the third level of division, resulting in eight groups containing a sufficient number of units to characterize existing landscape types. The results of the classification were then mapped to produce a map of Landscape Types (Figure 2.3).

Table 2.2: Attributes employed for Coastal landscape mapping in Sardinia

Climate[1]	**Landform**[2]	**Geology**[3]	**Land-cover**[4]
Medit. South 2	Plains	Quaternary deposits	Artificial terrain
Medit. South 3	Rolling hills	Sedimentary of Pliocene	Agricultural areas
Medit. South 5	Steep montane terrain	Volcanic Pliocene-Pleistocene	Forested and semi-natural areas
		Marine and continental	Humid zones
		Volcanic Oligocene, Miocene	Water bodies
		Transitional and marine of the Palaeocene, Eocene	
		Volcanic of Palaeozoic	
		Hercynian metamorphic	

[1] According to Metzger *et al.* 2005, in ascending order the numbers indicate higher July average maximum temperature
[2] From USGS-STRM
[3] From the Geological Map of Sardinia
[4] From CORINE Land-cover map

The main landscape types identified are the following (see also Figure 2.3):

1) High coastal landscapes on hard rocks: these units are found on steep montane terrain, on volcanic rocks, dominated by semi-natural vegetation;
2) Hilly agricultural coastal landscapes on hard rocks: these units are on rolling hills over volcanic rocks where agricultural practices are predominant;

3) Hilly coastal landscapes on hard rocks: forests and semi-natural vegetation dominate on rolling hills over hard rocks. According to the classification, a further distinction can be made between the northeast (3a) and southeast units (3b), the latter being drier;
4) Mosaic coastal landscapes on hard rocks: these landscapes, which occur on volcanic rocks, appear to be distinct due to the patchy nature of agriculture and semi-natural vegetation;
5) Urban coastal landscapes on recent deposits: lowlands on quaternary deposits with continuous urban fabric;
6) Agricultural coastal plains on recent deposits: lowland quaternary deposits where intensive agriculture dominates;
7) Lowland coastal landscapes on hard rocks: low-lying landscapes on hard Hercynian rocks dominated by semi-natural vegetation in the most arid zones of the island.

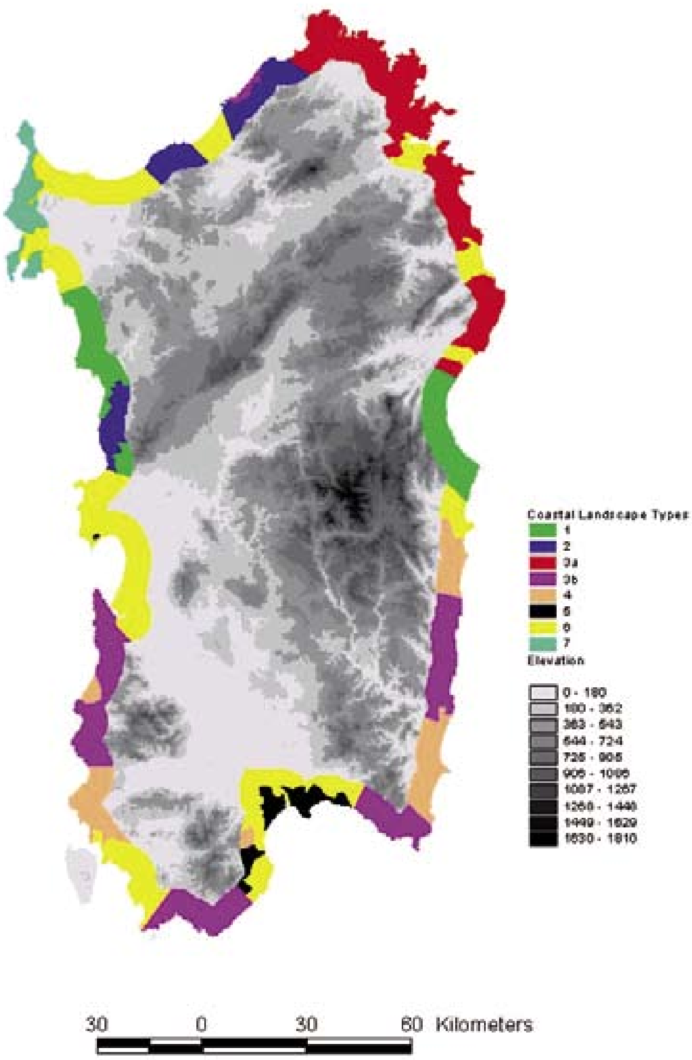

Figure 2.3: Coastal landscape types in Sardinia (for legend information see text)

Landscape Character and Sustainability

A landscape classification provides a convenient spatial context within which to derive SIs. People resonate with landscape. Landscape is physical – it can be seen and experienced. While its value may be highly subjective and so would be the way people bound a landscape (its spatial scale) and hence its components, it is a term which people know and understand. This property gives landscape, as a spatial unit, an advantage over more scientific and, in a technical sense, more appropriate constructs within which to analyze sustainability such as "ecosystem". Yet while the issue of spatial (and temporal) dimensionality has been an important concern in sustainability (Bell and Morse, 1999), there has been little effort to use landscape as a matrix for analysis. Instead, emphasis has been made upon socio-political units such as a state (e.g. Italy), a region (e.g. the Mediterranean) or an urban centre. While these are convenient and appropriate, in the sense that they are human-centric constructs (and sustainability is about people), they can be problematic in terms of boundary permeability. Landscape as a unit can have the same problems, of course, but it is perhaps the only recognizable matrix which crosses socio-political boundaries and hence induces a consideration of permeability from the analysis onset rather than *a posteriori*.

Table 2.3: Examples of SIs that could be employed for the pressures on the coastal landscapes of Sardinia

Landscape type	Location	Pressure	Possible SI
1. High coastal landscapes on hard rocks	Cala Gonone	Tourism	No. of beds available
2. Hilly agricultural coastal landscapes on hard rocks	South of Portobello di Gallura	i) Cork oak production ii) Grazing	Intensification Proportion of grazed area
3. Hilly coastal landscapes on hard rocks	Costa Smeralda	Tourism	No. of tourists
4. Mosaic coastal landscapes on hard rocks	i) Portoscuso, Inglesias ii) Costa Rey	i) Mining activity ii) Tourism	No. and extent of mines No. of tourists
5. Urban coastal landscapes	Cagliari and surroundings	Urbanization	Road and house density
6. Agricultural coastal plains on recent deposits	Oristano	Agricultural activity	Land-use change
7. Lowland coastal landscapes	North of Argentiera to Stintino	Tourism	No. of beds available

One of the major advantages of landscape units, at least in theory, is that they provide a spatial matrix that transcends the geo-political boundaries (i.e. the same landscape unit can cross geo-political boundaries). Thus it may be possible to get closer to Sis, which address pressures fundamental to that unit and not distorted by political concerns. Whether this is the case has yet to be seen – no research has taken place to date using landscape units for the assessment of sustainability.

Conclusions

Despite the great cultural and natural diversity of the Mediterranean, coastal landscapes throughout the Basin are faced with common threats including pollution, overgrazing and tourism development. These problems, combined with lack of public awareness, political commitment (demonstrated with inadequacy of legislation or ineffective enforcement) and inter-sectoral cooperation, hinder the protection and sustainable planning of natural and cultural landscapes. What differs is the scale of these problems and the means/tools employed to solve them which reflect a clear divide between the countries of the north and south Mediterranean.

Landscape classification provides an important strategic overview within which to develop policies for a multifunctional landscape, in which the conflicting demands of agriculture, development, recreation and nature conservation need to be solved. The development of landscape typologies provides the spatial framework for monitoring ecological processes but also for the derivation of sustainability indicators as demonstrated in this paper. The use of GIS technology enables data integration, increasing detail and efficiency in landscape inventory and analysis. The methodology is robust, transparent and repeatable, based on consistent datasets and can potentially be developed in a pan-Mediterranean scale.

A potential obstacle in the development of the methodology at a Mediterranean scale is the lack of truly Mediterranean datasets. The datasets identified so far exhibit high diversity in terms of quality, resolution and coverage. Finally, the issue of scale remains an important challenge necessitating the framework to be hierarchical. This would allow studies to be undertaken and comparisons to be made at different spatial scales in a way that, for example, local field data cold be placed in the Mediterranean context.

The adoption of a truly holistic landscape approach has been advocated as the link to sustainability in the Mediterranean region (Makhzoumi and Pungetti, 1999). The commonly used Environmental Sustainability Index (Morse, 2004) is a country level based index which, although useful for the construction of league tables of national performance, does not help with issues of sustainability operating at more site-specific levels. Given the advantages that landscape may have as a recognizable spatial unit for an analysis of sustainability it may be possible to link SIs to coastal landscape types in the Mediterranean. A first attempt of this kind was demonstrated herein but more work needs to be done.

The main challenge however, for the continued development of a spatial framework for landscape planning, is the integration of disciplines and data to develop an increasingly holistic view of the landscape at multiple scales. The emerging Mediterranean framework needs to be capable of translating policies and targets from the pan-Mediterranean down to national and local levels.

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3 Setting Sustainability Indicators in a Mediterranean Island Context

Louis F. Cassar and Elisabeth Conrad

Abstract

The concept of sustainable development highlights the need for a certain level of social well-being which can be maintained in the future. Such social well-being is dependent, to a substantial degree, on the well-being and resilience of ecological systems, as human livelihoods often depend, directly or indirectly, on a variety of resources and services provided by the natural environment. At the same time, management of ecosystems increasingly necessitates an understanding of pressures and threats acting on the natural environment, which are often of human origin. Successful planning and management, therefore, requires an understanding of both physical and socio-cultural dimensions and must seek to adequately address both. Sustainability indicators play an important role in monitoring and indicating progress towards the achievement of a level of well-being, in both ecological and social terms, which may be defined as "sustainable". However, the success of sustainability indicators is dependent, at its core, on what indicators are used, as this determines the success of the remainder of the process. The procedure used for their identification is, therefore, of prime importance. This chapter discusses research utilizing an innovative approach for the derivation of sustainability indicators, which combined expert input and participatory techniques, and its application on the island of Gozo (Malta).

Introduction

In one of the most commonly quoted definitions of the term, "sustainable development" was famously (or infamously) described by the Brundtland Commission, as "*development that meets the needs of present generations within compromising the needs of future generations to meet their own needs"* (World Commission on Environment and Development, 1987). The perspective proffered by this definition is primarily anthropocentric in nature, highlighting solely the requirements of the human species. It does, however, allow for attention to be paid to natural resources, even if only in so far as these benefit mankind. Humanity's dependence on healthy natural ecosystems was unambiguously highlighted in the Millennium Ecosystem Assessment Reports (Millennium Ecosystem Assessment, 2005), which clearly demonstrated how degradation of a variety of natural aspects can and does affect human well-being. At the same time, the Reports also highlighted the extent to which human activities have the potential to exact considerable damage to natural systems, a potential which is all too often translated into actual degradation. The concept of sustainability, whether focused primarily on natural systems or on social well-being, must therefore necessarily address both natural and human dimensions, incorporating environment, politics, socio-cultural concerns and economy, amongst others.

Such a task is not easily achievable, and is highly dependent on the availability of a solid and varied selection of scientific and managerial tools and methods. Sustainability indicators (SIs) provide one important element of this toolkit. The role of SIs is primarily related to the provision of feedback and monitoring as part of an interventionist agenda, but has also been seen as a useful way of engaging stakeholder interest and promoting a shared understanding of issues. An understanding of any system is critical for its management, and SIs provide a systematic and measurable method by which such an understanding can be achieved. Furthermore, SIs are flexible in application and allow an understanding not only of state, but also of driving forces, pressures, impacts and responses in managerial terms. An element of quantification may also be possible, allowing easier comparison across different situations. However, the success of the SI methodology is crucially dependent on the nature of indicators used, and hence the entire process hinges on the stage when indicators are selected. Given the fact that sustainability, as a concept, addresses both strictly scientific and broadly social concerns, it is evident that a methodology for selecting SIs must draw on scientific expertise as well as participation of the broader public. This chapter outlines the development of such a methodology and its application on the island of Gozo, Malta.

The Use of Sustainability Indicators in Malta

There have been various initiatives relating to sustainability indicators in Malta, including an initiative by Blue Plan as part of a Coastal Area Management Programme (CAMP) project, and the development of the Sustainability Indicators Malta Observatory (SI-MO) at a national level. The Blue Plan project was focused on the northern part of the island of Malta, and included a methodology to arrive at a list of SIs via participation from local stakeholders. The CAMP project was organized into five thematic sub-projects and three cross-cutting sub-projects, namely:

1) Sustainable coastal management;
2) Marine conservation areas;
3) Integrated water resource management;
4) Soil erosion/desertification control management;
5) Tourism: impacts on health;

and

1) Data management;
2) Participatory programme;
3) Systemic Sustainability Analysis (SSA).

The Sustainability Indicators-Malta Observatory (SI-MO) was set up by the Islands and Small States Institute of the University of Malta during the latter part of 2000. The initial aim was to establish a database and clearing-house for information on the environment and sustainable development. As a result of its participation in the Mediterranean Environmental Reporting and Information System (MEDERMIS) project, SI-MO developed a set of SIs based on a methodology proposed by the Mediterranean Commission for Sustainable Development (MCSD). The National Statistics Office (NSO) also collaborated in the exercise. SI-MO approached the issue by engaging a number of specialists, jointly encompassing expertise in the various fields covered by the MSCD indicators, which in total numbered 130. These specialists were expected to obtain the relevant data and compute the indicators in addition to preparing a commentary sheet for each indicator.

At least three indicators (22: Population change in mountain areas; 24: Exploitation index of forest resources; and, 64: Intensity of material use) were not found to be applicable to the local setting, while the remaining 127 indicators, as used by MCSD, were found to be suitable for the Maltese Islands, although data for 27 of these indicators could not be obtained (SI-MO, 2002). The remaining 100 indicators, which were considered to be relevant to the Maltese scenario, were included with data that covered, where possible, a five-year period, together with its interpretation. It is of interest to note that the group of specialists that made up the SI-MO biodiversity team recommended a fairly exhaustive list of SIs based on the PSR-model (Pressure-State-Response), but none of these recommendations were ultimately included in the final selection of indicators within the SI-MO output. The latter included 100 indicators, grouped under the following themes (Stevens *et al.*, 2001):

- Species protection;
- Habitat protection and use (including coastal zone, forestry and land-use);
- Fisheries and agriculture; and
- Other general enforcement and implementation indicators.

Merging Natural and Human Dimensions in Sustainability Indicators

The following discussion is based on research carried out on the island of Gozo between 2000 and 2003. Gozo is the second largest island of the Maltese archipelago, comprising a land area of 67.1 km^2 and having a population of approximately 31,000 (National Statistics Office, 2004). The island presents a diversity of land-use conflicts. On the one hand, it is ecologically important, having examples of several rare or threatened habitats and hosting several species which are either threatened or have a restricted distribution, including a number of palaeo-endemics and neo-endemics. On the other hand, Gozo also accommodates a variety of land-uses, including agriculture (the most extensive land-user), residential and tourist developments, other infrastructure, mineral extraction facilities, recreational demands, as well as several others. Biodiversity is increasingly threatened and declining, and with such losses, together with the accompanying degradation of landscapes, Gozo faces the threat of losing its potential to attract tourists, which constitute its economic life-line. The resolution of such land-use conflicts is therefore critical from all aspects of sustainability, both the more biocentric and the thoroughly anthropocentric.

Figure 3.1: Quarrying in the Dwejra area of Gozo, adjacent to a special area of conservation (Credit: L.F. Cassar)

The methodology utilized in this research combines expert inputs with participatory methods (Figure 3.2). The initial stage is expert-driven, whilst stakeholders are involved from steps 2 to 6, with experts taking over again during step 7. The rationale for this approach is based on a realization that "expertise" is not limited to that derived from formal academic study. There is also expertise that is derived primarily from experience, from exposure to a system and from an observed understanding of its functioning and of any changes and trends. The academic expertise of the scientific community is important for providing specialized knowledge and technical detail, which can not be derived from other sources. At the same time, the involvement of stakeholders provides experiential expertise, which is likewise often unavailable or inaccessible through other means. The latter is also important for several other reasons. In the first place, the level of stakeholders' involvement has been found to be directly related to the level of interest in management and to the success of management initiatives. Fostering a sense of involvement (action), therefore, contributes to the likelihood of beneficial outcomes. Secondly, the actions and activities of the general public have considerable influence on the future of ecosystems, and understanding the perspectives of different stakeholders is therefore critical to management. Thirdly, it is increasingly argued that stakeholders have the right to be involved in the management process, as decisions that are made ultimately affect their day-to-day life at a fundamental level. In the long-term, the sustainability, or otherwise, of our lifestyles will also be dependent on the extent to which our conservation and economic development ideals can be made complementary, and on the extent to which the lifestyles of the world at large can be rendered environmentally benign. Such a goal requires a move towards environmental management approaches that are focused on collaboration with stakeholders, rather than confrontation, and a recognition that the perspective of people as a threat to be managed can be replaced by a perspective of people as a "resource" which can contribute towards the achievement of the sustainability goal.

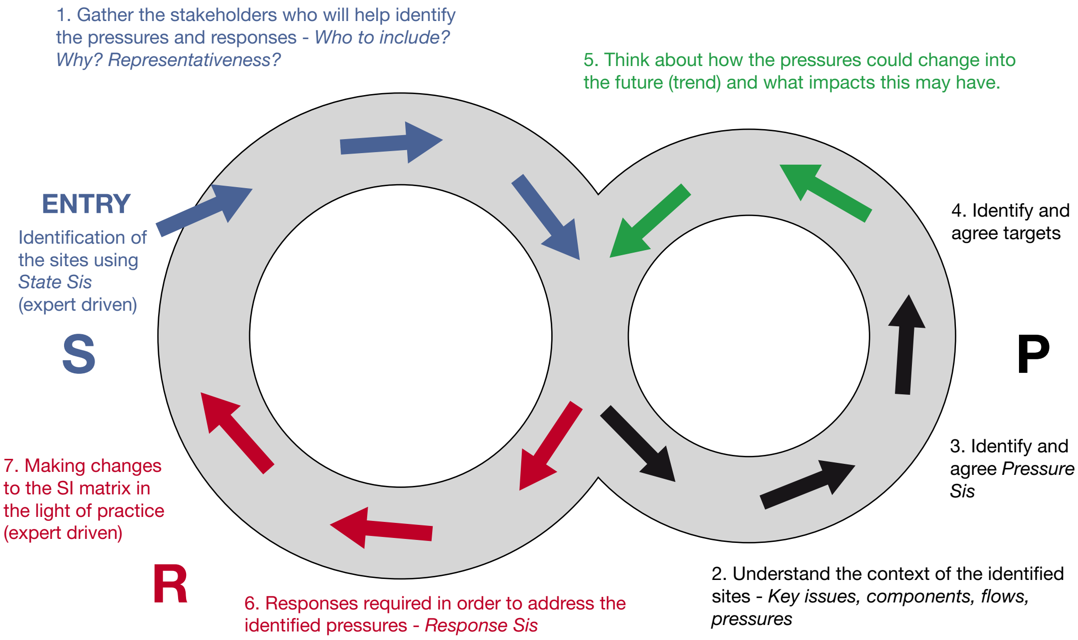

Figure 3.2: Combining specialist and participatory inputs in the determination of SIs (Source: Morse, 2005)

The methodology developed is illustrated in Figure 3.2 above. The process addresses state, pressures and responses at different stages and in different ways. The entry stage lies within the expert-driven loop (blue) to identify sites at risk, but the process then shifts to the participatory loop (black and green) for an understanding of the context and pressures operating at the sites, and the identification of targets and future scenarios. The latter is particularly useful as a means of getting participants to think about which "business as usual" will entail – the cost of doing nothing and not just the cost of doing something. The final stages (red) are then implemented in the expert-driven loop, bringing the process through to its conclusion by looking for responses to pressures which have been identified. While expressed here as "expert-led", it should be noted that this stage could involve some stakeholders but not necessarily all. After all, if a response is to ban an activity which some stakeholders wish to continue, then it is unlikely that they would even want to participate other than state their objections. It should also be highlighted that the process is not final with the testing and refinement of SIs in step 7, but like any other adaptive management approach is dependent on subsequent and regular monitoring, feedback, review, evaluation and adaptation. The application of this methodology in the Gozo case study is described in further detail below.

Figure 3.3: Ramla l-Hamra, one of the nine sites identified in step 1.
The site harbours an important sand dune ecosystem (Credit: L.F. Cassar)

Step 1: Ecological Appraisal

The initial stage of the research involved "setting the scene" through ecological field appraisal (corresponding to step 1 in Figure 3.2). Initially, a broad-brush survey of the entire island of Gozo was conducted, whereby biotopes were characterized by visual assessment during "walkover" surveys, on the basis of geomorphological features and biotic assemblages. This exercise was undertaken with a view to identifying sites of ecological importance within the island of Gozo, for further and more detailed investigation. Consequently, nine sites were selected for further elaboration of the process of developing SIs. All of the nine sites harbour significant proportions of species listed in the Red Data Book for the Maltese Islands, as well as indicators of disturbance. The sites, therefore, represent ideal settings for addressing the issue of conservation within landscapes under threat. Following a detailed ecological assessment of each site, through quadrates and transects, their conservation value was determined on the basis of conservation value appraisal criteria, which were defined specifically for the island of Gozo (Cassar, in press). The results from step 1 provided the basis for the remainder of the exercise.

Steps 2 to 6: Understanding the Context and Developing SIs

Subsequently, key respondents were brought into the process in order to identify the pressures and other issues that may be applicable to the sites (corresponding to step 2 in Figure 3.2). Bringing key actors together is not an easy task, particularly since some stakeholder groups, such as resource users (shooters, trappers, etc.), are not eager to meet around the table with environmental NGO representatives, due to a history of conflict and confrontation. Convening meetings between environmental agency officers and other stakeholder groups may likewise prove difficult. On the other hand, a one-time interview only creates limitations on a survey, since such an approach is less effective in capturing change over time. It may explore attitudes among stakeholders but not the meaning. Therefore, rather than carrying out formal interviews involving semi-structured questions, it was decided that casual discussions during informal seminars with key informants would indeed suit the purpose more appropriately. It was deemed important to maintain a balance during these discussions with key informants, particularly when different points of view were made, so that all those involved could express as unbiased personal views as possible. For this reason, any focused questions that were made by the researcher were open-ended, while some questions were preceded by a statement for which a response or reaction was sought. This key informants' group comprised a multidisciplinary team of freelance environmental planning consultants, mostly engaged in work related to environmental planning, management and assessment, and professional as well as technical personnel from the national planning and environment protection agency (Malta Environment and Planning Authority), mostly involved in nature conservation and sustainable development policy formulation. The primary aim of this key informants' group was to discuss environmental concerns afflicting Gozo and to identify the main parameters within which to pitch landscape conservation strategies.

Furthermore, a week-long activity on "*Landscape integrity assessment for sustainability in the coastal zone*" was held in Gozo with a view to discuss, identify and highlight issues pertaining to the conservation of Mediterranean semi-natural landscapes and their sustainability. The event was organized and coordinated under the auspices of the UN. The latter part of this specialized meeting was dedicated to participatory methods, particularly soft-systems analysis, during which a focus group seminar was held. Participants from various Mediterranean countries, together with Maltese and Gozitan counterparts, carried out cursory appraisals of the selected nine sites, following which they discussed key conservation issues and identified pressures adversely affecting the study sites and their contextual landscapes. The participants, sub-divided into working groups of between three and five persons per group, then produced "rich pictures" based on their observations and findings to describe key issues afflicting the sites. Rich pictures are an informal way for workshop participants to share their thoughts and express their concerns in a manner that could be discussed and reviewed by colleagues. As a tool of communication, rich picture methodology brings out a wealth of information in terms of emotions, description and content; it is only after the rich picture is produced and the intended outcome discussed with other groups that major issues of importance are raised and "new *foci* for shared concern raised" (Bell and Morse, 2003).

The step that followed was the identification of pressures and the tasks required to address the issues, which the participants then presented in plenary. The rationale behind this approach is to develop a participatory methodology, using rich pictures to identify pressures and, following a ranking exercise with a suite of individuals from different stakeholder categories throughout the island of Gozo, to further identify sustainability indicators for conservation purposes. A second focus group seminar was held during the initial part of 2005, where a group of local planners worked on the selected sites and their surroundings. Work parties visited each of the sites to identify key issues afflicting the sites. The planners then created rich pictures to describe pressures they had identified for each of the selected sites, subsequently deriving a list of the actions/solutions deemed necessary to tackle the issues. The nine selected sites and their surrounding landscapes were introduced to the group during a series of tutorials on landscape ecology, following which the group was sub-divided into three fieldwork parties with a view to analyze each of the nine sites and identify the key issues and required actions. Sufficient time was allocated for fieldwork at each of the sites, where the researcher briefed each field party on the ecological resources and other assets prior to commencement of walkover assessments. Subsequently, the planners, retaining the same group configuration they had in the field, participated in a SSA and created rich pictures to describe the environmental pressures they had identified for every one of the sites, later deriving a list of environmental issues and the actions deemed necessary to tackle them. The latter part of the process involved the identification of a draft list of sustainability indicators intended to:

a) Maintain/improve the state of the environment at the nine sites;
b) Address the pressures/impacts affecting the sites; and
c) Assess managerial responses.

During the key respondents' seminars and focus groups, a number of pressures were repeatedly identified as the most relevant with respect to the site. The most significant pressures were considered to be (in no particular order):

- Grazing;
- Hunting and trapping;
- Landfill;
- Pollution from agriculture;
- Quarrying;
- Reclamation, land abandonment and proliferation of alien species;
- Urbanization; and
- Visitor/recreational pressures.

While such participatory approaches generate "hard" outputs such as listings of pressures and issues, the "softer" output of learning which takes place within the SSA should not be underestimated. Stakeholders can learn much from other stakeholders, and even if they do not agree they can at least appreciate that differences exist and maybe even why those differences exist.

While participatory processes such as SSA are good at promoting understanding and even consensus, they are less effective at allowing for an understanding of variation in perspective. Teams may broadly agree on what the pressures are, and in a spirit of compromise may be willing to rank them in importance, but this can hide underlying differences of opinion. Therefore, the list of pressures that emerged from the participatory process was used as the basis for a subsequent exercise with a broader group of stakeholders from the general public. The aim here was to derive an appreciation of the diversity in perspective which exists between and within stakeholder groups. The above-listed key pressures relating to the nine sites were illustrated on individual laminated cards, using photographs from the local context to which respondents could relate. A total of 230 stakeholders were subsequently approached and asked to rank the pressures in terms of their relative importance. Stakeholders were selected from amongst the following groups:

- Affected locals, including farmers (land-owners), ramblers, locals that frequent the sites for their scenic value and Maltese residents in Gozo;
- Resource users, which include bird shooters and trappers, hoteliers, restaurant and café owners, shop owners, quarry owners, etc.;
- Government and other official agencies, including individuals from the Ministry of Gozo, Local Councils, the Malta Environment and Planning Authority, Heritage Malta, and others;

- Non-governmental organizations (NGOs), including individuals from Nature Trust, Birdlife (Malta), Wirt Għawdex (Gozo Heritage Society); and
- Scientific community, which includes individuals who have an academic interest in the natural history of Gozo, in its landscapes and landforms, and in its rural cultural heritage.

Every effort was made to ensure that the size of the sample was representative in terms of realities in Gozo, related to group size and geographical extent, so as to engage the widest possible stakeholder coverage in the exercise. Essentially, interviewees ranked the pressures identified for the nine selected sites with regard to impact significance and magnitude. Ranks were from 1 (least important or significant) to 8 (most important/most significant).

Thus by the end of step 3 the process has identified the sites at most risk, the pressures at those sites (expressed as SIs) and a sense of the relative importance of those pressures from the perspective of the stakeholders. From here it was but a small step to contemplate how the pressures could, if unabated, impact upon the sites in the future.

Step 7: Deriving Final List of Sustainability Indicators

The preliminary list of indicators identified by participants in the focus groups and key respondents' seminars was re-assessed in the light of the various insights offered by stakeholders in the course of the ranking exercise. The indicators derived in relation to the eight predominant pressures identified for the nine sites include those listed in Table 3.1 below. Further indicators were derived with reference to ecological and conservation status, based primarily on the results of the ecological appraisal exercise (Table 3.2). It should be noted that the lists of indicators are not intended to be exhaustive, as it was considered more important to develop a manageable number of feasible and measurable indicators, rather than an exhaustive list of all potential sustainability indicators, which would require unfeasible resources for measuring and monitoring. The indicators were intended directly for pragmatic management and hence it was recognized that academic thoroughness would need to be balanced with other considerations. In line with the principle of appropriate imprecision, i.e. not measuring more than is needed, it was deemed important to relate the costs of information to its useful truth, with trade-offs between quantity, relevance, accuracy, timeliness, and resources required. Furthermore, indicators were identified with a view to the S-M-A-R-T criteria, i.e. indicators which are Specific, Measurable, Achievable, Realistic and attainable within a specific Time-period.

Table 3.1: Selection of indicators derived relating to the predominant pressures identified

Indicator	Descriptor
Pressure: Quarrying	
Extent of quarried area	Percentage coverage
Contribution of quarrying to GDP	Percentage
People employed in quarry industry	Number of persons/percentage of workforce
Pressure: Pollution from agriculture	
Water quality in agricultural runoff	Contaminant levels (e.g. nitrates, heavy metals)
Water quality in perched aquifer	Contaminant levels (e.g. nitrates, heavy metals)
Pressure: Urbanization	
Land within designated development zones	Percentage coverage
Population density	Persons/km^2
Built-up area	Percentage coverage
Extent of road network	Length in km
Pressure: Visitor pressure	
Number of visitors	Number of people crossing by ferry/helicopter[6]
Hotel occupancy	Number of occupied beds
Land area occupied by hotels & amenities	Land area in km^2
Pressure: Hunting and trapping	
Registered hunters and trappers	Number of persons/Percentage of population
Land occupied by trapping sites	Percentage coverage
Land occupied by eucalyptus groves[7]	Percentage coverage
Pressure: Grazing	
Registered goat herds	No. of herds
Land set aside for grazing	Land area in km2
Pressure: Landfill	
Landfill area/s	Land area in km^2
Registered truck loads entering site/s	Tonnage
Pressure: Reclamation, land abandonment and proliferation of alien species	
Extent of abandoned agricultural land	Land area in km^2
Extent of reclaimed area	Land area in km^2
Extent of area colonized by alien species	Land area in km^2

Table 3.2: Selection of indicators derived relating to ecological and conservation status

Indicator	Descriptor
Bio-marker species	Patch density
Red Data Book status	Number of species
Species richness	Number of species
State/naturalness	Percentage
Regeneration	Coverage
Eurytopic/stenotopic species	Coverage
Agricultural land area	Land area in km^2
Type of agricultural land area	Percentage agricultural area used for different activities
Landscape fragmentation	Percentage land area affected by fragmentation
Habitat loss	Percentage area of habitats lost per annum
Fire	Land area in km^2 affected by fire per annum
Proximity of biotopes to infrastructure	Linear distance in km
Protection status	Positive/negative protection status
Funding for protected areas	Amount in currency units
Proximity to landscape corridors	Linear distance in km

[6] Gozo is only accessible through these means of transport.
[7] Hunters and trappers often plant groves of *Eucalyptus* sp., a species alien to the Maltese Islands, in order to attract birds.

Conclusions

The methodology developed was found to have several positive points. Firstly, it brought together a diversity of "knowledge" which contributed to a holistic and thorough understanding of the context, processes, pressures, threats and actions needed. Secondly, it related ecological management to the broader social, economic, political and cultural context, rendering the outcomes more pragmatic and achievable. Thirdly, it facilitated the dialogue between groups which have traditionally "faced off" across opposite sides of environmental debates. This latter consideration includes dialogue between technical experts and other stakeholders, as well as between different stakeholder groups. Fourthly, it illustrated the use of alternative approaches to stakeholder involvement, such as soft-systems analysis, which has several advantages in particular situations over more conventional survey techniques. Finally, and related to all of the above points, it contributed to substantial enthusiasm amongst stakeholders, particularly as their specific knowledge was actively sought and as techniques for involvement (e.g. rich pictures) were informal in nature. In terms of SIs, the results derived were undoubtedly strengthened by the input of both experts and stakeholders. The final lists derived (Table 3.1 and Table 3.2) also illustrate that the measurement of the identified SIs should also involve both experts and other stakeholders. On the negative side, the work was resource-consuming and required a great deal of expertise to facilitate. While the SSA-based workshops can be implemented relatively quickly and at a low cost the expert-led derivation of ecological value across the island of Gozo was not an easy process. Putting the two together still means that the process can only proceed as fast as the slowest stage! Nonetheless there are ways in which the expert-led steps can be speeded-up.

Future directions, not only in relation to SIs but also in all other aspects of sustainability and environmental management, should increasingly seek to develop such collaborative and complementary processes of expert and stakeholder involvement, and should also move towards integration and mutual learning. It is recognized that the experts' and stakeholders' input may be more or less suitable or adequate in different circumstances, and the approach promoted is, therefore, one of flexibility and adaptability. However, what is being advocated is a move towards methodologies that contribute towards more than short-term results by pushing for a change in our general philosophy and culture of environmental management. The goal of sustainability only stands a chance if we can direct our joint efforts towards the same goal via complementary pathways, fostering a culture of collaboration rather than confrontation. All stakeholders, including scientific and technical personnel, and people with experiential knowledge, have much to learn from each other and much to contribute, and all these resources are required if we are to identify ways in which the ecological well-being of ecosystems, and our social well-being can both be achieved and sustained into the long-term future.

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4 Approaching Sustainability through Stakeholder Participation: Myth or Reality?

Stephen Morse

Abstract

The notion of including stakeholders in both the design and implementation of sustainable development projects has grown in importance, especially since the Rio Earth Summit in 1992. Such an approach is often referred to as "stakeholder participation", as "participatory development" or more simply still as "participation". Rationales for participation often include a statement for it as a basic human right as well as to allow a maximization of the effectiveness and efficiency of sustainable development projects. Having the public "on board" and taking decisions is assumed to make for better and more cost-effective projects. A third dimension rests with the advantage public participation presents as a vehicle for promoting greater learning about sustainability and shared appreciation of the constraints which may work against potential solutions. Against these advantages there is a number of disadvantages such as the myth of community (the potential problems of individual/group/institutional capture of the agenda), expense (costs of workshops, etc.), risk (much depends on the involvement of experienced and skillful facilitators) and, ironically given the assumption mentioned above, inefficiency as much "reinvention of the wheel" can occur as stakeholders may not be aware of previous work which can lead to a piecemeal and fragmented approach to sustainability. A further issue is the complexity of participation in practice as it's more of an art than a science, and with a sometimes bewildering plethora of different methodologies presented and promoted by respective adherents in the sustainable development literature. Surprisingly there has been little critique in the sustainable development literature as to the limits and dangers of participation irrespective of the approach employed to "best" facilitate it. The starting point is always an assumption that participation is good and the issue is how best to achieve it and harness the energy for making the project better. To the author's knowledge, this assumption has never been questioned, and has indeed almost reached the scale of being a mantra, yet it is of critical importance. This chapter seeks to critically explore the general interest of participation in sustainable development.

Introduction

Sustainable development is often defined as:

"development that meets the needs of current generations without compromising the ability of future generations to meet their needs and aspirations."

World Commission for Environment and Development (1987)

It embraces a key concept of equity – within current and future generations – and is classically represented as an area of interaction (Figure 4.1) between community, economy and ecology such that positive change (development) does not come at a social or environmental cost in the present or in the future (sustainable). However, while the rhetoric of sustainable development has been an increasingly popular mantra, practical achievement has arguably been mixed. Indeed some critics argue that sustainable development is nothing more than a co-opting of a wide range of groups into an agenda that does nothing more than promote neo-liberal economic growth at all cost (Doyle, 1998). But clearly there are supposed to be trade-offs although these can be hard to sell to a public who have to make sacrifices, and it is perhaps unsurprising that the rhetoric has been difficult to translate into practice (Dovers and Handmer, 1993; Meadowcroft, 1997).Yet the sustainable development literature is replete with calls for participation from those who would be impacted upon from sustainable development policies, projects and programmes. This principle is embodied within Principle 10 of the 1992 Rio Declaration of Environment and Development:

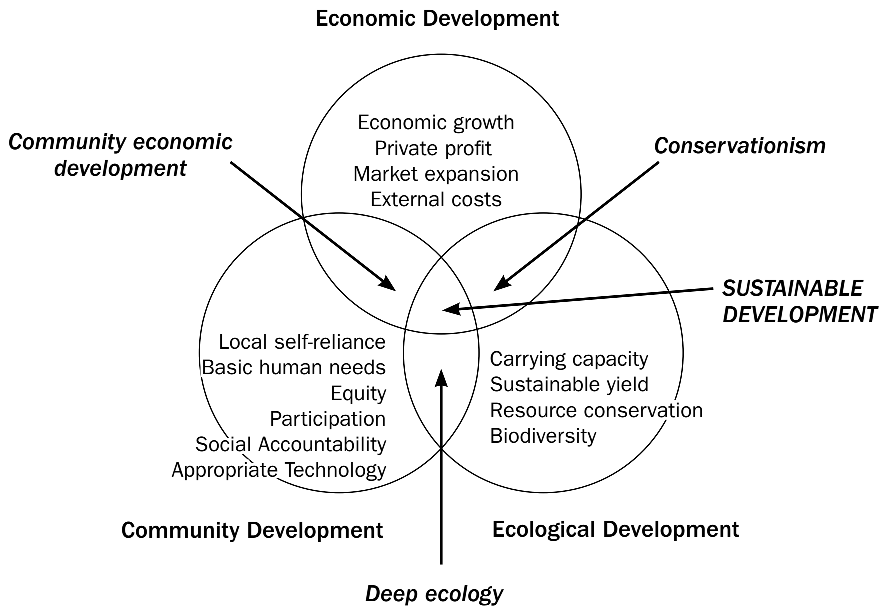

Figure 4.1: The complexity of sustainable development

"*One of the fundamental prerequisites for the achievement of sustainable development is broad public participation in decision-making. Furthermore, in the more specific context of environment and development, the need for new forms of participation has emerged. This includes the need of individuals, groups and organizations to participate in environmental impact assessment procedures and to know about and participate in decisions*."

UNCED (1992). Earth Summit. Preamble of Chapter 23, "*Strengthening the role of major groups*"

"*Democracy, respect for all human rights and fundamental freedoms, including the right to development, transparent and accountable governance in all sectors of society, as well as effective participation by civil society, are also an essential part of the necessary foundations for the realization of social and people-centered sustainable development*."

UNCED (1997). Earth Summit+5. Paragraph 23.

How can the call for participation be reconciled with a trade-off that is considered impossible (Dovers and Handmer, 1993)? This chapter explores the rationale for public participation in sustainable development and contrasts this with the alternative approach: a top-down-driven process of change. The aim is to provide a more theoretical backdrop on participation with which the reader can explore the various case studies provided in other chapters.

Participation

The history of what we now call "development" can really be traced to the end of the Second World War and the rise of modernization The idea that people have a right to participate in how they are governed is ancient, and it is impossible to define an origin that is, in any way, meaningful for a short chapter such as this. One of the earliest and most cited attempts to categorize participation within community development was presented by Shelly Arnstein (1969) and is summarized in Figure 4.2. The categories vary from one extreme, at the bottom end of Figure 4.2, where participation is absent to the top of the table, where there is self-mobilization. Arnstein's insight was that in between these extremes there is a variety of positions which share a common denominator in that the participation is being facilitated by an external agency and hence is open to more or less subtle manipulation. There may be some representation from stakeholders who do have a say in what happens, and perhaps the same voting rights as everyone if the body is a committee or board, but as they are out-numbered then in practice they have little power to influence decisions. Interestingly, while notions of participatory development are not geographically specific (Arnstein's ladder emerged within a USA context), it did achieve its greatest and most visible prominence in developing countries. There are reasons for this (Miller *et al.*, 2005b), but perhaps the foremost is that many developing countries emerged from a non-democratic colonial past during the late 1950s and 1960s. Prior to independence, policies were set by the colonial power and intervention by that power comprised what needed to be done to produce and export raw materials. Planning was highly centralized and participation, where it occurred, was confined to ensuring the best value for money for the agents of the colonial power instead of finding ways to improve the life quality of local communities. Even with national independence, freedom of action was still limited and many countries rapidly developed into dictatorships. Development, in such contexts, was almost inevitably top-down in nature, typically implemented through a succession of development plans. Participation was very much in line with the "passive" category of Figure 4.2.

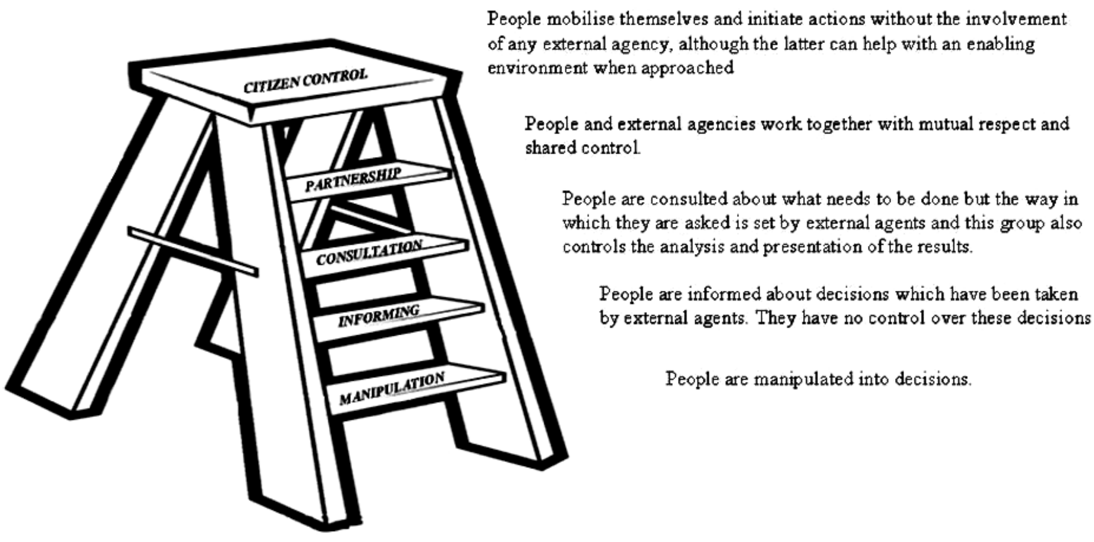

Figure 4.2: Arnstein's ladder of participation

While the colonial legacy and the democratic *vacuums* which continued after independence created one backdrop for the rise of participatory development, these were by no means the only impetus. During the 1960s, there was a gradual disenchantment amongst social scientists with macro-economic policies as the tool for development. These tended to follow the assumption that economies could be modernized and the resulting benefits would trickle down through the community to eventually reach the poorest. However, this trickle down often did not occur and development projects seemed to, at best, generate little in the way of sustainable improvements, and at worst, to make matters worse for many while benefiting a few. Participation was seen as a counter to this worldview, and in the view of a writer (Francis, 2001), took on almost mystic undertones amongst major development donors as a rite of communion for previous sins when trickle down held sway! Social scientists working in development began to initiate a process of dialogue with primarily rural-based populations in order to better understand their circumstances and wishes. The initial emphasis on rural populations was not surprising, given that in many developing countries this was where the majority of the population resided, as well as due to the importance of agriculture as a source of food and livelihood. This broad process was called Rapid Rural Appraisal (RRA), (Chambers, 1983) and was an extractive process focused on information gathering in order to feed into the planning of policy, research and other interventions. During the 1980s, RRA evolved into a reinforcement of community awareness and action (Chambers, 1993, 1997). In other words, the same techniques could be employed to let communities learn about themselves and instigate change as a result: a facilitation of empowerment and even liberation. The new approach was termed Participatory Rural Appraisal (PRA), and this widened in the 1990s to include urban settings. The term "appraisal" was also dropped in favor of collaborative learning: Participatory Learning and Action (PLA). Such latter approaches encouraged the deconstruction of the meaning of "development" rather than the imposition of an outside vision and thus led to calls for an era of post-development by Escobar (1995), Estreva (1992) and others. This vision addressed a sense of imposed domination, inflicted by the north to the south, in terms of meaning and practice of development (Sellamna, 1999).

Within a quite different context, the writings of Kurt Lewin (1890-1947) and others regarding organizational structures and management in the developed world became influential. Lewin coined the term "action-research" epitomized by the notion that "*research needed for social practice can best be characterized as research for social management or social engineering. It is a type of action-research, a comparative research on the conditions and effects of various forms of social action, and research leading to social action. Research that produces nothing but books will not suffice*". (Lewin, 1948; pp. 202-3). This idea that research should directly facilitate change helped to spawn what we now generically refer to as Problem Solving Methodologies (PSMs), with one of the best known examples being the "soft systems" methodologies of Checkland (1981; Checkland and Scholes, 1990). The PRA-PLA approaches can be seen as a branch of PSMs designed for a specific context. Examples of the use of PSMs in developed country contexts are provided by Tippet (2004), Vantanen and Maritunen (2005), Jonasson (2004) and Conroy and Berke (2004).

However it is phrased, interpreted or done, participation is typically geared towards helping to bring about a positive change and it tends to be facilitated (and owned?) by an agency external to the groups that gets immediately affected. While the community may have some control over the form of the process and its pace, they are still being "acted upon" (Kothari, 2001). More recently still, there is the notion of participation as a means to facilitate knowledge rights in scientific decision-making (Leach *et al.*, 2002) and citizenship (Williams, 2004a; Hickey and Mohan, 2005). Here, the language is one of a wider sense of emancipation or empowerment rather than a more precise focus on an immediate action (Chhotray, 2004).

Given this long and rich history, it is of no surprise that sustainable development has also embraced participation as a core ideal (Rockloff and Moore, 2006), and this is typically presented as a matter of human right as well as practicality: participation can make for better sustainable development as those being impacted upon are involved in the decisions. There is, of course, something of a dilemma in what happens if the consensus is not to do something which experts might regard as sustainable (Lundquist, 2001)? Is it enough to make sure that people are, at least, aware of the reasons for the intervention, even if they may not like or want it? Ironically given the discussion above, this may be tolerated if the people have no power, but what can happen in situations where there is the vote right?

Democracy and Sustainable Development

It can be argued that in countries which have a democratic system of governance, sustainable development is participatory by definition. After all, if the electorate does not like what a government has done in its name (including policies to bring about a more sustainable form of development) it can remove politicians at the next opportunity. Humphrey (2006) makes an interesting point: acceptance of defeat in a democracy can in part be justified by the reversibility of policy and the losers have the right to make their case at the next election and hence try to win a consensus. However, if changes are irreversible, as with environmental degradation, then does this not provide a justification for "direct action" (Humphrey, 2006)? Nonetheless, if the context is one of democracy, then it may be argued and any participation specific to an individual sustainable development project or programme is an extension to this bedrock.

Representation expressed through democratic institutions of governance is, of course, quite different from the sort of participation discussed in the previous section. Politicians are influenced by many concerns, some of which will be quite short-term and only spanning the period till the next election. Also, the scales at which democratic institutions function will be larger than a specific project or programme, and such scales do matter (Rockloff and Moore, 2006). While there is a growing literature on the "politics of sustainability" especially as a way to open up public spaces for debate (Sneddon *et al.*, 2006) there has been little focus on perceptions of legitimacy within governance akin to the discussion of "direct action" mentioned above by Humphrey (2006). Democracy is often not unpacked and like sustainable development it can mean many things (Castro, 2004). Taking a simple example, different voting systems can generate different degrees of representation. Many democracies have a system of proportional representation (PR) where the make-up of the government mirrors the relative proportions of those that voted for the parties. However, with a First Past The Post (FPTP) electoral system it is possible to have a government that is some distance from reflecting the proportion of those voting for the parties. In the UK general elections of 2005, for example, the New Labour Party won 35% of the votes of those who did vote (61% of the registered electorate actually voted) and a total of 356 seats in Parliament out of the 645 contested (equivalent to 55% of the seats). This hardly seems representative. Irrespective of Humphrey's (2006) point about reversibility (or not) of policy, this does leave plenty of scope for the 39% who did not vote at all and the 65% of those who did not vote New Labour – together accounting for a massive 79% of the total electorate – to feel disenfranchised with what the government is doing in their name. If such, a government chooses to introduce measures to assist sustainable development which result in many of the 79% losing out it is perhaps not unreasonable for them to claim that what is being done is only in the name of the 21% who put the government in office. Of course, such concerns may arguably become less valid if there is consensus amongst the political parties with regard to environmental governance, and Meadowcroft (1999) has made a convincing case that such multi-party approaches require serious attention.

In recent years, there has been a rise of deliberative democracy based on the argument that citizens also have a right to routinely and directly partake in lawmaking. Voting within elections is thus but one form of expression within a democracy. There is much resonance here with the broad literature on participation referred to above, but there are also differences. Deliberative approaches are geared towards extraction – the gaining of a sense as to how a representative group feels about an issue through the use of citizens' juries or perhaps by a "deliberative opinion poll". They are thereby said to improve the health and vitality of democracy (Hamlett and Cobb, 2006). PSMs, by way of contrast, are designed not just to involve people in designing solutions to constraints but to engage them in the implementation of these solutions and not just in talking about them. Thus deliberation is perhaps a basic form of participation akin to RRA. Nonetheless, it is almost always assumed that deliberative democracy and participation in general should be good issues (Cleaver, 2001): are they?

Capturing Participation

There is surprisingly little evidence to support the contention that participation in its interventionalist PRA-PLA mode does generate positive benefits (Cleaver, 2001), and a few empirical studies have actually pointed to the contrary (e.g. see Beard, 2005, Study of participation in development in Indonesia). Unfortunately participation is often assumed to be another word for *"panacea"* (Bevan, 2000; King, 2003). Since the late 1990s, there has been a rise of a series of critiques (Cooke and Kothari, 2001; Mansuri and Rao, 2004) and counter-critiques (Mutamba, 2004; Parfitt, 2004; Williams, 2004a) on participation in development, especially when applied as an empowerment to action. What prevents participation from succeeding?

While participation could help in highlighting problems and issues that need to be tackled, and could perhaps even provide some insights as to how these could be best addressed, if people have no real power to change a situation, and unfortunately this is often the norm rather than the exception, then highlighting the problems is not going to change their circumstances. Giving people more power does not necessarily mean that the authorities will listen. After all, policy-makers and managers are often tied to other more pressing mantra, including "value for money" and efficiency of service delivery. Participation and deliberation can become corrupted terms as they may do nothing more than reinforce external power and deepen distrust and resistance (Nuijten, 2004; Parkins, 2006).

Furthermore, there is the myth of consensus (Peterson *et al.*, 2005) allied to a myth of community (Guijt and Shah, 1998). Participatory techniques are usually applied for ordering to draw out some underlying issues or to go further and explore solutions that can emerge from the community itself. What is typically being sought is the consensus; an agreement as to "what is" and "what needs to be", even if these are multiple rather than single in nature. It is assumed that such a consensus can be reached and that it adds legitimacy to the actions that would follow (Heysse, 2006). Well-established techniques such as multi-criteria analysis (MCA), integrated assessment (IA) and risk analysis can help elicit a pattern given such a set of multiple goals, objectives and perspectives (Marjolein and Rijkens-Klomp, 2002; Willis *et al.*, 2004; Mendoza and Prabhu, 2005). There is an inevitable move to reduce and arrive at consensus but is this realistic and does a participatory or deliberative process inevitably have to end in consensus?

Obviously there are practical concerns over representation; ensuring that all those who have a stake in sustainable development, either as winners or losers, have a voice (Barnes *et al.*, 2003). This is more difficult than it sounds. Even if an adequate representation is achieved, how can the plurality of outcomes be best handled? What if there is little agreement as to what the important issues are, and how to address them? Any community encompasses a wide range of individuals and social units spanning gender, age, ethnicity, experience and wealth spectra, and *a priori it* would be expected to find plurality rather than consensus (Hibbard and Lurie, 2000). Indeed, plurality is not in itself a bad concept (Dryzek and Niemeyer, 2006). A participatory approach could well discover such richness and that would be a valid finding (van de Kerkhof, 2006), but it is hardly a good starting point for focused action within sustainable development. It is more likely that these differences lead to a diverse set of actions, some of which may well be contradictory such as environmental protection and economic growth (Holden, 1998; Castro, 2004; Peterson *et al.*, 2005). Worse still it may be that differences are suppressed either by the community or, even worse, by the facilitator(s), in order to arrive at an imagined consensus or even "steered" in a particular direction so as to appease a sponsor (Parkins, 2006).

The MCA is a useful approach for achieving an apparent consensus, but does tend to hide two critical points. First, it is usually applied by an external facilitator and second, it seeks to arrive at consensus, even if combined with a participatory *ethos* (Mendoza and Prabhu, 2005). While everyone may feel a sense of fulfillment when the process is finally over, agreed action points may rapidly evaporate. The participatory exercise may do no more than draw out the views and wishes of those with the loudest voice and simply reinforce and exacerbate existing power inequalities within the community (Mosse, 2001; Cornwall, 2003; Peterson et *al.*, 2005). Forde (2005) describes how "pseudo-participatory" approaches were applied in Ireland as a means of strengthening the role of citizens in local democracy, but instead the process consolidates a top-down administration rather than enhancing the development of a participatory democracy. A not dissimilar example is provided for South Africa by Williams (2004b).

Unfortunately, given all of the above, it would sometimes appear that participation is an appealing and convenient catch-phrase that can hide business as usual. Real participation leading to real change can often appear to be as elusive as the end of a rainbow (Eversole, 2003).

Back to the Expert?

If participation is fraught with problems when applied to help achieve sustainable development, maybe we should accept that a degree of top-down technical dictate is inevitable. Should there not be an "ecocracy" which makes objective decisions free of the need to consult and debate (Ophuls and Boyan, 1992)? There has certainly been no shortage of attempts to derive top-down and technocentric drivers to help encourage sustainable development. A good example is provided by the Environmental Sustainability Index (ESI) of nation states, backed by the powerful World Economic Forum (WEF), in collaboration with Yale and Columbia Universities (USA). This partnership refers to themselves as the Global Leaders of Tomorrow, or simply Global Leaders. Their aim is a simple one – to condense complexity into a single index so as to allow comparisons between countries:

"Man is an over-complicated organism. If he is doomed to extinction he will die out for want of simplicity."

Ezra Pound (1968), *Guide to Kulchur.*
New York: New Directions Publishing Corporation, p. 253.

The ESI is the embodiment of this simplification. It is designed to "name and shame", in other words to highlight and put pressure on those countries that do not perform accurately. Hence, the derivation of a single index for easy comparison and the values presentation of that index in a league table format with countries doing well (high environmental sustainability) at the top, and those performing deficiently at the bottom. At the time of writing, values of the ESI have been published for 1999 (pilot study), 2000, 2001, 2002 and 2005.

The ESI methodology (to get a value for a country) is somewhat complex and the precise details do not need to be presented here. The 2005 version of the ESI (Esty *et al.*, 2005) covers 146 countries, and the process begins with the assimilation of raw data sets for 76 environmental variables which are aggregated into 22 indicators and finally into the ESI. The datasets cover a diverse range of variables such as environment pollution and pollutant emissions (pressure variables) through to concentrations of pollutants in water and air (state variables), and impacts on human health being a signatory to international agreements (response variables). Included, amongst them, there are one measure of corruption and measures which relate to human life span (e.g. child mortality rate) and education (enrolment and completion rates). Gaps are filled by a process of regression which predicts what the missing values would be based upon associations with other variables. The variables are standardized by subtracting the mean or subtracting from the mean (depending upon whether high values of the variable are regarded as good or unsatisfactory for environmental sustainability) and dividing by the standard deviation. The resulting z-values for an indicator (a group of related variables) is then calculated for each country and converted to a more intuitively meaningful statistic ranging from 0 to 100. In turn, these are averaged over all the indicators to provide a single value (the ESI) for each country. While the ESI is presented by the Global Leaders in a league table format, in Figure 4.3, the values of the ESI for 2005 are presented as a map (darker colours correspond to lower values of the ESI = worse environmental sustainability). From this figure it can be seen that the countries with the worst record on environmental sustainability stretch from Sudan and Ethiopia through to the oil-producing countries of the Middle East, Iran, Pakistan and China. Europe and North America registered quite good values.

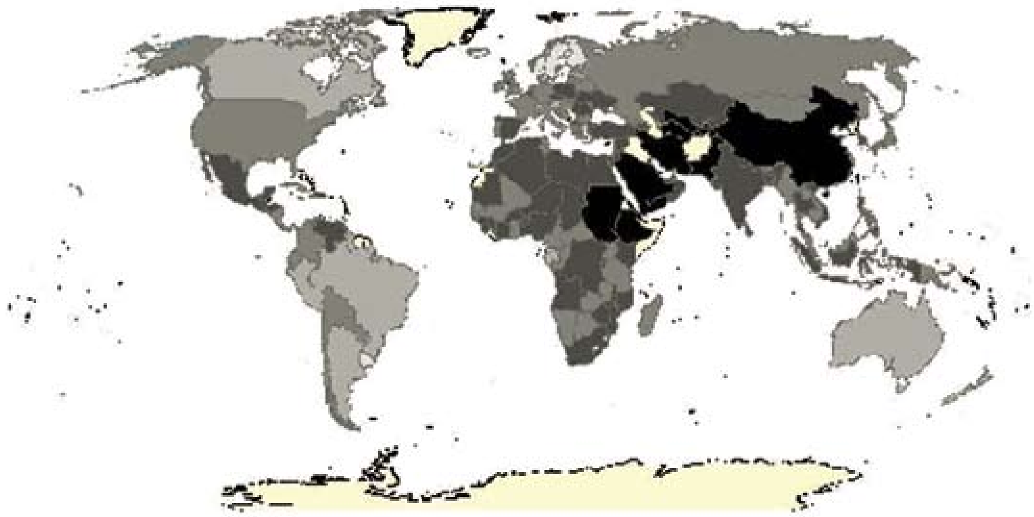

Figure 4.3: Results of the ESI (2005):
the darker the color, the worse the level of environmental sustainability

The ESI has been reported by the popular press of many countries upon its publication and this does engender some sensitivity amongst politicians. The following extract from The Guardian newspaper in the UK is but one example:

"*Britain has one of the worst environmental records in Europe… It ranks 66th out of the 146 countries on the index, considerably behind most of northern Europe, the US (ranked 45th) and even most of the former Soviet Union… Last night a spokesman for the Department for Environmental Food and Rural Affairs said "The UK has a good record on sustainability. Drinking water quality, bathing waters, river water and air quality are all improving year by year and many endangered species are now recovering due to government action. We strongly dispute the methodology of the index which is flawed and potentially misleading. However, Norman Baker, environmental spokesman for the Liberal Democrats, said "The government is always at pains to point out that the sustainability index isn't reliable. I'm sure if they came near the top they'd have an entirely different view of the matter"… Belgium's abysmal ranking in 2002 triggered an outcry in that country*."

Julian Borger and Ian Sample, The Guardian (25 January 2005)

But for all its appeal in terms of simplifying complexity, the ESI does have disadvantages (The Ecologist, 2001). As can be appreciated from the above summary the derivation is technical and somewhat complex and hence it is difficult for a non-specialist to assimilate. A key point is the control over variables that should be included in the first place. It has been pointed out that the ESI includes many variables that measure the response of a country to environmental problems and that these are related to availability of resources. Richer countries tend to do well with such response variables and hence tend to have a high ESI. Figure 4.3 is not just an ecocratic vision of the world but a result of the decisions made in the methodology; it is the Global Leaders vision of the world and not necessarily anyone else's.

So the advantages of the ESI in terms of a non-contested methodology allowing for ease of creation, update and presentation push against the disadvantage in terms of presenting just one picture of the world as seen by one small group of technocrats. At the same time, the job does get done and its influence is generated, hopefully for the better. At least with the ESI there is no pretence of participation.

Conclusions

Having made the cases both for and against participation and expert-driven approaches to sustainable development, it is perhaps no surprise that the answer, if there is one, is often stated to be a mixture of both (Birrer, 1999). The ESI works in raising awareness of sustainability problems. There is no public participation in the creation of the ESI and hence consensus is easily managed within a small group of ecocrats. Decisions can be easily made and the turn around is relatively rapid. The ESI can presumably succeed in helping to influence public deliberation via its wide reporting in popular press. The usefulness of such information in helping to inform deliberation has been noted by Lehtonen (2006) with regard to OECD environmental performance reviews. The reviews are not generated in a participative mode but do have an influence which may be indirect as with the ESI. Thus, expert-generated information may still provide an input into participatory approaches if it has been widely reported. While participation and deliberation have advantages, they can also be captured by a few and used to prepare a picture as to what needs to be done and how.

Therefore, the answer to the question *"Approaching sustainability through stakeholder participation: myth or reality?"* is a bit of both. Public participation and experts have a role and there is more overlap than often considered. It is not about "all or nothing". So is what we currently have, in terms of an apparent "mess" of top-down techno-centric and bottom-up participatory approaches, an inevitable and unavoidable consequence of the pluralism and trade-offs within sustainable development? Based on experience to date it would seem so. The sustainable development "space" is crowded with an array of approaches spanning participation and deliberation through to technocratic and ecocratic. There are also many overlaps: those engaging in deliberation may have been exposed via the popular press to indices such as the ESI or other messages. Neither should this diversity be seen as necessarily a bad thing. The world is a complex place and our efforts to try and make development sustainable need to be flexible.

In this book, the reader will come across a variety of participatory and expert driven approaches in the case studies. The reader is invited, in each case, to consider the nature of the groups involved and their role. In a microcosm, the book illustrates the above outlined diversity with projects set in certain place (the Mediterranean) and time.

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5 Applying Systemic and Prospective Sustainability Analysis for Coastal Areas: Building on the Malta Experience

Anthony Ellul

Abstract

*The use of sustainability indicators (SIs) as a tool to measure sustainable development is very important, provided that the SIs are suitable and measure what needs to be measured. The systemic and prospective sustainability analysis (SPSA) approach, now called IMAGINE, is an approach to define and measure SIs in a holistic and participative manner. Sustainability and SIs are stakeholder-defined. The approach, however, goes beyond measuring SIs and also seeks to use SIs to achieve change. Through scenario building, SIs are projected into the future and stakeholders agree on the preferred projection, thus defining actions to be taken to achieve the agreed outcome. Through this approach, SIs become a means to an end. Using a pictorial representation of the SIs through what is called the AMOEBA, it is possible to identify which SIs are moving away from or tow*ards the agreed sustainable threshold, which in this *case is termed the Band of Equilibrium.*

Introduction

Interest in the development and formulation of sustainable development indicators (SDIs) gained momentum in the 1990s and the subject still sparks great interest, particularly with regard to the methodologies used to identify and formulate such indicators. This aspect is considered more important than the actual indicators themselves since the methodology determines the relevance and utility of such indicators, particularly to stakeholders and other interested parties. However, despite the large extent of SDIs available at international, national or even local levels, the literature on the subject is very limited when it comes to approaches and methods. Why is the approach important?

One of the difficulties with sustainable development has been, and apparently still is, the definition of the concept and achieving agreement on what actually constitutes sustainable development. There is agreement, in general, with the definition given in the report *"Our Common Future"* and many variations have been proposed. However, the discussion on the meaning of sustainable development emerges from the realization that what is perceived as being sustainable varies from country to country and from region to region, depending on various factors, particularly the economic and social structures of the societies concerned. In this respect, it is therefore important to ensure that any discussion on sustainable development actually reflects and evolves from the conditions of the country/region/locality concerned and that indicators are formulated with relevance to the specific context concerned.

One of the most recent approaches in this regard is the Systemic Sustainability Analysis (SSA) or Systemic and Prospective Sustainability Analysis (SPSA) or as it has now been called – IMAGINE. This approach of formulating SDIs, and subsequently using these in scenario building, was first applied in Malta as part of the CAMP Malta Project. The Blue Plan introduced and coordinated the SPSA approach, developed by Dr. Simon Bell and Dr. Stephen Morse, based on its previous work in the field of sustainability indicators. The scope of this chapter is to explain this approach, highlighting lessons learnt during its implementation in the Maltese context.

Description of the Approach

Systemic and Prospective Sustainability Analysis (SPSA) has been designed to produce SIs in a manner which maximizes their chances of producing a holistic perception of the context in question, in an inclusive and participatory manner. The stages followed are indicated in Figure 5.1 and each stage is briefly described below.

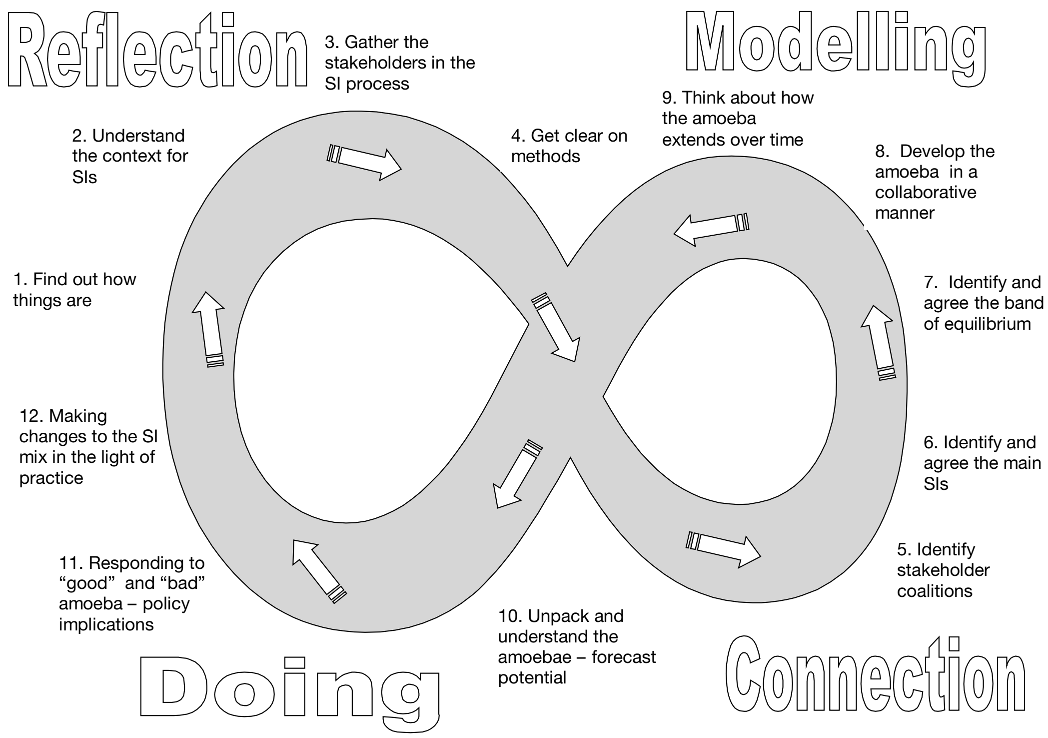

Figure 5.1: The SPSA process

Stage 1 – Find Out How Things Are

The first stage in the process is to understand the system being addressed. This is done by bringing into play the various actors and stakeholders involved, to identify controversial and common interests in the system. This initial “soul-searching” exercise identifies problems to be addressed, players and their roles, strengths and weaknesses as well as opportunities and threats (SWOT) and inter-relationships between the various actors. This approach sets the issue in context and establishes the particular climate within which the various stakeholders are to operate – whether a climate of conflict or cooperation. “*The outcome of this stage is insight into the potential for the people involved in the project intervention to deal with the issues and tasks which the context may throw up. It also provides an opportunity for emerging new themes and ideas*.” (Bell and Morse, 1999).

Stage 2 – Understand the Context for SIs

This stage is very much an extension of the first, and both can be regarded as integrally linked. This second stage extends the first by pictorial representation of the system under review through the use of the rich picture. The rich picture, as applied in SPSA, summarizes what has been identified and what is known about the system under review in a manner that can be easily understood in a "cartoon-type representation". The rich picture presents formal and informal elements, structures and processes which are then translated into tasks and activities necessary to address the various problems of the system.

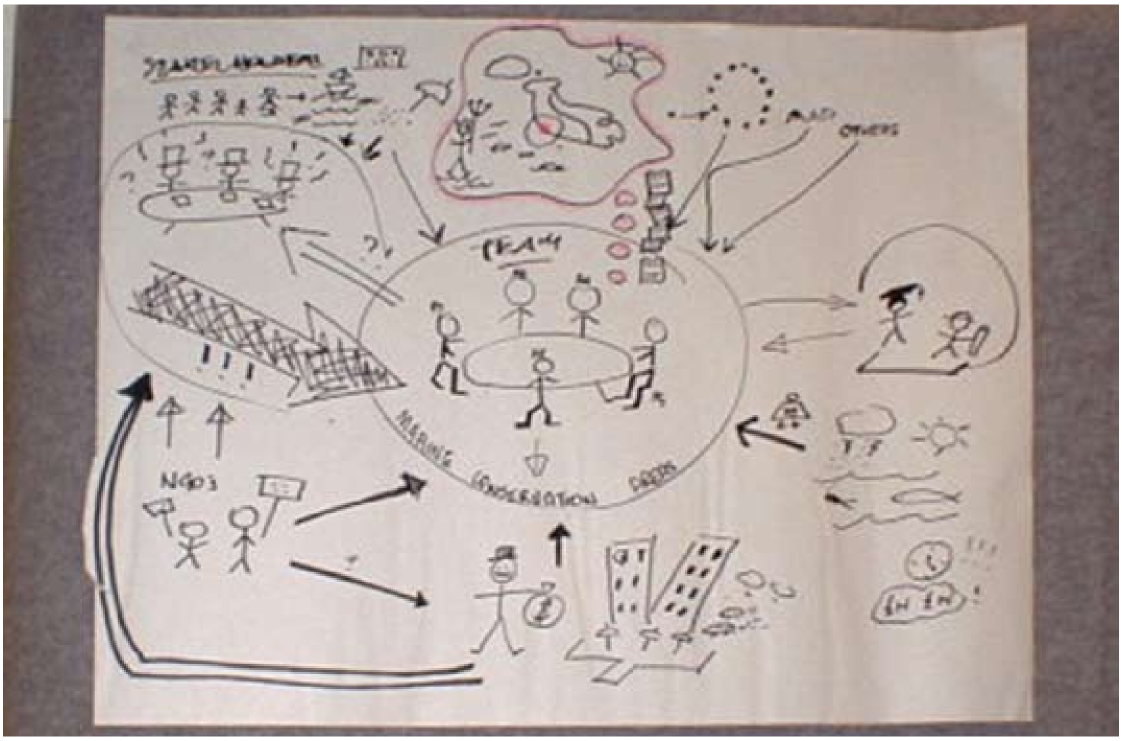

Figure 5.2: The rich picture

The result of these first two stages provide a clear understanding of the prevailing states of mind of the various actors and stakeholders involved and the complexities of the system being reviewed.

Stage 3 – Gather the Stakeholders in the SI Process

The main characteristic of this approach is the stakeholder's participation. The methodology advocates participation, learning about and respecting the views of stakeholders. It is also important to find a common definition of sustainability with regard to the system being reviewed, since various stakeholders may be viewing this concept from a personal perspective and it is important to find common trends to come to an agreement on sustainable development within this context. This will condition the process and outcomes of the subsequent stages.

The stakeholder's participation is not only consultative: stakeholders should also influence decisions. This, however, must stem from an informed basis since a diversity of interests and experiences may risk turning the exercise into a power game rather than a collaborative effort. Means of getting stakeholders together must be identified – workshops, seminars, focus groups, meetings, etc. Once stakeholders are brought into the process, they become an integral part of the approach, although it may often be the case that stakeholders have to be selected to ensure a manageable forum.

Stage 4 – Get Clear on Methods

Having identified the context, the tasks and activities to be carried out as well as the stakeholders to be involved, it is then important to clarify the outputs and the form these should take, and therefore, the methods to be used. The issues of sustainable development and hence SDIs may be new to stakeholders, and thus the level of understanding of this concept will determine the form the approach should take and the methods to be used.

Figure 5.3: Rich picture, issues and tasks

Stage 5 – Identify Stakeholder Coalitions

The identification and bringing together of stakeholders is a crucial stage in the SPSA process, particularly to define the sustainable system expected to be achieved at the end of the process. The stakeholder group becomes the basis for future decisions taken with regard to the project. The sustainability system is now clarified through a **root definition**. The root definition, formulated in not more than 30 – 40 words, becomes the mission or the vision of the system which, stakeholders agree, has to be created. The basic vision of the system is now defined and agreed. The next task is to identify the SIs that will measure the sustainability of the system.

The following is an example of a root definition identified in the CAMP Malta Project with regard to Sustainable Coastal Management: *"A Sustainable Coastal Management Project, owned by MAP/Government, developed by CAMP teams with local stakeholders, for affected interest groups, to achieve balanced development and integrated policy-making, assuming public participation, support and political will under constraints of social inertia, economic growth pressures and sectoral thinking".*

The root definition should include the transformation to be achieved, for whom (customer), by whom (actor), based on the worldview, within environmental constraints, and clarifying who will own the process (owner).

In the Maltese case study, the above stages were completed during the first workshop which involved participants in CAMP (Malta), particularly team members of the various projects. This first stage in the process did, therefore, not include all the relevant stakeholders.

However, the result was important for better understanding the diversity of issues to be addressed in each project.

Stage 6 – Identify and Agree the Main SIs

The composition of the stakeholder group determines whether the identified SDIs can cover the major aspects of the system. Stakeholders in the Maltese case study represented various sectors, including actors from sectors such as tourism, agriculture, fisheries, environmental NGOs, and local government, amongst others. It is important that the identified SDIs provide a snapshot of the system sustainability. State SDIs provide this snapshot, whilst Pressure SDIs show why the desired situation is or is not being achieved. Coming to an overall agreement on the final list of SDIs may happen to be an extensive exercise and the process may take different formats, e.g. brainstorming amongst stakeholders or using already established and relevant SDIs.

Stage 7 – Identify and Agree the Band of Equilibrium

This is a delicate stage in the SPSA process, particularly since it may entail compromises to determine what stakeholders consider as sustainable. The band of equilibrium is simply a range within which a particular indicator can be considered as having reached a sustainable level. Below or above this range would not necessarily be considered as sustainable. Determining what is acceptable and deciding on the agreed band entails having relevant data, and both professional and practical expertise. This may turn out to be a tug of war but also serves to indicate that sustainability is somewhat subjective as a concept, and what is sustainable for one may not be sustainable for another.

Table 5.1: Some SDIs identified by the soil erosion and desertification control team

Driving force Rainfall intensity % of watershed which is built % area covered by non-absorbent surfaces % area trampled within fields Location and width of foot paths within fields No. of days with gale force wind	**State** Slope steepness % irrigated land % abandoned land % of land under vegetation cover No. of trapping sites and hunting hides
Response No. of rills within watershed (depth and width) Monetary compensation Quantity of natural fertilizer	

Stage 8 – Develop the AMOEBA in a Collaborative Manner

The *AMOEBA* is simple in presentation but rich in information and serves to map out the SDIs, indicating the level and extent of the overall sustainability of the system. The SDIs are distributed into four categories – economic, social, environmental and technological – represented, on the *AMOEBA*, in four quadrants. The band of equilibrium is represented by an inner circle in the *AMOEBA* and each SI is represented by a line drawn from the centre of the circle radiating outwards towards the band of equilibrium circle. Should the line stop within this band, the specific SI is considered to be within the agreed sustainability range, but if outside this band, the SI is not within the agreed range and it may be necessary to investigate the reason for this. The *AMOEBA* immediately shows, through visual representation, where intervention is needed and may also indicate relationships between the SDIs, thus emphasizing the importance of a holistic approach to sustainable development. The second and third workshops consolidated the work conducted in the above-mentioned stages, particularly defining further the SDIs as well as introducing this approach to various stakeholders, e.g. tourism actors, local government, NGOs, etc. The approach sparked interest amongst certain groups, particularly the NGOs, and this formed the basis of further discussion with these stakeholders in the future. The stakeholders were also asked to comment on the band of equilibrium set for the chosen SDIs and some even suggested new bands of equilibrium. Responses came primarily from NGOs and one local council.

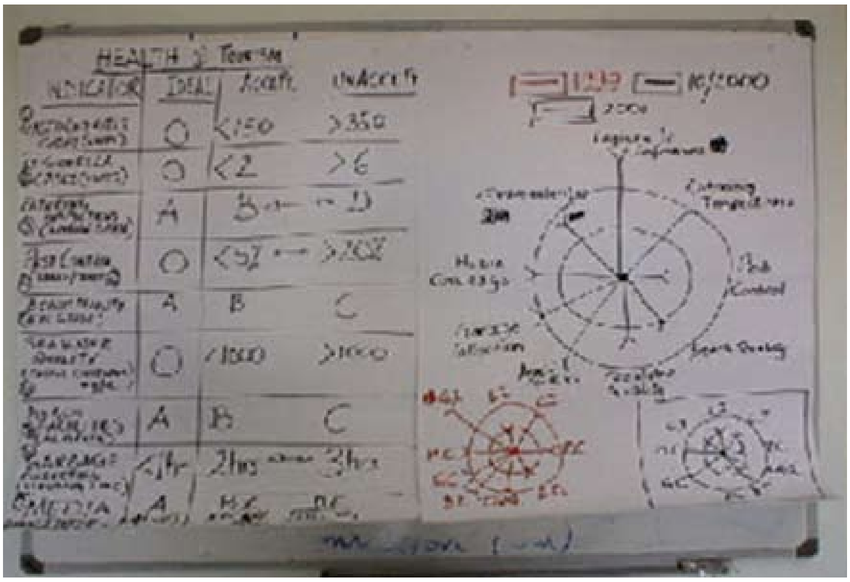

Figure 5.4: Defining bands of equilibrium and producing AMOEBA

Figure 5.5 shows an *AMOEBA* example, indicating the four quadrants together with a sample of SIs and their relation to the band of equilibrium. The *AMOEBA* is actually formed by joining each indicator to obtain a shape within the circle.

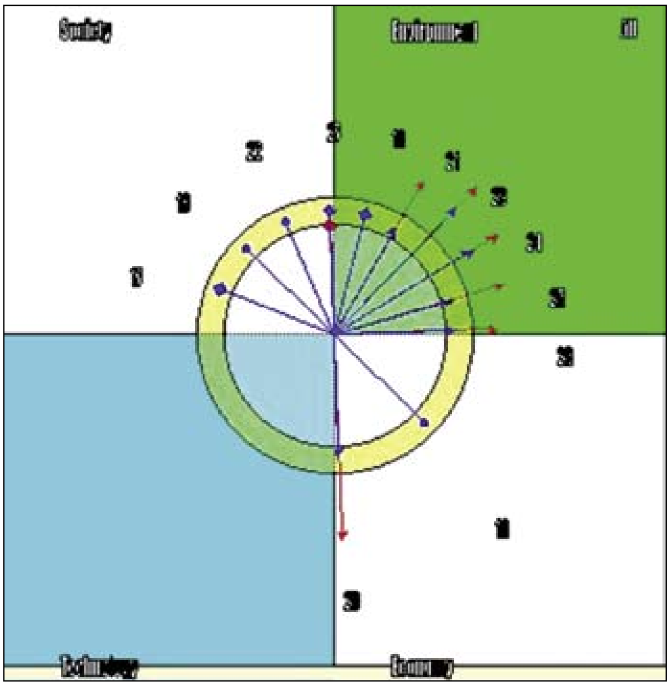

Figure 5.5: The AMOEBA

Some of the main SDIs identified during the various workshops are listed as follows:

Indicator	Domain	Polarity	Note	Maximum	Minimum	2000
Scheduled/protected areas in NW	1	>	% of the total coastal area of the NW	80	65	66
Abandoned agricultural land	1	>	% of total agricultural land	25	7	15
Fish farms in the NW	1	<	number of farms	5	2	5
Cars travelling through the NW	1	<	number of cars during peak	3000	1000	4500
Marine vessels in the NW	1	<	number of marine craft during peak weekend	700	400	1000
Enforcement actions by PA	1	>	annual number of cases	60	25	68
Marine conservation/protected areas	1	>	% of coastal length	20	10	0
Diving in the NW	1	<	No. of dives	40000	15000	55000
Bathing water quality	1	>	% of samples meeting acceptable levels of faecal coliforms (<1000mg/l)	95	85	98.3
Number of breaches in rubble walls	1	<	No. of breaches	10	5	11
Pollution in ground water	1	<	Level of nitrate (mg/l)	50	25	65.27
Unemployed as a % of working population	2	<	% of working population in NW	3	1	1.8
Full time farmers	2	>	% of total farmers	50	40	44
Tourist accommodation occupancy - winter	2	>	occupancy % during winter	55	35	26
Employment in tourism	2	>	fulltime employees in NW % of total	25	15	14
No. of claims for storm damage	2	<	No. of annual claims	50	25	72
TSE recycled water	2	>	% of water consumed	80	50	4.6
leaked water	2	<	cubic metres per hour	600	300	1200
level of bunkering operations	2	<	% of total operations in Malta	20	5	19.3
Population growth in the NW	4	>	annual rate of growth	5	2	1.4
population density in NW	4	>	population per sq km	500	300	328
Beach closure	4	<	number of days during summer	15	2	25
Tourist resident ratio -summer	4	X	daily tourists as a % of residents	95	70	136
Gastroenteritis outbreaks in NW	4	<	No. of total outbreaks in a year	3	1	5
Quality of drinking water (1)	4	<	Level of chloride (mg/l)	800	200	517
Quality of drinking water (2)	4	<	Level of nitrate (mg/l)	50	15	56
Quality of bathing water	4	>	No. of points obtained on faecal coliform readings	50	35	40

Stage 9 – Think About How the AMOEBA Extends Over Time

This stage examines the potential for extending the *AMOEBA* over time and projecting SDIs into the future to gain an understanding of what is likely to happen based on past trends and data. Producing *AMOEBAE* allows monitoring of specific indicators over time to evaluate whether actions being taken are being effective in achieving the desired result. The important aspect of the *AMOEBA*, as already stated, is the possibility to see a holistic picture of the level of sustainability of the system and to identify which indicators may be affecting each other.

SDIs are a means to an end, a means to provoke change where it is needed. The SPSA is a cyclical process and is continuous since the SDIs may need to change and new ones may need to be introduced; bands of equilibrium may also change. Sustainability is dynamic and changes over time and, therefore, those factors measuring sustainability also need to change to reflect the new context. SDIs in the SPSA approach provide the basis for scenario building, identifying what is likely to happen and what could happen should certain tasks be undertaken. The marketing of SDIs is equally important to encourage change in the direction desired. Marketing change is not easy, but through promotion of a better environment or better income and social conditions, the general public might be encouraged to change customs and methods moving towards more sustainable practices. Appendix A provides an example of three scenarios that have been identified with regard to the SDI relating to abandoned agricultural land. Appendix B provides a list of SDIs and the expected changes under two specific scenarios. These are then represented diagrammatically through the *AMOEBAE*.

Figure 5.6: Use of the rich picture to project future scenarios

Reducing sustainability to a mere index is misleading and does not identify where action needs to be taken or where intervention is giving results. Another important element identified during this process is hence to look at the inter-relationship between the SDIs and at how changes in specific SDIs may be affecting other SDIs. A matrix was prepared indicating the relationship between the SDIs identified in CAMP (Malta) in 2001, on the basis of positive (green), negative (red) or neutral (orange):

		1	2	3	4	5	6	7	8	9	10	11	12	13
	SUSTAINABLE COASTAL MANAGEMENT													
1	Scheduled/protected areas in NW													
2	Applications granted - agriculture													
3	Abandoned agricultural land													
4	Fish farms in the NW													
5	Bunkering operations in NW													
6	Hardstone quarries													
7	Cars travelling through the NW													
8	Marine vessels in the NW													
9	Full time farmers													
10	Fish catch													
11	Tourist accommodation occupancy - winter													
12	Employment in tourism													
13	Population growth in the NW													
14	population density in NW													
15	Full time fishermen													
16	Beach closure													
17	Tourist resident ratio -summer													
18	Marine conservation/protected areas													
19	Diving in the NW													
	TOURISM AND HEALTH													
20	Gastroenteritis cases													
22	Pest control													
23	Sea water quality													
	SOIL EROSION & DESERTIFICATION													
24	Rills and gullies													
25	Monetary compensation for storm damage													
26	Breaches in rubble walls													
27	Hunting and trapping sites per catchment area													
	INTEGRATED WATER RESOURCES MANG.													
28	Quality of drinking water													
29	Use index													
30	Water consumption													
31	Pollution in groundwater													
	MARINE CONSERVATION AREAS													
32	phc in effluent (bunkering)													
33	Marine vessels in MCA													
34	Complaints by visitors													

Stage 10 – Unpack and Understand the AMOEBA (Forecast Potential)

The scope of the *AMOEBA* is that it is an action-oriented tool. This stage identifies which SDIs are showing an existing problem or a tendency towards a problem, thus highlighting where corrective or preventive action has to be taken. This stage again brings into play the vision of stakeholders with regard to the sustainability of the system and identifies which actions are giving the desired results and which are not.

Stage 11 – Respond to "Good" and "Bad" AMOEBAE (Policy Implications)

An *AMOEBA* which tends to be close to the band of equilibrium signifies that all sectors are operating satisfactorily; however, this should not be cause for complacency since further analysis may be necessary to determine with certainty that the system has actually reached a sustainable level. Other aspects may have been missed and this is why the *AMOEBA* looks "good". In case the *AMOEBA* looks "bad", action must be directed to those areas where SDIs are not performing at desired level and particularly to those tasks which do not assist in achieving the desired state. The evaluation of the SDIs over time may indicate whether the remedial action undertaken has in fact solved the problem.

Stage 12 – Make Changes to the SI Mix in the Light of Practice

The *AMOEBA* is intended to provoke. It is the means to an end. It should encourage debate and subsequent action to achieve the desired state. This is where the prospective aspect of the SPSA comes in. Trends in SDIs indicate potential future scenarios and stimulate discussion on the tasks to be undertaken to reach the transformation necessary for the desired scenario.

Conclusions

The two years, during which the project operated, were a learning process. The main conclusions that emerged from the five workshops held in relation to this project can be summarized as follows:

a) Although participants showed a general interest in the approach, at times attendance and participation fell short of what was expected. Nonetheless, those that attended showed an enthusiasm to participate in the workshops and were eager to discuss, despite their different backgrounds. The lack of participation was not due to a lack of interest but was primarily due to other pressing commitments. It is, therefore, important that should this approach be adopted, the team members involved are committed to the exercise and stakeholders are brought into the project from the start to instill the desired level of commitment.
b) The project brought together participants from different backgrounds, offering an opportunity for different sectors to discuss and identify common areas of interest of which they may not have been aware. Workshops with stakeholders also discussed the concept of sustainability, which to some was relatively new, as was the concept of SDIs.
c) The SPSA showed that it can be a means whereby the concept and application of sustainable development reaches a wider target audience. Since the effectiveness and success of the SPSA depends on the involvement of stakeholders in the process, it is important that these are brought into the project from an early stage, even when the project is being developed. This is important not only to ensure effective participation throughout the process but also to encourage ownership and continuity of the process

This approach has evolved since its first application in the context of the northwestern areas of Malta, as part of the CAMP Malta Project. The Blue Plan has also applied this methodology in other areas of the Mediterranean, e.g. Lebanon, Algeria and Slovenia, as part of CAMP Projects within the Mediterranean Action Plan. A handbook has since been finalized to assist in the application of this methodology.

The SPSA activity was a learning experience for the SPSA team as well as for those team members that participated in the various workshops. The use of this approach has been transferred to the local scene and the method can be re-applied to other new projects which seek to approach development along sustainable lines. The experience of SPSA has shown that diverse sectors can meet and discuss issues in a systemic manner where each sector seeks to understand the others, and diverse interests can together express common concerns and seek to respond to solutions in an integrated and coordinated manner. The SPSA is not a main tool for conflict resolution but should serve to reduce potential conflicts, particularly since the level of sustainability is stakeholder-defined and accepted. Participation should also provide the basis for stakeholders to implement specific actions which should lead to the achievement of the desirable scenario or future outcomes.

References

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Appendix A:

Three Scenarios for SDIs on Abandoned Agricultural Land

ABANDONED AGRICULTURAL LAND

The first SI discussed was the % of abandoned agricultural land. The data collected indicates that this has been increasing over the last years. The following three scenarios were identified:

Scenario 1: A sharp increase in the % of abandoned agricultural land

This scenario can occur should the current situation prevail. Agricultural production exceeds demand, with respect to specific produce resulting in a low return. Technological improvements have increased production from the same piece of land and thus the farmer has no incentive to add more land into production. The current level of full-time farmers is high.

Scenario 2: An increase in the % of abandoned agricultural land but at a lesser rate

This scenario can occur should specific actions be taken up. The most important would entail a restructuring of the agricultural sector with more coordination amongst the various farmers, particularly with regard to what to produce and when, even though this is limited by the type of land being worked and its production potential. The availability of more recycled water would reduce potential abandonment of good quality agricultural land. Better production practices can ensure that supply satisfies demand levels.

Scenario 3: A decrease in the % of abandoned agricultural land

This scenario can be achieved provided the agricultural sector is given the attention needed, including incentives and assistance to ensure that farmers make use of their land rather than abandon it. This can be achieved by providing better information on what produce is required and in which season. The tourism sector has indicated that certain products are scarce when most needed and collaboration between sectors can bridge the gap, directing farmers to produce what is in demand. The availability of second class water through sewage treatment would also encourage the conversion of abandoned land into productive land.

During the discussion it clearly emerged that the transformation to achieve is **restructuring and an improved organizational strategy for the agricultural sector.**

In terms of marketing activities that need to be undertaken, the following were some of the suggestions:

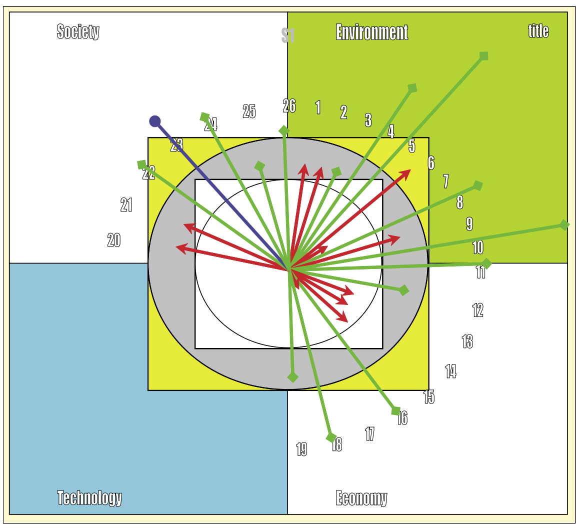
a) Information sessions amongst the farming community to encourage improved agricultural practices particularly in keeping an eye on demand.
b) Training sessions on the presentation of agricultural produce.
c) Information leaflets issued by Pitkali (the agricultural market depot) to farmers indicating the likely demand for specific produce during the different seasons.
d) Collaboration between the agricultural sector and other interested sectors (e.g. tourism) through joint committees and exchanges of information.
e) More publicity concerning local agricultural products to promote the quality of local produce.
f) Training programmes for farmers to ensure a quality product.
g) Information leaflets on the use of abandoned agricultural land for production of products in demand.

Some of the problems identified concern the quality of agricultural land, which constitutes a constraint on the proportion of this land which can be cultivated and for what type of produce, as well as the lack of water resources and competition from products imported from abroad. These are also other issues, which need to be addressed.

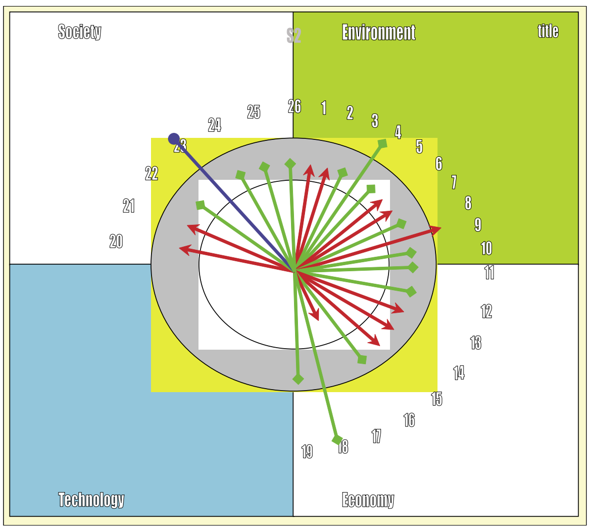
Appendix B:

Projections of SDIs Based on Two Future Scenarios

Indicator	Note	Maximum	Minimum	2000	Scenario 1 Current trends	Scenario 2 Improved environmental performance
Scheduled/protected areas in NW	% of the total coastal area of the NW	80	65	66	73	75
Abandoned agricultural land	% of total agricultural land	25	7	15	20	10
Fish farms in the NW	number of farms	5	2	5	5	5
Cars travelling through the NW	number of cars during peak	3000	1000	4500	5000	3500
Marine vessels in the NW	number of marine craft during peak weekend	700	400	1000	1500	650
Enforcement actions by PA	annual number of cases	60	25	68	70	30
Marine conservation/protected areas	% of coastal length	20	10	0	5	15
Diving in the NW	No. of dives	40000	15000	55000	60000	40000
Bathing water quality	% of samples meeting acceptable levels of faecal coliforms (<1000mg/l)	95	85	98.3	90	99
Number of breaches in rubble walls	No. of breaches	10	5	11	20	8
Pollution in ground water	Level of nitrate (mg/l)	50	25	65.27	70	30
Unemployed as a % of working population	% of working population in NW	3	1	1.8	2.5	2
Full time farmers	% of total farmers	50	40	44	30	50
Tourist accommodation occupancy - winter	occupancy % during winter	55	35	26	25	40
Employment in tourism	fulltime employees in NW % of total	25	15	14	13	20
No. of claims for storm damage	No. of annual claims	50	25	72	65	35
TSE recycled water	% of water consumed	80	50	4.6	10	30
leaked water	cubic metres per hour	600	300	1200	800	800
level of bunkering operations	% of total operations in Malta	20	5	19.3	18	10
Population growth in the NW	annual rate of growth	5	2	1.4	2	3
population density in NW	population per sq km	500	300	328	350	400
Beach closure	number of days during summer	15	2	25	20	10
Tourist resident ratio - summer	Local residents as % of foreign tourists	95	70	136	140	125
Gastroenteritis outbreaks in NW	No. of total outbreaks in a year	3	1	5	4	2
Quality of drinking water	Level of chloride (mg/l)	800	200	517	500	300
Quality of drinking water	Level of nitrate (mg/l)	50	15	56	55	40
Quality of bathing water	No. of points obtained on faecal coliform readings	50	35	40	45	50



Scenario 1



Scenario 2

6 Green Business: A Call for Place-based Best Practices and Sustainability Indicators

Amy K. Townsend

Abstract

Indicators of sustainability have been regarded with increasing importance as people search for ways to establish baselines and measure changes in environmental health. However, what is the role of sustainability indicators in business? As a proxy for human subsistence and material desires, businesses have depleted and polluted ecosystems in the Mediterranean and around the world. Thus, they are one of the primary reasons for which sustainability indicators are needed. This chapter explores how sustainability indicators can be used to baseline and measure environmental progress as well as encourage businesses to improve their relationships with the natural world. First, it examines why many companies are seeking to become "greener"[8], or more environmentally friendly. Then, it explores the targets that companies want to enhance. Next, it discusses today's green business best practices and suggests that, while helping to reduce the harm that companies cause to the environment, most best practices cannot result in ecologically sustainable businesses. Finally, the paper introduces the concept of business ecology and explores its implications for the development of new and more place-based sustainability indicators.

The Business-Environment Relationship

The ecological effects of businesses, industries, and economies have been well documented in the green business (Buccholz, 1998), environmental (Worldwatch Institute, 2002), and ecological economics literatures (Costanza, 1991). At least since the industrial revolution, most businesses have had a discordant relationship with the natural world via non-sustainable resource acquisition and pollution. Both the speed with which technology can extract resources and the increasing demand for resources globally pose a grave threat to ecosystems, which are losing health, resilience, and evolutionary opportunities.

Businesses respond to their environmental harm in several ways, as illustrated in Figure 6.1.

[8] Business greening activities can be divided into two general categories: those enhancing human and ecosystem health and those improving efficiency. Greener activities that relate to health might include the use of non-toxic paints, carpeting, furniture, and office products indoors and native plantings outdoors. Those that relate to efficiency might include the use of composting toilets, rainwater collection, greywater recycling (water efficiency); the use of daylighting, efficient lighting, and alternative energy (energy efficiency); and building renovation, recycling programmes, and product repair and reuse (materials efficiency).

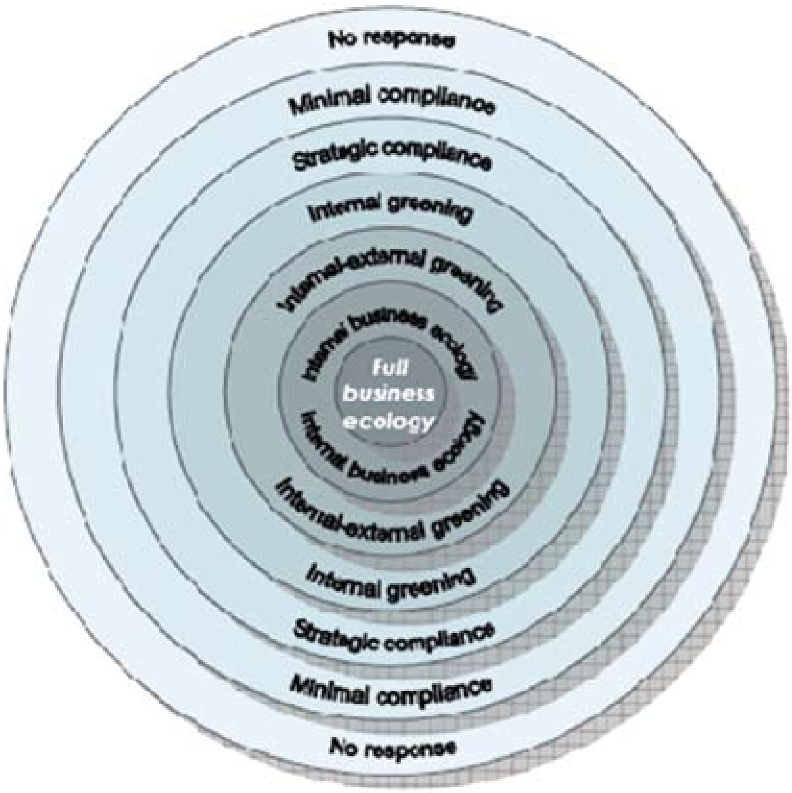


Figure 6.1: Proximity of seven business environmental response types to sustainability (represented by full business ecology at centre)

Each of the seven response types is discussed below.

No Response

This stage is characterized by a company's failure to respond to environmental issues. Companies that do not comply with environmental regulations or that intentionally move their production or other facilities to countries with less stringent environmental regulations are represented here.

Minimal Compliance Response

In this stage, the company addresses compliance-related issues. It might consider itself to be a good "citizen" because it abides by the law. Yet, it does not seek to extend its environmental commitment or responsibility beyond that required by law.

Strategic Compliance Response

More sophisticated than the minimal compliance response, companies responding in this way seek to comply with environmental regulations in a more strategic manner. For example, they might work to stay ahead of upcoming environmental regulations. They also might work hard to develop new processes or technologies and, then, lobby hard to have their processes or technologies adopted as the new standards.

Internal Greening Response

In this type of response, the company exhibits greener responses internally but does not extend its area of greening beyond its own activities. Though this response can arise from a company's concern for the environment, there are other reasons that can motivate companies to take this approach to environmental issues. Many of today's greener companies fall into this category.

Companies can exhibit a broad range of internal business responses to environmental concerns. For example, they might become more resource-efficient by minimizing or eliminating waste or create more resource-efficient (e.g. energy, water), healthier (e.g. non-toxic, daylit) facilities. They also might develop greener products or services.

Internal-External Greening Response

With the internal-external greening response, businesses extend their environmental response outward. For example, they might partner with other businesses for mutual benefit. Such is the case with eco-industrial parks, in which companies develop synergistic processes or benefit from one another's wastes. They also might help their suppliers to become greener or require them to become ISO 14001 certified. Additionally, they might work to educate their customers about environmental issues.

Internal business ecology response

The business ecology response moves beyond the idea of the business as an individual enterprise or even as part of a network of businesses. In this response, a company's environmental relations are an explicit part of every aspect of business. Its actions benefit all stakeholders – most notably, the environment, from which it draws raw materials and on which it relies for ecosystem services. In the business ecology response, the business relationship with the environment is defined as a partnership. The environment does not only inform about a business activity: it drives it.

Internal-External Business Ecology Response

This response is the ultimate expression of business ecology. In using and learning business ecology for the first time, a business is likely to focus mainly on how it relates to its own sites (internal business ecology response). However, once it has begun to gain experience in applying business ecology practices, it can network outward to form partnerships with local and regional land users to regenerate ecosystems and rebuild natural capital.

Reasons for Companies' Greening

Research indicates that many businesses are nowadays working to become greener for one or more of five reasons (Townsend, 2006), detailed below (these are *not* presented in order of importance):

1) Some companies choose to reduce their environmental harm because they are committed to environmental values. Such commitment typically comes from a company's founder who has the authority to integrate environmental values and behaviours at all levels.
2) Businesses might choose to become greener as a result of government regulations. Some companies might wish to comply with government regulations while others might become greener in order to influence government regulations and stay ahead of their competition.
3) Businesses can respond to economic incentives or disincentives by becoming greener. For example, greener products might command higher prices, which can act as an incentive for companies to supply such products. Conversely, products that are highly toxic or otherwise harmful to the environment (including humans) might not sell well. As a result, the manufacturers might change their formulations or decide to stop their production.
4) Environmental crises can drive businesses to improve their environmental performances. Companies that suffer public humiliation for a chemical spill, an oil spill, or some other environmental disaster might find it in their best interest to commit to environmental improvements. Similarly, other companies within their industry might find themselves under increased public or governmental scrutiny and might change their environmental policies/behaviors accordingly.

5) Stakeholder pressure can influence a company to become greener. Such pressure can be levied through consumer boycotts, pressure from environmental groups and other non-governmental organizations, letters from shareholders, and other forms. Stakeholder pressure might be particularly strong following an environmental crisis, but it can occur at any time.

Companies' Greening Targets

As the concept of greening is quite new to may businesses, a basic directory for greener companies has not yet been standardized. This chapter divides companies into five elements and suggests including them all in a list of companies' greening targets. However, it is important that, regardless of how the company is divided, the entire greening process is achieved. The five elements are *not* mentioned in order of importance.

The companies can be divided into five elements: the mission, the employees, the operations, the products and services, and the facilities and sites, as illustrated in Figure 6.2:

Figure 6.2: The five elements of business

The **mission** refers to the company's purpose, its reason for existence. This is the primary and often overlooked step in the greening process of a company. If a company's purpose is not sustainable, there is no way that it can turn out to be sustainable, although this should not preclude it from taking steps in improving its environmental performance in other areas.

A company that is dedicated to improving its environmental performance also needs to green its *employees* at all levels. Every staff member, regardless of rank, needs to be involved in environmental improvements in her/his job.

Operations are considered another aspect in which environmental improvements need to occur. Operations is used here as a catch-all phrase to include a wide variety of activities such as procurement, investments, marketing, accounting, and other company activities that are outside the purview of the production of goods/services and facilities/sites.

Products and services refer to the processes and products that go into the manufacture and/or delivery of goods and services.

Facilities refer to all buildings/structures constructed and/or used by the company. **Sites** are divided into three categories: primary, secondary, and tertiary:

1) Primary sites are those that a company inhabits through its facilities, the places in which the company and all of its subsidiaries/franchises are located. They are the specific locations of corporate headquarters, storage facilities, and even non-terrestrial or temporary facilities, such as boats or spacecraft. Primary sites are generally easy to identify as they are demarcated by the boundaries of property ownership or leased space.
2) Secondary sites are all of those places from which the company extracts natural resources. Secondary sites might be identified by the boundaries of land/aquatic ownership or use. Some of these sites might be owned or leased, such as government land used for mining or grazing, or aquatic areas used for fishing and other marine activities. They might include a bauxite mine, a river used for hydropower, or a forest from which the firm takes some of the materials used in production, or in facility construction or renovation. Firms should recognize that their primary and secondary site boundaries are not likely to correspond directly to ecosystem boundaries.
3) Tertiary sites are those places that are affected by the company. Tertiary sites can be the most difficult to identify because they include places affected by both point-source and non-point source pollution. In fact, they also span multiple spatial and temporal scales, from global climate to human DNA and other species; for instance DNA that succumbs to genetic mutations can be considered a tertiary site that has been affected by some sort of mutagenic pollutant. Tertiary sites include every place on earth and beyond, including communities living downstream or downwind from company activities, earth's ozone layer, the global climate, and outer space (e.g., anthropogenic waste from spacecraft). However, it might be difficult or impossible to identify all of a company's tertiary sites because all of those places that are affected by the company's activities might never be known. Yet, identifying tertiary sites to the extent is an essential part of business environmental accountability.

If a company does not include all these five elements in its greening efforts, it might make important improvements in its environmental performance but would not achieve sustainability. Regardless of how a company is divided for the purposes of greening – not necessarily split into these five elements – all the business aspects should be included in the greening targets.

Green Business, Best Practices and Sustainability Indicators

Current green business best practices have played a crucial role in helping companies and other organizations to reduce the environmental harm caused by their products and activities. Best practices can be divided into four general types: principles, methods, certification programmes, and environmental reporting. *Principles* are used to guide the company behavior. **Methods** are used to improve or assess the business environmental performance. **Certification programmes** provide a standard set of criteria by which to judge a company's environmental performance. **Environmental reporting** communicates to the public the company's environmental goals and its successes and failures. Companies generally use a combination of best practices. For example, popular greening activities include recycling, greener building, greener procurement, the use of life-cycle impact assessment, securing environmental certification, and conducting some form of environmental reporting.

Green business sustainability indicators, used to identify and assess a company's greening progress, fall into the category of *methods*. There are several common indicators; for instance, the ecological footprint measures the amount of ecologically productive land and sea that is required to support a person's/group's material consumption and absorb their wastes. An environmental audit is a periodic, systematic, third-party assessment of a company's environmental performances and it focuses on equipment and systems. The environmental benchmark sets internal standards against which a company can measure its environmental performance. The benchmark can be used to measure substance emissions, energy use, recycling volume, or any other activity a company wants to track and improve. After establishing a benchmark, a company can set the goals for improvement (e.g. 40% CO_2 emissions reduction by 2008). An environmental performance evaluation (EPE) is an internal management process used to assess environmental performance. It uses indicators to assess a company's past and current environmental performance against its overall environmental performance goals. The International Organization for Standardization (ISO) has established a set of guidelines to help businesses conduct EPEs. Meanwhile, life-cycle assessment provides a means for identifying the potential environmental impacts of a product or service throughout its entire life. This is a technical, time-intensive process that accounts for all phases of a product's (or service's) life, from resource extraction and manufacturing to use and disposal or re-use. Life-cycle cost accounting was developed in order to make the environmental and social costs of a product visible. It differs from normal environmental cost accounting as the environmental costs of a product/project are accounted for the product's/project's entire life-cycle. Life-cycle cost accounting identifies as many environmental and social costs as possible throughout a product/project's lifetime.

Limitations of Current Green Business Best Practices and Sustainability Indicators

Unfortunately, most of current green business best practices, including the sustainability indicators mentioned in the previous section, do not go far enough to inspire ecologically sustainable business. This happens for several reasons:

1) Existing green business best practices do not include the entire company in their scope. As a result, companies might actually inhibit their ability to achieve their greening goals when trying to green only partially.
2) Most of the green business best practices focus on reducing a company's environmental harm. Although this is important, companies need to move beyond this goal and plan to renew degraded ecosystems, thereby rebuilding natural capital.
3) Most companies rely on "reduction and replacement strategies". Such strategies seek to reduce resource use and waste through efficiency measures. They also replace toxic substances with non-toxic or less toxic ones. Although reduction and replacement strategies are beneficial, they do not result in ecological sustainability.
4) Present green business best practices are almost all quantitative in focus. Although the business adage "what gets measured gets managed" might be accurate, quantitative green efforts are often missing the rich qualitative details of human-ecological relationships, social equity, quality of life, and other topics associated with sustainability.
5) Most of the green business best practices seek to integrate environmental issues into company activities. As important as this is a unidirectional focus that establishes the company as the baseline rather than earth's systems. The focus needs to be on integrating the firm into the environment rather than merely the other way around.
6) Most of the green business best practices are not ecologically based. They often fail to incorporate the natural and social sciences into greening perspectives and methodologies. Although all greening efforts should be applauded, most of today's best practices might actually put companies at disadvantage by providing:
    - Little to no ecological knowledge about the environment, in general, and about a company's sites, in particular;

- Little knowledge about a firm's specific environmental impacts;
- No mechanisms for perceiving/responding to ecological feedback;
- No means for adapting the firm to ecosystems – instead, some companies force ecosystems to match business values/schedules (e.g. engineer faster-growing trees or cows that produce milk continuously).

This problem is compounded by the fact that, at least in the United States, the best green business school programmes do not require students to be ecologically literate. How will the world's future business leaders be able to determine if their companies are sustainable if they do not know how ecosystems function? To date, only one business school programme (Antioch University, New England) has incorporated environmental science into its *curriculum*.

7) Green business best practices typically use generic approaches to greening. Such approaches are not informed by the unique ecological qualities, constraints, and opportunities of particular sites.
8) Current green business best practices tend to address only a single (human) scale in space and time. Yet, nature works on multiple spatial and temporal scales simultaneously. These scales are connected through relationships both within and across ecosystems. Thus, best practices do not mirror the natural complexity found in nature.

An Introduction to Business Ecology

The Concept

The nascent field of business ecology might provide a solution for greening business. Business ecology may be defined as the study of the relationship between businesses, organisms, and their abiotic environments. The goal of business ecology is ecological sustainability, which is to be achieved through *"the full ecological synchronization and integration of a business with the places that it inhabits through its facilities, uses for resources, and affects"* (Townsend, 2006). The goal of business ecology has several implications that require some articulation. These implications are discussed below.

A complete Ecological Synchronization

To begin with, this definition of business ecology stresses a *complete ecological synchronization* with sites, meaning that a firm using a business ecology approach would coordinate all five of its business elements with its sites. This would require quite a stretch for most businesses, even those inclined to be green, because most businesses committed to greening focus only on a limited part of themselves. When seeking to coordinate with sites, firms typically try to match the sites to their needs (e.g. tree farms replace forests) and not the other way around.

Integrating with Sites

The business ecology goals also emphasize the importance of intentional and careful integration between businesses and their sites. A site is not merely a specific geographic location but is a suite of simultaneous, overlapping, and multi-scaled relationships among biotic and abiotic ecological components that occur within a spatial-temporal framework. In any site, some of these relationships fall within the site's conceptually constructed boundaries, while others extend beyond those boundaries.

The goal of business ecology implies that the criteria and priorities for a company's integration with its primary, secondary, and tertiary sites would be derived from the specific characteristics of those sites rather than from a non-place-based set of business desires, values, or priorities. Therefore, a company's primary, secondary, and tertiary sites – rather than simply the economic market – provide the most important contexts to which the company should adapt and with which it should change and evolve over time. Ultimately, the company should work to develop mutually beneficial relationships with its sites and with others who are implementing business ecological measures. Successful businesses already practice such integration with the economic markets in which they function and with business partners; however, business ecology requires them to integrate with and be informed by "ecological markets" first and economic ones next; and for economic markets to re-orient themselves to do the same.

Although it is beyond the scope of this chapter to address economies in depth, it is important to note that as businesses begin to make this shift toward integrating with sites for mutual benefit, they will need the support of world economic markets. Otherwise, some companies will be working to rebuild natural capital by regenerating sites while others, now or in the future, might become free riders that take advantage of increases in natural resources that result from regenerated ecosystems.

According to this definition of business ecology, a company should seek to become an integral part of and accountable to its primary, secondary, and tertiary sites. In order to achieve this, the company should embed itself within and learn about those sites. It should also seek to understand how its sites interact with and connect to others' sites through energy and material flows and processes such as those inherent in weather patterns and watersheds.

Business ecology acknowledges that all business activities must be conceptually and actually tied to, informed by, and driven by the opportunities and constraints of ecological sites. Thus, business ecology occurs when a company learns as much as possible about its sites and incorporates its activities with those sites in order to regenerate ecosystems rather than harm them. In order to be ecologically benign, a company should return the materials taken from the ecosystems to their original source; otherwise, source ecosystems will become increasingly depleted over time. Therefore, full integration with sites will require a fundamental shift in the way companies are run, in the way they view their relationship with their sites, and in the way they interact with the environment in general. This shift will need to be accompanied by underlying changes in cultural paradigms, industries, economies, and the infrastructures in which they are embedded, amongst other things.[9]

In business ecology, the company sites become explicit business partners,[10] and the company intentionally connects with, supports, and feeds the ecosystems and ecological landscapes in which they are embedded. Thus, the role of the company is not merely to reduce its harm; instead, the company acts as a co-creator with the other organisms in its sites, on multiple levels of spatial-temporal scale, to enhance the site's health in the short-term and long-term, thereby increasing its evolutionary opportunities. This is a crux of business ecology.

Thus, the goal of business ecology is not about environmental management: it is about human management in an ecological context, a management that demands awareness and the creation of mutually sustaining business-ecological relationships. It is about developing mutually beneficial relationships with the rest of the living and non-living world.

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[9] While the topics of culture, industry, economics, and physical infrastructure are beyond the scope of this book, there are many resources available for those interested in pursuing those topics (see Costanza, Robert, ed., 1991, *Ecological Economics*. New York: Columbia University Press; Daly, Herman E., and John B. Cobb, Jr., 1994, *For the Common Good*. Boston, MA: Beacon Press; Dailey, Gretchen C., 1997, *Nature's Services: Societal Dependence on Natural Ecosystems*. Washington, DC: Island Press).

[10] This differs from past ways of working with earth's systems, in which the environment has been viewed as a passive backdrop or landscape filled with resources that could be taken, creating a sometimes parasitic between people and place.

Companies that want to be sustainable must begin to intentionally work with nature for the benefit of both.

This represents a considerable paradigm shift. However, a small but growing body of literature suggests that only through fundamental organizational changes and paradigm shifts will sustainability be possible (Hutchinson, 1995; Senge, 1990). According to Yorque *et al.* (2002), *"there will be a paradigm shift from approaches emphasizing optimal solution and control over limited temporal and spatial scales toward approaches emphasizing cross-scale interactions and living with true uncertainty and surprise"*. This has tremendous implications for business, which traditionally has ignored ecological specifics, could largely be defined as ecologically illiterate, and has sought constant, predictable command-and-control approaches and goals of continuous growth rather than learning, flexible, adaptive ones that recognize both ecological opportunities *and* constraints. Yorque *et al*. further stress the importance of "adaptation and response to changing conditions".

The idea behind business ecology goal is that companies will become ecologically sustainable when they create mutually beneficial relationships (partnerships) with ecosystems. In order to achieve this, companies will need to alter their fundamental relationships with the natural world.

The Twelve Guiding Principles of Business Ecology

Some companies have sought to become greener by embracing one or more sets of principles. A principle is defined as "an accepted or professed rule of action or conduct," "a fundamental, primary, or general law or truth from which others are derived," "a fundamental doctrine or tenet," "a personal or specific basis of conduct or management," "an adopted rule or method for application in action," "a determining characteristic in something; essential quality," or the like (Webster, 1989). Thus, principles are guidelines or doctrines that reflect certain shared values. They can help a company to establish its priorities with regard to greening or to redevelop its mission and vision, articulate its values, and align all staff throughout the organization as well as suppliers and others outside the company. The principles used by businesses in their greening activities can be existing ones, or companies can create their own. This section offers 12 guiding principles, or steps, that companies can use in their journeys toward business-ecological sustainability. Together, these principles can serve as a guideline for the development and practice of business ecology.

These guiding principles of business ecology are further divided into 50 sub-principles. Each of these 12 principles also serves as a step that is carried out in the context of the five business elements discussed earlier (i.e. mission, employees, operations, facilities and sites, and products and services). The 12 guiding principles/steps and the 50 sub-principles are described in Table 6.1.

Table 6.1: Guiding principles and sub-principles of business ecology

I.	Commit to sustainability – Commit to the ongoing adoption, use, and improvement of sustainability principles and practices throughout the company.
	1. Commit to sustainability at all organizational levels, particularly at the top.
II.	Align organization and employees with sustainability – Align all elements of the firm to sustainability.
	2. Build organizational values for sustainability.
	3. Align the organizational structure and processes for sustainability.
	4. Integrate sustainability into all decisions and activities.
	5. Educate and empower employees for sustainability.
	6. Create mechanisms to facilitate perception, learning, and business-ecological co-evolution.
III.	Identify scope of efforts – Identify the company's primary, secondary, and tertiary sites and the efforts to be undertaken within each.
	7. Identify sites and, if necessary, prioritize for renewal.
IV.	Develop ecological knowledge – Develop general and site-specific ecological knowledge on multiple spatial and temporal scales.
	8. Develop detailed local ecological knowledge on multiple spatial and temporal scales.
V.	Identify an ecological niche – Identify an ecological niche, or role, for the business in its sites.
	9. Find opportunities in everything.
	10. Engage in ongoing research to identify areas for business-ecological improvements and innovations.
VI.	Design for sustainability - Create an integrative, appropriately scaled design for mutually beneficial business-ecological relationships.
	11. Acknowledge nature's role as mentor, model, and partner.
	12. Create forms that guide the movement of energy to benefit business-ecological systems.
	13. Develop ecologically beneficial products and services.
	14. Assess and design out likely harmful ecological impacts on all temporal and spatial scales.
	15. Use ecological knowledge to avoid "overdesign," scaling (pace/size) company activities accordingly.
	16. Learn about and work with nature for mutual benefit, keeping company activities local and within the means of the site and local ecosystems.
	17. Recognize and work from patterns at multiple scales, synchronizing the company's temporal and spatial patterns with those of the sites.
	18. Ensure that all designs are not only context-sensitive but context-driven.
	19. Design flexibility into human systems to allow for adaptation and innovation.
	20. Maximize benefit for the greatest number of systems on the greatest number of scales.
	21. Facilitate and protect ecological (including human) diversity.
	22. Design to rebuild energy stores in order to rebuild natural capital.
	23. Address system problems rather than symptoms.
	24. Make ecological forms, flows, and processes obvious in all designs.
VII.	Inhabit the business-ecological niche – Engage with the sites by inhabiting the company's niches.
	25. Develop and use management practices that have emerged from local ecological contexts.
	26. Synchronize with natural direction and momentum (flows and activities).
	27. Facilitate and support ecospheric health forever.
	28. Build inclusive rather than exclusive relationships.
	29. Ensure green facilities and operations.
	30. Choose renewable resources over non-renewable ones, using them conservatively.
	31. Use minimal technology appropriate to the need.
	32. Work with the system to build enough ecological capital to establish enduring self-reliance.
VIII.	Pay attention to negative and positive feedback – Develop, use, and refine site-specific, business-ecological feedback mechanisms. Monitor general business and ecological trends on multiple spatial and temporal scales.
	33. Create mechanisms for identifying and assessing feedback.
	34. Identify both positive and negative ecological feedback for learning and improvement.
	35. Gather and use knowledge regarding life cycle impacts of the thing or activity.
IX.	Adapt for improved business-ecological relations – Adapt to and with specific ecological contexts through time as they respond to change on different scales.
	36. Develop mechanisms for adaptive management.
	37. Use adaptive management for continuous business-ecological improvements.
X.	Network with others to make sustainability possible – Create linkages up and down the value chain; also, network outward with other local organizations and individuals working to regenerate sites.
	38. Green others up and down the value chain (e.g. suppliers, distributors, wholesalers, consultants, customers).
	39. Share knowledge of green products and processes with other sectors.
	40. Engage in broader discourse and activities regarding sustainability.
XI.	Exercise accountability to all stakeholders – Acknowledge and practice complete responsibility to all stakeholders.
	41. Redress harm and renew ecosystem health.
	42. Use resources sustainably and ensure resource equity for all species.
	43. Encourage and facilitate everyone's voice and involvement.
	44. Eliminate waste.
	45. Prevent environmental harm.
	46. Minimize or eliminate risk of harm to all stakeholders.
	47. Inform stakeholders on handling product safely through life cycle.
	48. Prepare for (but preempt) emergencies.
XII.	Be transparent in all words and actions – Operate with openness and honesty regarding company activities and potential and real impacts on stakeholders.
	49. Exercise absolute honesty and transparency with all stakeholders.
	50. Assess and report on the company's environmental performance regularly.

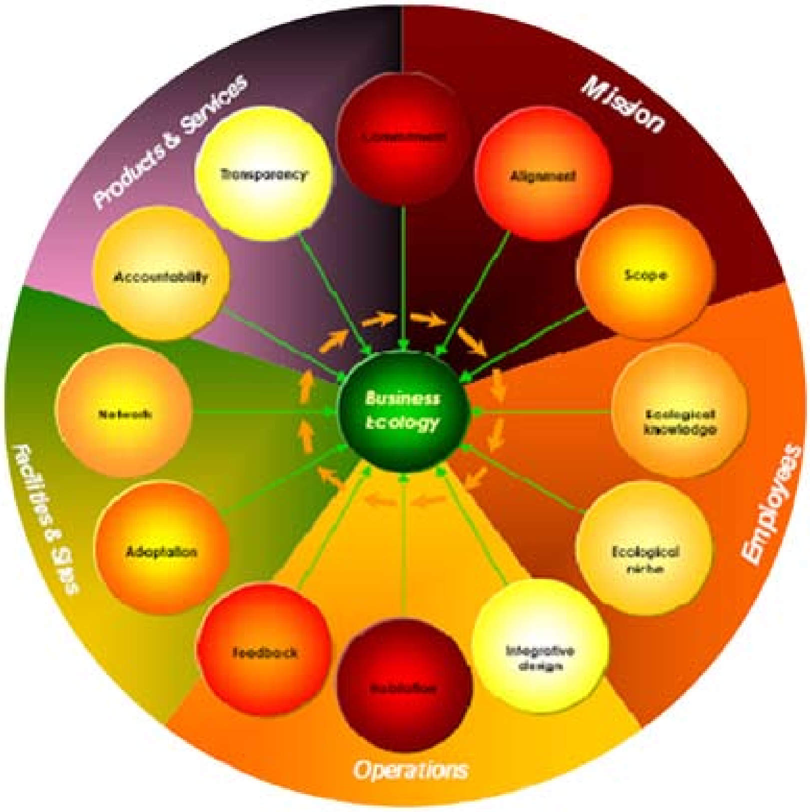

Figure 6.3: Relationships between business ecology principles and business elements

Conclusions

There is an urgent need to develop truly sustainable businesses that can work to regenerate the world ecosystems, including coastal and inland areas around the Mediterranean. As helpful as they have been in reducing companies' negative environmental effects, many of the sustainability indicators that are used in green business today are too generic or simplistic. While they might be used to assist companies in reducing their environmental harm, they do not necessarily guide them to sustainability.

Businesses need a new path toward sustainability and new indicators for determining if they are progressing toward their goal. This chapter suggests that the nascent field of business ecology might provide an ecologically grounded way forward that all companies could follow in their aim to become ecologically sustainable. Business ecology also can be used as the basis for a new suite of sustainability indicators that could enable companies in the Mediterranean and worldwide to determine if they are progressing successfully.

In order to create business-ecological solutions to the Mediterranean's environmental challenges, better indicators that are suited to the region's unique ecological qualities need to be developed. Such indicators should cover a broad range of topics such as environmental literacy, identification of ecological niches, perception of ecological feedback, systems, organizational change, adaptive management, and other topics. Businesses will be able to truly track their paths toward sustainability in an ecologically-informed manner only when a better set of indicators will be made available.

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7 Environmental Planning and Sustainable Industrial Development in Developing Countries: Ensuring Environmental Sustainability

Mounir Ghribi and Gennaro Longo

Abstract

Whether it is motivated by government regulation or just good practice, environmental planning is the first step in the development of any project. This chapter contributes, through a pilot case study in the Gulf of Tunis, to improve the integration of decision-support tools and methods, and to enhance decision-making in developing countries through modelling environmental change and mapping human development in order to ensure sustainability in developing countries. It makes use of environmental indicators such as vegetation indices by means of remote sensing techniques and GIS (Geographic Information Systems) technology. The main objectives of the study are: (i) to analyze change in land-cover categories and to predict scenarios and trends of change; (ii) to monitor vegetation dynamics through time series analysis, and (iii) to map areas depicting most suitable sites for industrial development. The research also addresses the potential use of the sustainability approach in order to better understand impacts of climatic conditions and anthropogenic activities on human health and environment. Sustainability approaches integrate socio-cultural, economic and environmental components and give a comprehensive picture of the study area potentialities and requirements. This is strongly related to the United Nations 7th Millennium Development Goal.

Introduction

Environmental planners integrate sustainability concerns pertaining to ecological, socio-cultural and economic issues within the decision-making process to better plan for human development. The application of decision-support tools is done to assess environmental impacts of human development and contribute towards the quantification of environmental indicators. The use of vegetation indices is important for monitoring purposes, allowing an indication of change without the need for environmental managers to have specialized botanical knowledge. Along with atmospheric and oceanic systems, vegetation is a reliable indicator of environmental change. While it is directly influenced by natural disturbances and interacts with climate, soil, water and fauna, it is also susceptible to human impacts (CCSP, 2003). Our knowledge of the mechanisms behind environmental change is fairly limited beyond short-term forecasts. Systematic research, through continuous monitoring of the state of vegetation, helps to further understanding of some scenarios and permits the description and prediction of changes that might occur in some major environmental components. The indicator value of vegetation for monitoring environmental change is thus essential for short-term observation but also significant for long-term forecasts.

As defined by Feoli and Orlóci (1991), vegetation is a complex system with states determined by all the interactions between living organisms and the chemical-physical environmental factors. Both are changing in time, according to cyclic and/or non-cyclic trends; for this reason, vegetation needs to be addressed through a dynamic systems perspective. Vegetation is influenced by a number of key parameters. Accordingly, vegetation is of importance in relation to production systems (e.g. timber, grazing), water quality (e.g. catchments, nutrients), soil condition (e.g. erosion, landslide) and ecosystem conservation (e.g. plant diversity, habitat diversity, fragmentation). Monitoring has been defined as “the process of repetitive observations of one or more elements of the environment, for defined purposes, according to pre-arranged schedules in space and time and using comparable methodologies for environmental sensing and data collection” (Van der Meulen and Janssen, 1992). Monitoring vegetation requires knowledge of vegetation types and plant diversity, the selection of appropriate scales (the spatial scale which determines the amount of biomass, the spatial distribution, the density and structure of the vegetative cover and the temporal scale which depends on vegetation dynamics and changes over time) and the use of proper instruments, such as remote sensing techniques. According to Steven and Rondeaux (1997), remotely sensed vegetation indices are widely used for their ability to estimate green biomass and the photosynthetic activity of plant canopies. Thus, the role of remote sensing is crucial to analyze, interpret and evaluate spatially and temporally changes in land-cover. Besides the many advantages of remote sensing, the integration of data from different sources in a Geographic Information System (GIS) provides valuable information for mapping and monitoring vegetation, especially if a modelling approach is adopted as part of the monitoring system, thus enabling the description of long-term trends (Fedra and Feoli, 1998). According to Campbell and Wallace (2001), the aim of monitoring vegetation using remotely sensed data is to provide credible information, to assist in the management of resources and to support remedial actions.

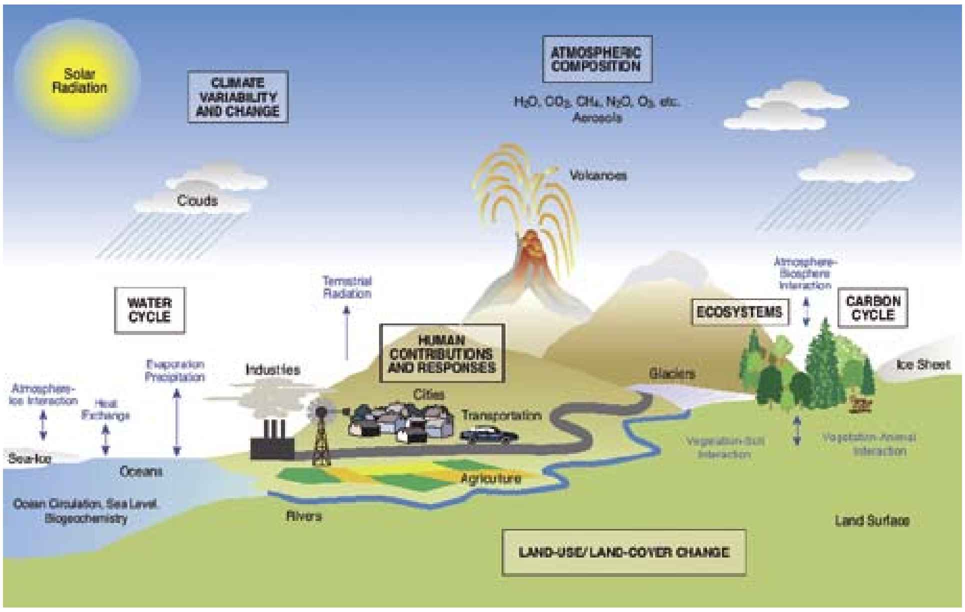

Figure 7.1: Major components needed to understand environmental change (Source: CCSP, 2003)

Aims of the Research

The aim of this research was to monitor human impact on vegetation and soil in a region of Tunisia. Vegetation is used as an indicator to measure change through the use of vegetation indices as biomass indicators, and to evaluate the spatial distribution and change in vegetation cover through the use of models for detecting and predicting land-cover dynamics and simulating land-cover change. The prediction of soil erosion and soil loss potential is a key focus. The area selected is of particular interest because of its bio-climatic characteristics (arid to semi-arid) and due to its vulnerability to desertification and land degradation.

In Tunisia, land-cover is characterized by a dynamic system, which is the result of inter-annual variability of climate and land-cover conversion. Tunis (including both the capital city and suburban areas), has a population of more than two million and an area of at least 300,000 ha. According to UNDP (2003), continuous migration flows have contributed to an increase in the built-up areas of the Tunis Metropolitan region. One of the main effects is the transformation of settlement structures and the loss of agricultural lands. The issue of urbanization has been addressed in Tunisia for several years. In 1983, the Ministry of Agriculture designed a directive scheme to control territorial and socio-economic process on rural and natural environments, aimed at curbing urban expansion, regulating migration flows and protecting agricultural areas (Mtimet and Mizouri, 1995). Despite such efforts, the Tunis Metropolitan built-up area is expanding continuously. The need to monitor environmental change and ensure environmental sustainability is thus crucial. However, as Bounfour and Lambin (1999) note, “our inability to monitor land-cover changes in a consistent way over the long term is a serious limitation in our capacity to understand the driving forces and process controlling these changes”. Indeed, changes are often associated with specific situations concerning a variety of aspects. This has given rise to an unmanaged development of sub-urban areas, consequently complicating the socio-economic functions of the capital. To tackle this issue, managers are faced with the challenge of balancing the distribution of population and human development, whilst taking into account conflicts of use, environmental impacts, socio-economic benefits, and spatial planning problems for the community.

The study area is situated in the rural urban interface (RUI) of Tunis facing the Mediterranean Sea. In the West, it borders the plains of Beja and Bizerte, both regions characterized by extensive agricultural activities, in particular cultivation of cereals, forage and animal fodder, and livestock breeding. In the South, it borders the hills and mountains of Zaghouan, from which water (drinking water and water for irrigation) is conducted to the city of Tunis. The area is also an attractive environment for investment from both European entrepreneurs and Tunisians resident in Europe. There are several national parks in this region such as Boukournine, El Nahli, and Sidi El Bahri, even if financial resources for such parks are severely limited. The area encompasses multiple patterns of vegetation bio-diversity (ANPE, 1995). It includes typical Mediterranean landscapes that are vulnerable to land degradation processes, with vegetation ranging from crops (such as citrus groves, vineyards and olive orchards) to wild vegetation (grasses, shrubs and forests) spread throughout different ecological sites (plains, mountains, marshes and lagoons), all along the coastal areas of the Mediterranean Basin. Halophytic vegetation is the largest entity covering sub-merged spit and former rivers *(oued)* and lagoons *(sebkha)*.

The study area is affected by land degradation, resulting from climatic variability, as well as extensive urban settlement and large industrial areas. According to ANPE (1995), vegetation is severely degraded and is often subject to destruction relating to the extensive use of land for farming (cereal and tree cultivation) and overgrazing. Production, resource-use and land-use system mutations are the main economic reasons for land degradation. Related social impacts include the population growth, privatization of collective land, cultivation of range land, changes in pastoral techniques and the acceleration of the rural exodus. Furthermore, cultivated land is under constant threat from flooding, in particular in watershed areas and former watercourses. A further concern is the degradation of certain vegetation species which are used as a resource by local populations. The increased soil erosion represents another indirect impact of vegetation degradation.

Figure 7.2: Satellite image of the study area

Methodology

The research involved the development of an integrated framework to monitor environmental change and support decision-making in a GIS-based environment. Data was integrated into a comprehensive GIS structure, facilitating the exchange of information between inventory-based GIS applications and analytical tools, such as statistical analysis, process modelling and pattern recognition. Data utilized included digital (NOAA/AVHRR, LANDSAT TM, ERS-SAR radar images, vector layers in shape files) and ancillary information (statistics, inventories, reports). The IDRISI software was utilized for analysis, along with other statistical software packages such as SPSS.

Commonly used vegetation indices are defined as algebraic combinations of reflectance measurements in the red (or visible) channel and the near-infrared (NIR) channel of remote sensors. According to Steven and Rondeaux (1997), the popularity of vegetation indices arises from their ability to monitor regional and global changes in vegetation cover. They are very well correlated with foliage density (unit saturation level at full canopy cover) and are, therefore, linked to the biophysical properties of plants such as absorbed photo-synthetically active radiation (APAR), and vegetation efficiencies and productivity. In remote sensing, a vegetation index is a digital number that is generated by some combination of bands on the basis of the spectral response of the vegetation canopy, and may have some relationship to the amount of vegetation in a given image pixel (Terrill, 1994). Chlorophyll primarily absorbs light in the violet to blue and red wavelengths. Green light is not readily absorbed and is reflected thus giving the leaf a green color appearance. The internal cell wall structure of the mesophyll causes high reflectance of near infrared radiation, while chlorophyll is transparent to near infrared radiation. Within the electromagnetic spectrum, the sharp increase of reflected energy is at the red edge, which ranges from the red region of visible light to the near infrared region of wavelength in (μm) micrometers (Campbell and Wallace, 2001). Figure 7.4 shows the sharp reflection-increase positioned at the red edge around the 0.7 μm wavelength of the electromagnetic spectrum. According to Hoffer (1978), the location of the red edge is not static throughout the life of a leaf. As the leaf matures, the chlorophyll absorbs slightly longer wavelengths in the visible red region.

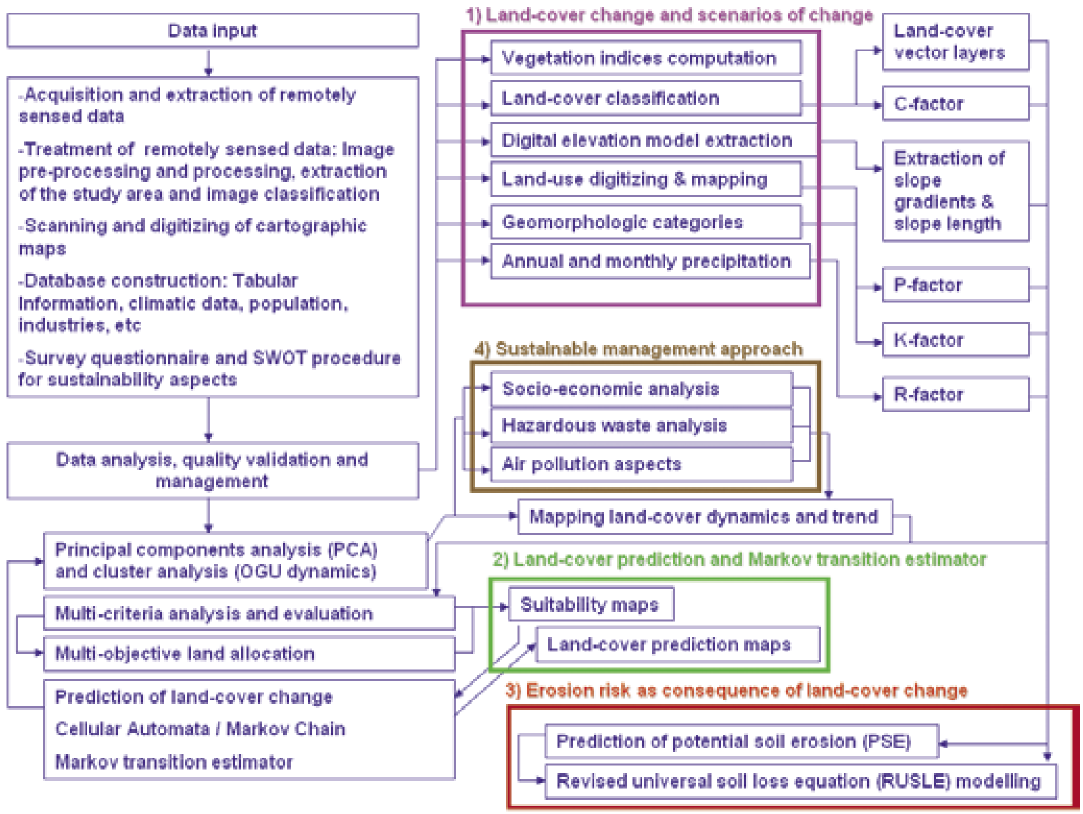

Figure 7.3: Sequential steps of the overall research methodology

According to Colwell (1997), vegetation has different reflectance from one region of absorption to another. Differences between red and infrared measurements could provide better results, as compared to measuring reflectance within a single band. In this context, the research made use of remotely sensed data (NOAA/AVHRR and LANDSAT TM) to monitor vegetation dynamics through time series analysis, by computation of different vegetation indices, namely normalized difference vegetation index (NDVI), soil adjusted vegetation index (SAVI), enhanced vegetation index (EVI) and green vegetation index (GVI). Based on the NDVI values, the fractal dimension pixel values (roughness raster image) were computed. Using the two variables (NDVI values and FD values) 15 classes of land-cover categories were extracted. The image classification was elaborated using NDVI and fractal dimension to analyse the vegetation/landscape indices relationships. For each land-cover category, the NDVI, SAVI and FD values were extracted, and the graphical representation of the NDVI/ SAVI curves was outlined.

Decisions about site planning for industries and urban settlement on certain land areas typically involve the application of multicriteria algorithms based on logical PAIRWISE comparison. The purpose of building-up a multicriteria evaluation (MCE) typology is to enhance decision-making by combining a set of criteria to achieve a single composite, which serves as the basis for the final decision according to specific objectives. In this research, an attempt was made to create a suitability map by considering interactive effects of several contributing factors and constraints (delineated in a set of raster and vector maps) that may contribute in enhancing or decreasing the susceptibility of change for each pixel. The factors comprised the raster images containing the target features from which distance was measured. The target features were vector files such as roads, rivers and coasts. The constraints, on the other hand, were the raster images, which excluded certain areas from consideration (sea, lagoons, lakes, rivers, urban settlements and industrialized estates). The process was also characterized by some level of assumed risk. To minimize the risk and reduce errors relating to the objectivity of the decision, it is best to have a group of decision-makers, rather than a single individual. Such decision-making groups should bring together a variety of stakeholders.

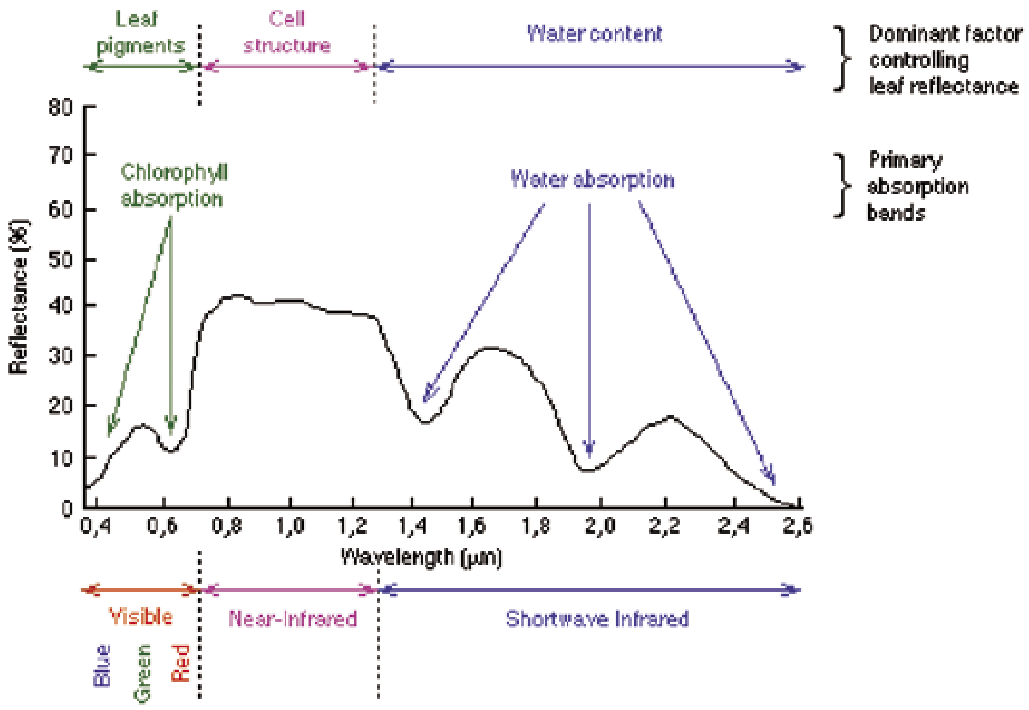

Figure 7.4: Spectral response of vegetation (Source: Hoffer, 1978)

Two of the most common methods for multicriteria evaluation are weighted linear combination and concordance-discordance analysis (Carver, 1991). The weighted linear combination method was used in this case study. A suitability map was derived on the basis of:

$$S = \left(\sum_{i=1}^{n} WiXi\right) . \prod_{j=1}^{m} Cj$$

where:
S: suitability
Wi: weight of factor i
Xi: criterion score of factor i
Cj: constraint j
N: number of factors
m: number of constraints
∑: sum
∏: product

Weights were developed by providing a series of PAIRWISE comparisons of the relative importance of factors to the suitability of pixels for the activity being evaluated.

Table 7.1: Contributing factors and constraints

	Description
	Factors
F1	Proximity to urban settlements
F2	Proximity to industrialized zones
F3	Proximity to main roads
F4	Proximity to water (sea, lakes and rivers)
F5	Proximity to forests, shrubs and national parks
F6	Proximity to barren lands
F7	Proximity to hills and slope (>10%)
F8	Proximity to wetlands
F9	Proximity to agriculture fields
F10	Proximity to rangelands
F11	Proximity to rural-urban interface strip
	Constraints
C1	Water (sea, lakes and rivers)
C2	Build-up areas (urban, industries, roads, etc.)

All contributing factors and constraints were standardized using the fuzzy set membership functions. The fuzzy set membership is characterized by a grade (also called a possibility) that ranges from 0.0 to 1.0, indicating a continuous increase from non-membership to complete membership of a pixel in a specific category (Eastman, 2001). This procedure rescaled the distance from feature objects (or factors) in a non-regular distance range. Preferences of pixel-vicinity were utilized within a certain group of pixel membership, and new pixel distribution was defined according to fuzzy set membership functions (Altman, 1994).

An element of spatial contiguity of the study area, and an element of knowledge on the likely spatial distribution of matrix transitions (suitability maps) to Markov chain analysis were included in this process. The change in land-cover was predicted for a period of 4 years. Within the Markov Transition Estimator, three data sets of land-cover images obtained from classified LANDSAT TM satellite data (1989, 1993, 1997) were utilized. The aim was to test the Markov Transition Estimator model through the prediction of existing land-cover (on the basis of the 1997 data) using the 1989 and 1993 land-cover images. Images and predicted (or projected) and classified land-cover images were compared. Cross-tabulation of classified land-cover against projected land-cover was also carried out. The results of this procedure were linked to several measures of change between the two images, through the percentage of each category, computation of area superficies for each land-cover category and cross tabulation. The KAPPA Index of Agreement (KIA) was also computed. In this case study, the KIA was used to check for accuracy between the two (classified and projected) land-cover images of 1997. The process aims at perceiving if there is a difference and, if so, is this due to “chance” or to “real disagreement” or to “real agreement”.

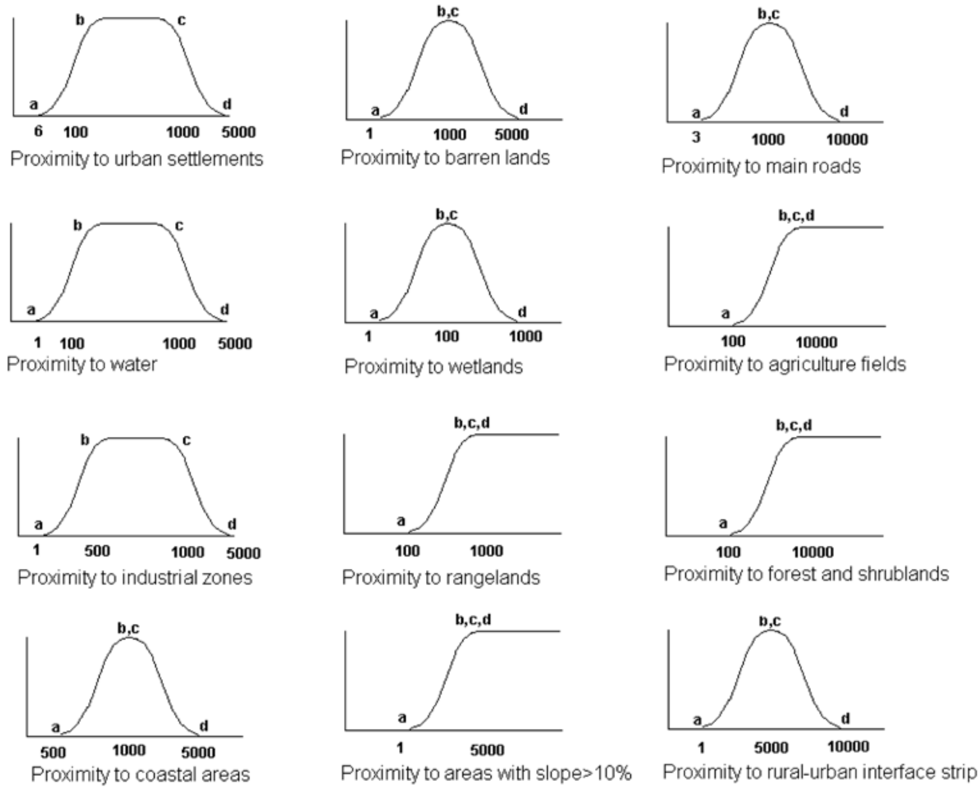

Figure 7.5: Standardization of contributing factors using Fuzzy set membership functions

A modelling approach was developed to assess erosion risk through a soil erosion-prediction model. The model allows the integration of the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) in a GIS typology and permits the mapping of areas at high risk for land degradation. The RUSLE is expressed as:

$$A = LS\ R\ K\ C\ P$$

where:
A: soil loss in t/ha over a period selected for R, usually a yearly basis;
R: rainfall-runoff erosivity factor in MJ mm/(ha h);
K: soil erodibility factor (t h/(MJ mm));
L: slope length factor;
S: slope steepness factor;
C: cover and management factor;
P: conservation practices factor.

The overall methodology involves the use of factors obtained from climatic data, land-use maps, soil maps, topographic maps and results of the treatment of remotely sensed data, in particular land-cover maps and digital elevation model. Within the IDRISI software package, the RUSLE model can predict potential erosion on a pixel-by-pixel basis. This has many advantages when attempting to identify and localize the spatial patterns of soil loss. The Prediction of Potential Soil Erosion (PSE) was then used to isolate and query identified locations, to yield and analyze the importance of vegetation and the role of socio-economic individual variables in contributing to the observed erosion potential value. The potential soil erosion map served to define and recommend prioritization and remedial actions with respect to the intensity of soil erosion. A RUSLE map, which quantifies erosion risk, was also developed.

To investigate the correlation between vegetation and soil erosion, a simple linear regression between the two variables was performed. Vegetation values were generated from the NDVI images, and erosion risk classes were quantified through the RUSLE map categories. The aim was to analyze the importance of vegetation in reducing soil erosion and to localize the areas for prioritization intervention and remedial actions. Using Image Processing/Accuracy Assessment/SAMPLE, a vector file of point locations was used in sampling sites for each variable image. The points were selected according to a random sampling scheme. Records of both NDVI values and yearly soil loss in t/ha per year were thus extracted.

In order to develop a sustainable management approach to respond to human impacts on vegetation, three main components of sustainability (society, economy and impact on environment) need to be analyzed. According to WTO (1995), indicators are often quantitative measures (figures, percentages, quantities, etc.). However, they may also be in the form of qualitative information. Questionnaires and interviews were conducted with local stakeholders, in order to examine social aspects of the situation. A SWOT (strengths, weaknesses, opportunities and threats) technique was used to integrate both social and economic aspects, enabling a better understanding of environmental changes, better identification of appropriate strategies for development. This aspect of the research was based on considerations of the United Nations 7th Millennium Development Goal (UN MDG Report, 2006), which sets out a number of targets to be achieved by the year 2015, including:

- The integration of principles of sustainable development into country policies and programmes;
- Reversal of the loss of environmental resource;
- Reducing by half the proportion of people without sustainable access to safe drinking water; and
- Achieving significant improvements in the lives of at least 100 million slum dwellers by 2020.

Selected Results

Selected results emanating from the research are presented in Appendix A. Further results relating to the sustainability analysis are discussed below. Sustainability is affected by the social, economic and environmental dimension of the study area and its surroundings. Components and issues of sustainability are related to job, food production systems, urbanization, education, general knowledge and innovation policies/activities, and trade besides environmental management. A SWOT analysis presents a range of issues under environmental, economic and sociocultural aspects. It should be stressed that the issues reported under each aspect are the results of a series of questionnaires and interviews with local people and authorities. From an alternative point of view, some of the issues appearing as strengths can also be interpreted as weakness.

Table 7.2: Summarized SWOT analysis

<table>
<tr><th>Strengths</th><th>Weaknesses</th></tr>
<tr><td><u>Environmental</u>:
different ecological sites (mountains, plains, river basins, coastal areas, marshes and lagoons, etc.)
multiple patterns of vegetation bio-diversity (cropland, grassland, rangeland, forest, etc.)
wide range of domestic and wild animals
both sandy and rocky beaches

<u>Economic</u>:
large set of industrial activities
international ports and airports
tourism/recreation activities
fishing industry
nearby market and retail trade
nearby administration
availability of facilities and services (roads, electricity, telephone, etc.)
various agriculture vocations in the RUI
water provision from neighboring regions

<u>Sociocultural</u>:
historic site with Roman influence
museums and cultural centres offering good services
high level education institutions and research centres
good local communication
solidarity between neighbours</td><td><u>Environmental</u>:
semi-arid to arid bioclimate influence
increased of water salinity and disturbance of hydrological cycle
invasion of uncontrolled urbanization
prone to land degradation
over-fishing
endangered species and habitat loss
increase of pollution

<u>Economic</u>:
need for housing due to population growth
need for space due to urban expansion
need for irrigation
limited adequate local water resources
pressure on agriculture fields

<u>Sociocultural</u>:
attractive site: increased immigration
increase in poverty and criminality</td></tr>
<tr><th>Opportunities</th><th>Threats</th></tr>
<tr><td><u>Environmental</u>:
national and international strategic plans for environmental protection
water management and water treatment
government forestation strategy

<u>Economic</u>:
Euro-Mediterranean market
new international entrepreneurs
new forms of agriculture activities: urban agriculture and animal breeding
new agro-industry development: olive oil, tanning, etc.

<u>Sociocultural</u>:
job creation
capacity building
public participation</td><td><u>Environmental</u>:
soil loss
increased demand for water
new highway and other infrastructure
spreading of urbanization and uncontrolled settlements
impacts of air pollution
impacts of liquid effluents
impacts of solid waste

<u>Economic</u>:
depletion of agriculture
reliance on small businesses and industries
privatization
decrease of purchase capacity
transport congestion

<u>Sociocultural</u>:
loss of historic architecture/Arabic style
drift from rural to urban areas
social impact: elements of new culture</td></tr>
</table>

Overall, the SWOT technique outlined in the socio-economic analysis showed that with the economic development strengths and the environmental strategic plan opportunities, the study area is still in a good stage to enlarge sustainability approaches for protecting its environment and developing its economy. Even though many weaknesses were outlined, in particular due to the area vulnerability to land degradation, and because of human pressure, these could be controlled and potentially overcome in the future. Threats should not present a danger but should be taken as baselines for remedial actions. An effective and sustainable plan is needed to connect decision-makers and local people and take strengths and opportunities a step further, in order to enhance community involvement, which could ensure social recovery.

Results of the survey questionnaire indicated that even though it lies close to the capital city, the study area is influenced by rural elements and practices, including traditional agriculture and livestock breeding.

Table 7.3: Rural exodus to the study area

Origin of the population	Northwest: Beja Jendouba Le Kef Siliana	Northeast: Nabeul Zaghouan	Central: kairouan kasserine S.Bouzid	Eastern Coasts: Sousse Monastir Mahdia Sfax	South: Gafsa Tozeur Kebeli Gabes
Proportion	48 %	22 %	16 %	4 %	10 %

According to the results of the survey questionnaire, almost 50 % of the population living in the RUI (rural-urban interface) is rural. Half of this rural population comes from the northwestern regions of the country, where agriculture is the principle activity. The spread of green spaces within built-up areas, dedicated to small and medium sized urban agricultural activities, serve as potential local supply of agricultural products to the local market and as strategy to landscape protection. This transformation and growth of urban green space and agricultural areas also results from the measures being implemented by the city administration and decision-makers in order to extend designated public parks, to protect forests and to reinforce agriculture as means to create jobs and to provide food to the local market.

Discussion

The examination of vegetation as an environmental indicator over a sequence of satellite images and through time series has shown a reduction of the vegetation. The vegetation index values for both data sets (NOAA/AVHRR and LANDSAT TM) have demonstrated an overall decline for both periods May 92 to May 96 and Sep. 89 to Sep. 97. By excluding the built-up areas (urban settlements, roads and industrialized areas), the NDVI values were enhanced and showed a relative increase with respect to the total area's values but global evolution was still characterized by a continuous decrease. The use of AVHRR-derived NDVI was effectively important for mapping, measuring and monitoring plant cover distribution and growth at large scales. Its relationship to other standard measurements gave an idea on the state of the environment. Change in NDVI values is reasonably linked to the effect of weather variability (climatic conditions: rainfall amount and regularity, temperature, wind, etc.) but is also due to anthropogenic activities in the study area. NDVI offered the best dynamic range of the vegetation indices used, and it demonstrated the best sensitivity to changes in vegetation cover. SAVI was also very useful in evaluating low vegetation cover using a correction factor (L). L was taken to be larger than 0.5 for very sparse vegetation. However, many of the vegetation indices work defectively if no atmospheric correction is performed. The optimal choice of vegetation index is mainly related to the purpose of the study, the objectives of the research and the type of vegetation considered, as well as to the amount of prior information available. The NDVI was considered the most appropriate as a measure of the greenness or vegetation health. High values indicate presence of healthy vegetation, while lower values indicate less vegetation or stressed vegetation.

The vegetation spatial distribution and densities differed from one province to another. The provinces of Ariana and Mannouba are the provinces with the lowest NDVI values. This can be explained by their proximity to the capital, which makes them very attractive areas for urban expansion, but also by the existence of large industrial estates within the suburban areas of both provinces. Tebourba and Sidi Thabet, on the other hand, have relatively high vegetation index values and this is due to the dominant agricultural vocation (farming and livestock breeding). According to correlation coefficients resulting from simple linear regressions between NDVI as dependent variable and respectively rainfall, industrial growth ratio, urban growth ratio and elevation as independent variables, correlations between variables were statistically significant at 95% and 99%. The NDVI (absolute maximum, absolute minimum, average values) was significantly positively correlated to rainfall ($r=0.9604$ and $r>p$ at 95% and 99%) and elevation ($r=0.7081$ and $r>p$ at 95% and 99%) but was negatively correlated to urban growth ratio ($r=-0.7457$ and $|r|>p$ at 95% and 99%) and industrial growth ratio ($r=-0.7481$ and $|r|>p$ at 95% and 99%). Thus, urban expansion and industrial development within the study area were followed by a decrease of vegetation. Some previous research studies have led to similar results. It was also shown that NDVI is significantly correlated to rainfall amounts and vegetation is thus highly sensitive to non-regularity of rainfall distribution within the whole study area.

Through the use of GIS and cluster analysis, landscape patterns and spatial dynamics were analyzed as a function of time. Trends include expansion of urban settlements and development of industries towards the northeast of the capital, in the direction of Tunis-Bizerte, along the coastal areas of the Gulf of Tunis in the rural-urban interface. Suitability maps resulting from multicriteria evaluation (MCE) and multi-objective land allocation showed different classes for which the degree of susceptibility to accept new industrial estates and urban settlements varies from extremely prone to weakly prone areas. Areas with high suitability are concentrated in the surroundings of main industrial zones such as Echarguia, Ariana, Ettadhamen and Mannouba. Their suitability relates to proximity to existing industrial zones, which are likely to harbour required infrastructure and organized industrial systems. Other factors include proximity to residential sites, shopping centres and commercial areas, proximity to main roads, and good connections to the market and access to transportation.

According to the potential soil erosion and erosion risk maps, only 2% of the study area is deemed to be at high risk of erosion. The annual soil loss was estimated at about 10t/ha ~12t/ha. More than 50% of the area is at low to minimal risk, which is a good indicator relating to land protection and good practices to minimize desertification and degradation. It is, therefore, necessary to continue using appropriate soil and water conservation practices to control the volume of soil loss.

Conclusions and Recommendations

Environmental sustainability was approached from three complementary perspectives: monitoring and analysis of the state of vegetation, modelling scenarios of environmental change and assessing impacts of human development on vegetation and soil, and consequent land degradation. Several recommendations for remedial actions were developed. Within agricultural areas, fencing, replanting, landscape rehabilitation, corridor plantings, water management, rotation, weed control, improvement of logging practices, establishment of reserves, and protection of rangelands are important actions. For the conservation of vegetation biodiversity, reinforcement and support of the national sampling dataset and seed bank is essential, but detailed ground floristic sampling is also crucial. With regard to urban and industrial site planning, the use of decision-support tools is indispensable for appropriate spatial management of urban expansion and industrial development in the area.

Decision-support tools are computer-based systems that strongly sustain a single decision-maker or a group of decision-makers in evaluating certain alternatives for a specific objective. It is, however, the decision-maker who should determine the criteria, the factors and the constraints that may enhance or reduce uncertainty in decision rules, and it is also the decision-maker who should take the decision. This research is a contribution to the possible future strategies and tools that can be adopted by decision-makers in the planning of sustainable development in Tunisia. Collaboration between all stakeholders is deemed to be an essential component.

Critical actions and recommendations that can sustain effective protection of the environment in the study area and in the rest of the country through an integrated management approach are as follows:

Legislation and institutional aspects:

- Improvement of the coordination and operation of agencies and organizations dealing with environmental management (governmental and non-governmental organizations, academic institutions, research and development centres, private agencies, etc.);
- Clarification and enforcement of the law regulating land ownership;
- Clear specification of the duties and responsibilities of involved organizations and authorities in regional management.

Planning aspects:

- Development and implementation of an integrated management strategy through interaction and cooperation among environmental researchers, managers, policy-makers and other stakeholders;
- Establishment of national management plans in co-ordination with international standards and environmental protection strategies;
- Improvement of land-use planning, industrial development and urban planning;
- Involvement of the local communities through public awareness, information and capacity building through training in advanced environmental technologies and informatic tools.

It is, furthermore, essential to set up guidelines and national strategic plans to face the challenges of the future in sustainable way. International collaboration plans should be developed whereby sustainable development is brought to both Tunisia and the overall Mediterranean Region.

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Appendix A

Indicator Value of Vegetation for the Assessment of Environmental Change

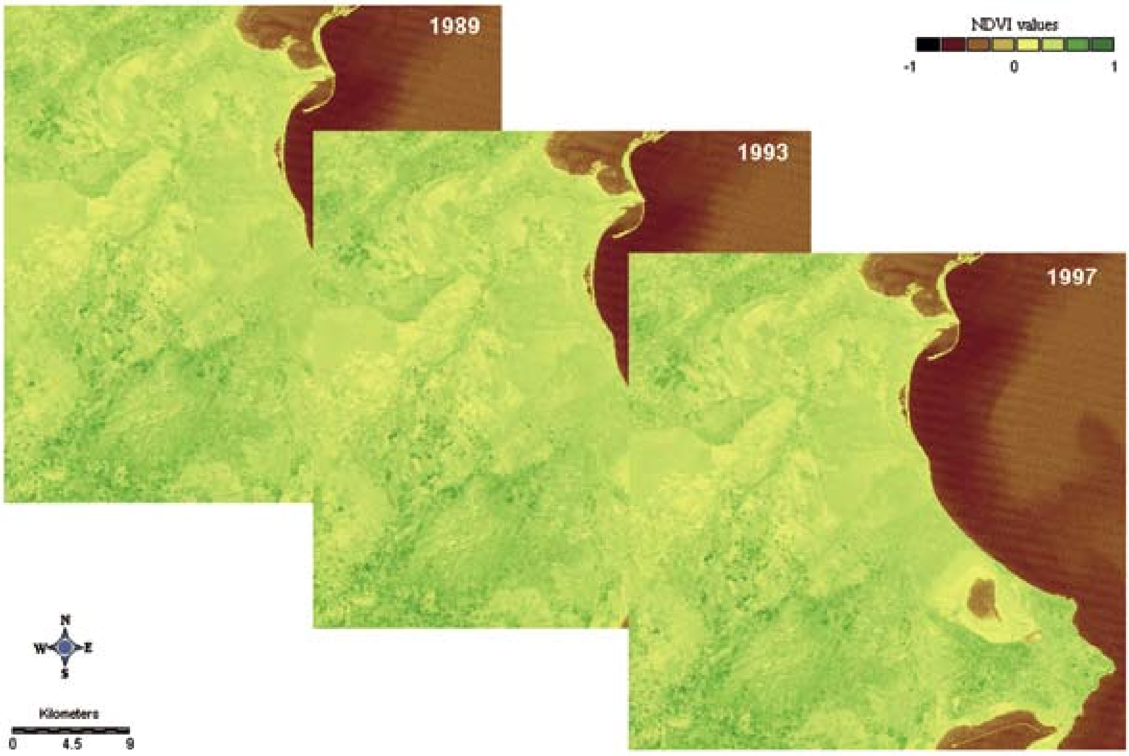

Figure 7a: Computation of vegetation indices (NDVI, SAVI and GVI) using band 3 and band 4 of LANDSAT TM images to monitor vegetation dynamics through time series analysis (September 1989, September 1993 and September 1997)

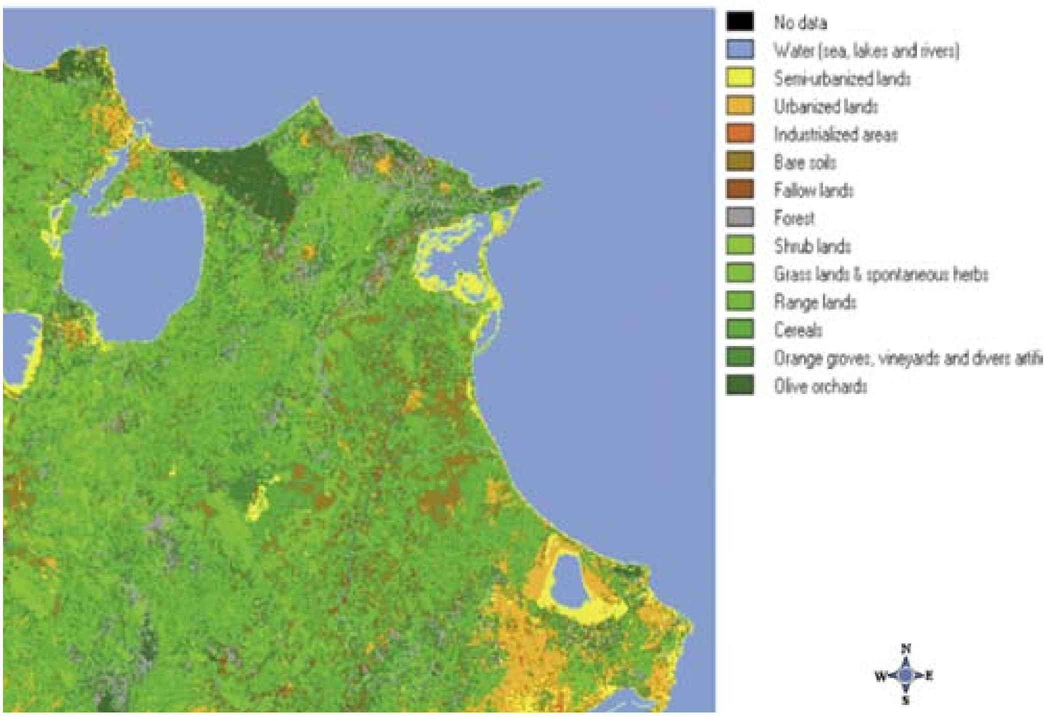

Figure7b: Land-cover map resulting from digital classification rectification using training sites

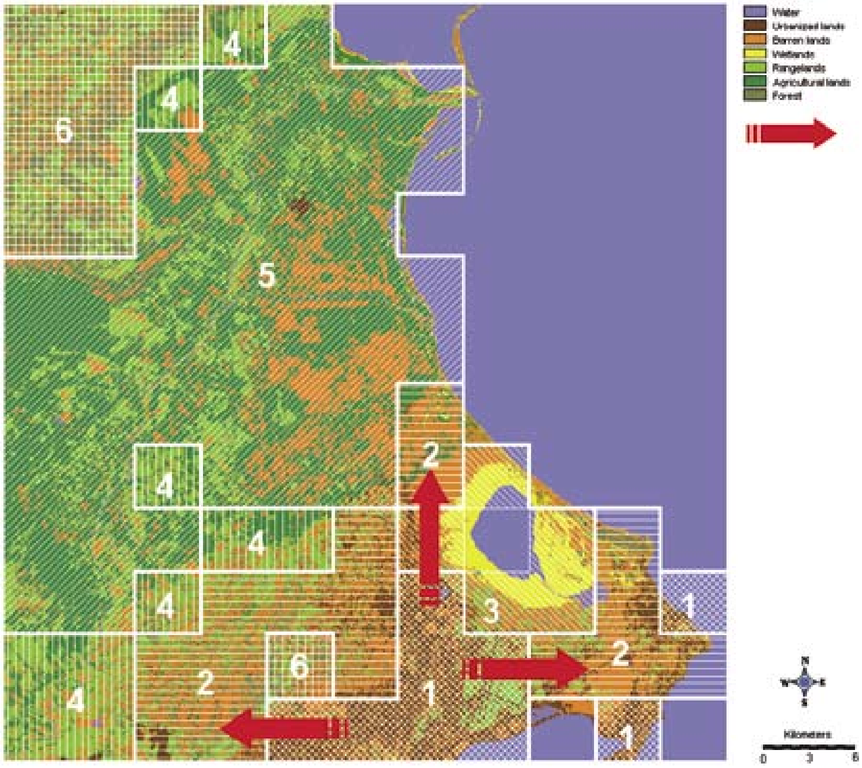

Figure 7c: Reclassification of OGUs into 6 categories according to the land-cover map of September 1989

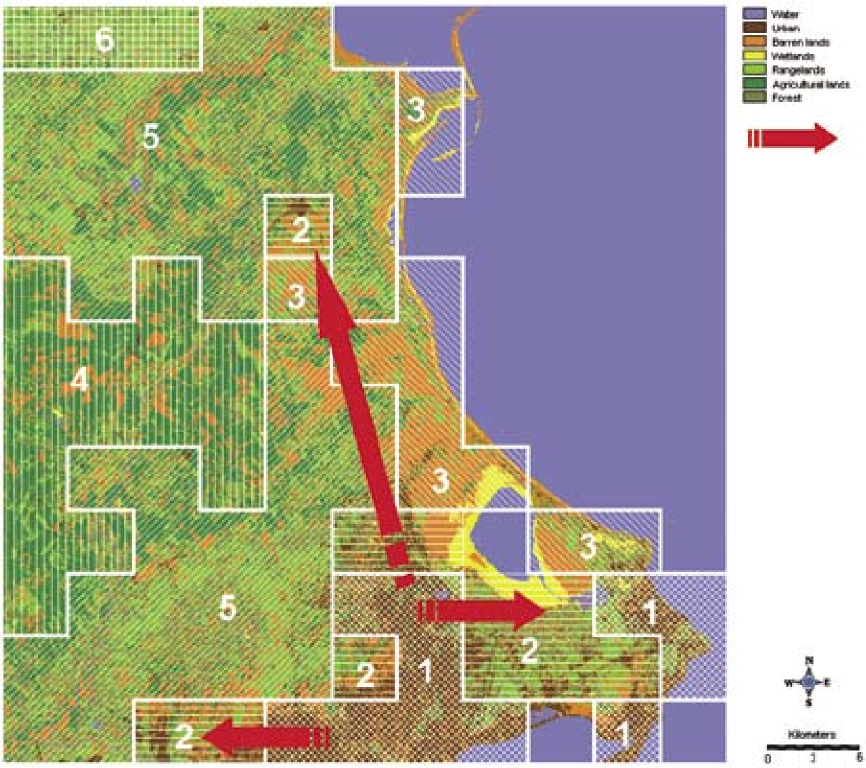

Figure 7d: Reclassification of OGUs into 6 categories according to the land-cover map of September 1993

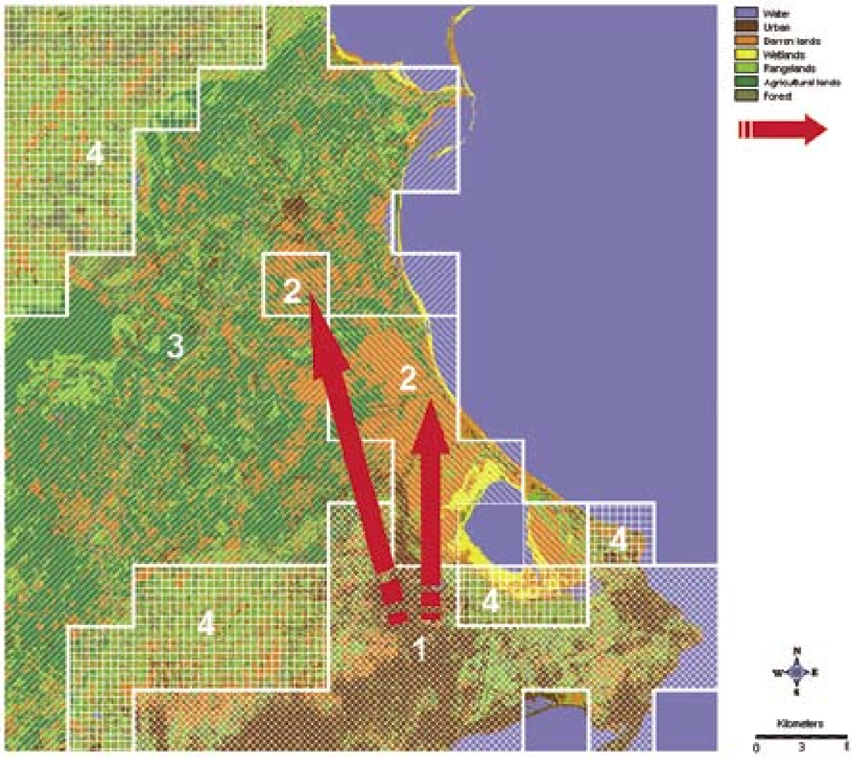

Figure 7e: Reclassification of OGUs into 4 categories according to the land-cover map of September 1997

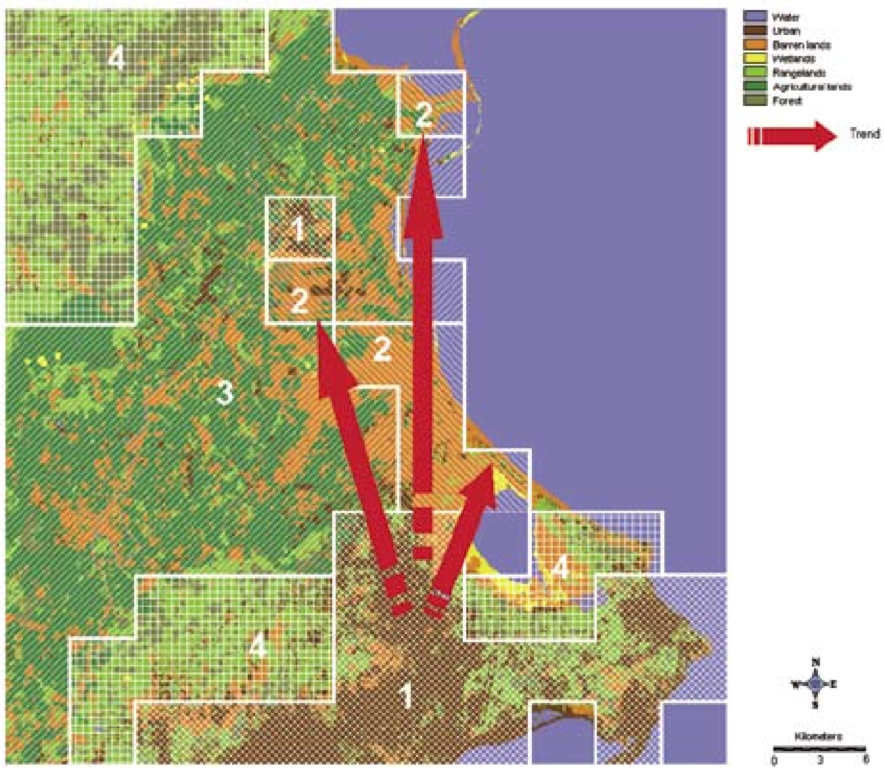

Figure 7f: Trend map for 2005 through interpolation of surfaces based on the input reclassified OGU maps of 1989, 1993 and 1997

Figure 7g: Hierarchical classification of OGUs into 5 categories according to the land-cover map of 1989, 1993 and 1997

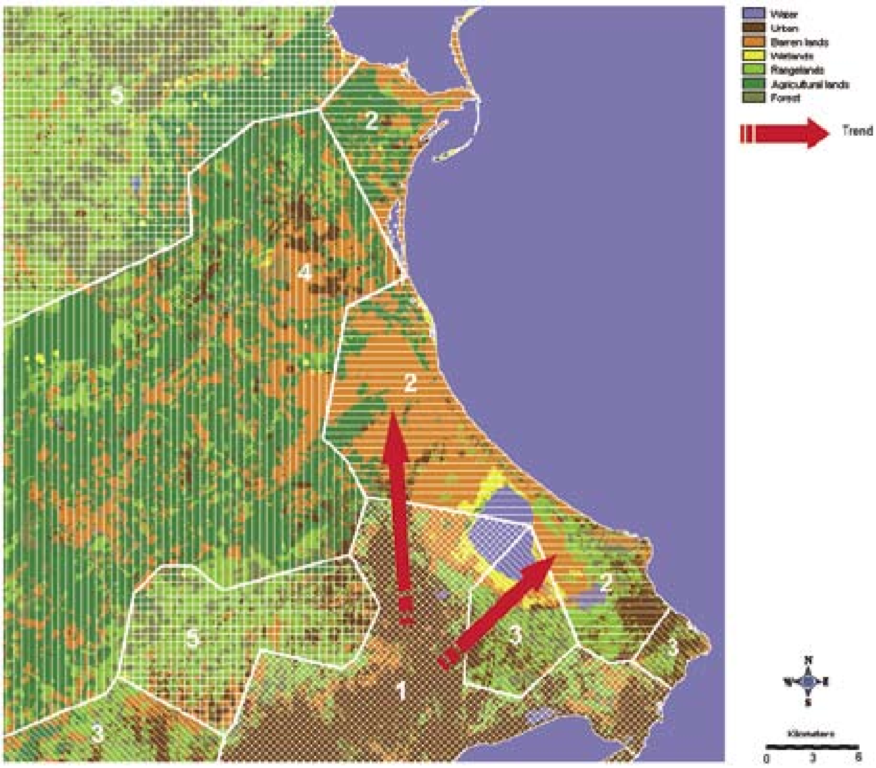

Figure 7h: Trend map for 2005 through interpolation of surfaces based on the input reclassified OGU maps of 1989, 1993 and 1997

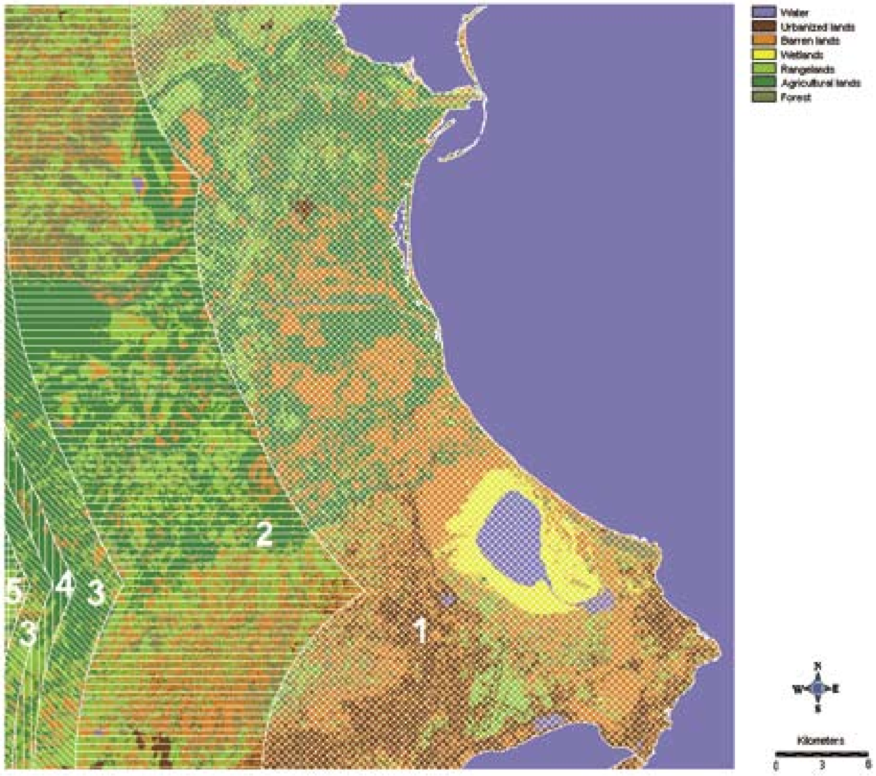

Figure 7i: Hierarchical classification of OGUs into 5 categories according to the land-cover map of September 1989

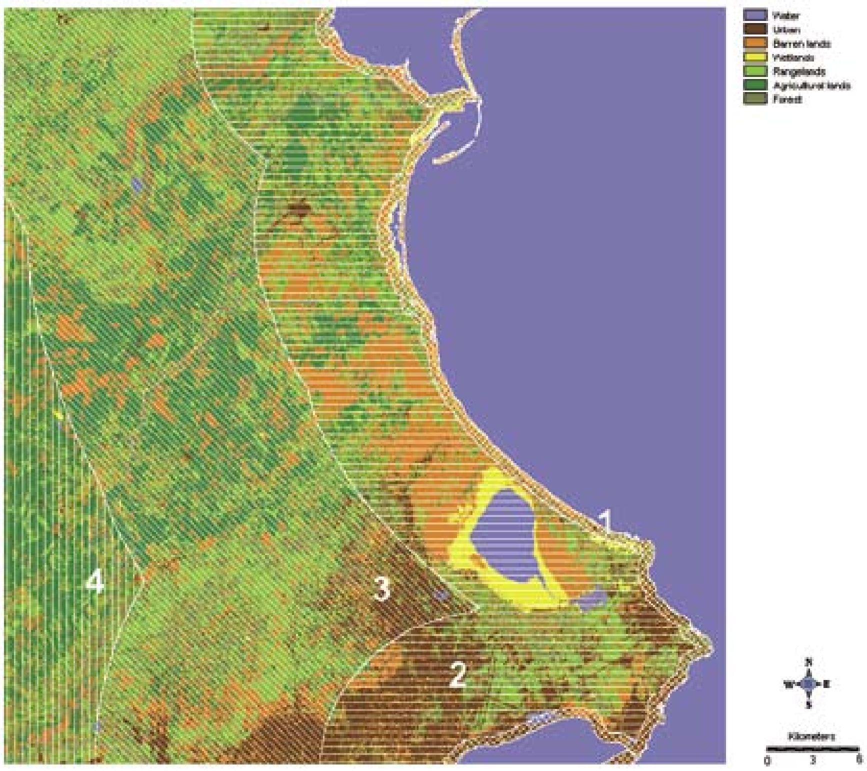

Figure 7j: Reclassification of OGUs into 4 categories according to the land-cover map of September 1993

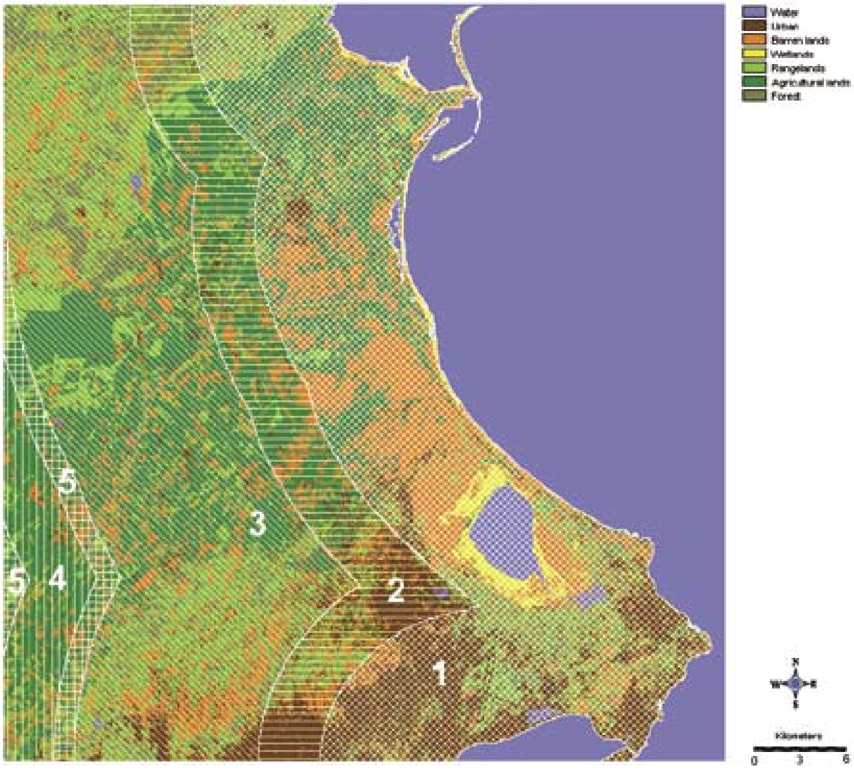

Figure 7k: Reclassification of OGUs into 5 categoriesaccording to the land-cover map of September 1997

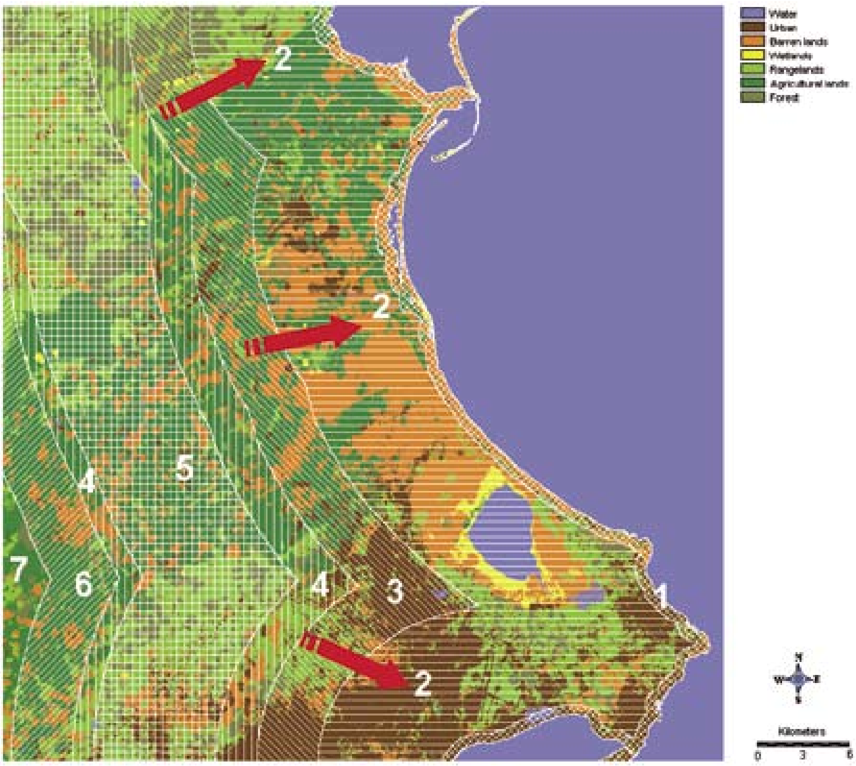

Figure 7l: Trend map for 2005 through interpolation of surfaces based on the input reclassified OGU maps of 1989, 1993 and 1997

Environmental indicators provide a simple means of characterizing the physical properties of an environment and their dependence. In this context, NDVI sensitivity to rainfall, urbanization, industrialization and elevation was examined through correlation techniques.

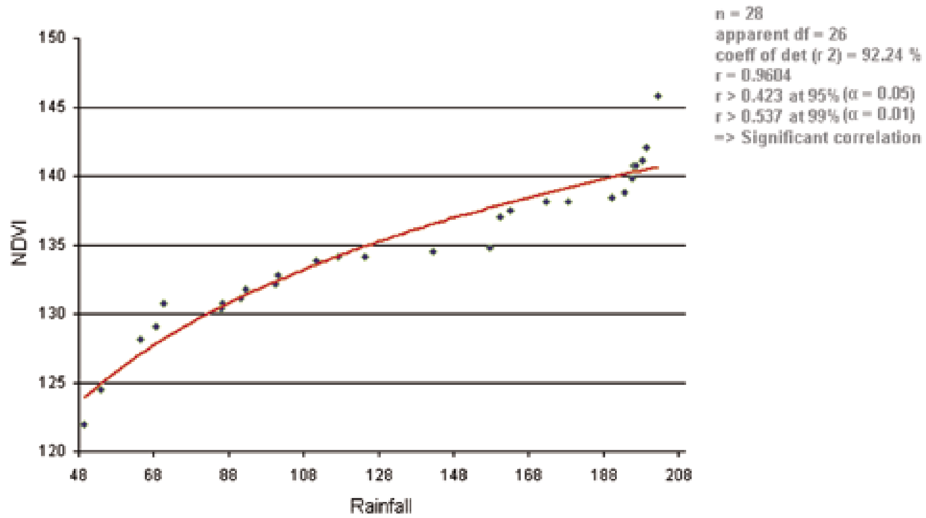

Figure 7m: Simple linear correlation between NDVI values and rainfall amount (NDVI= 77.682 + 11.859 [Rainfall])

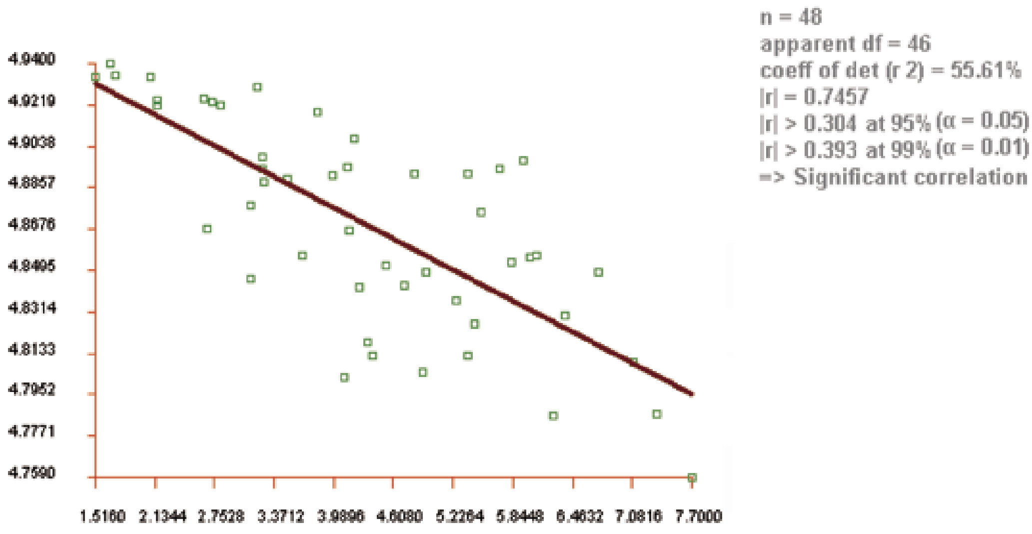

Figure 7n: Simple linear correlation between NDVI values and urban growth ratio (Ln(NDVI)= 4.964 – 0.0219 [urban growth ratio])

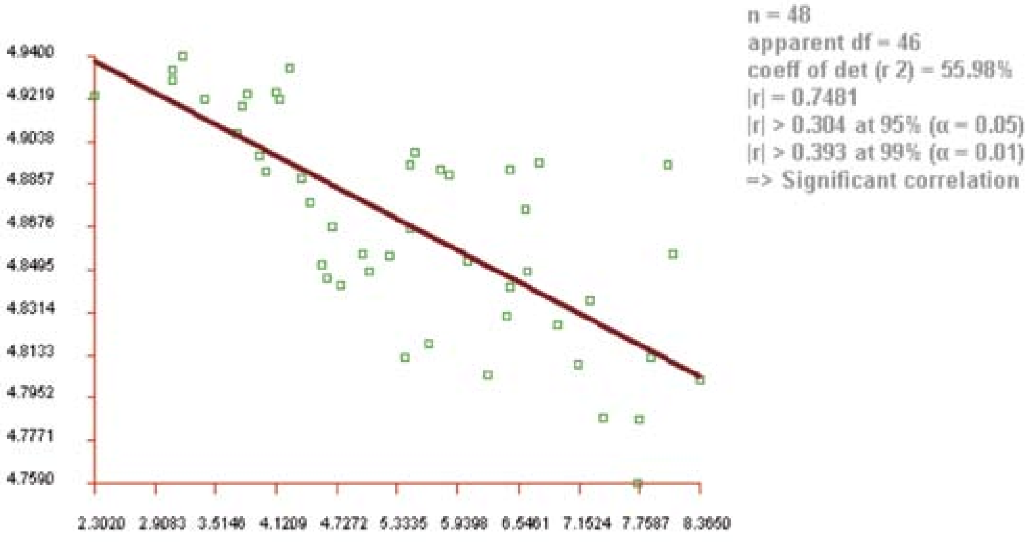

Figure 7o: Simple linear correlation between NDVI values and industrial growth ratio (Ln(NDVI)= 4.964 – 0.0219 [industrial growth ratio])

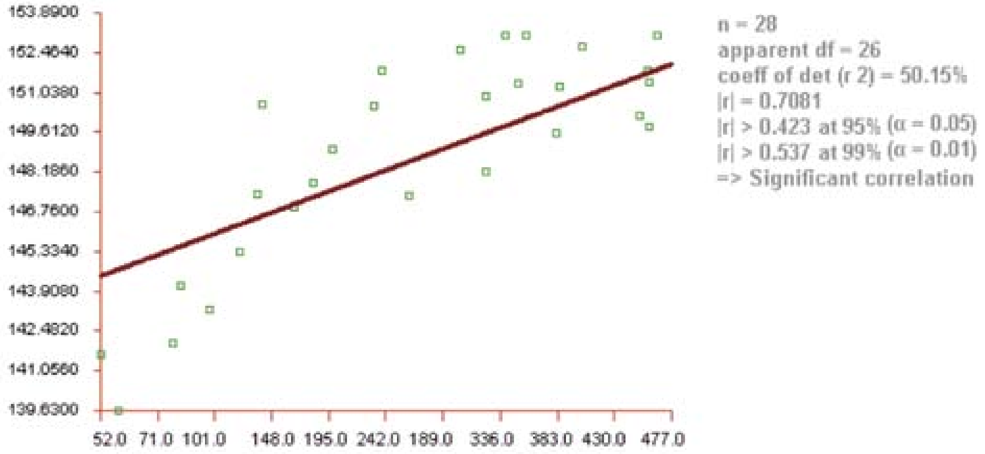

Figure 7p: Simple linear correlation between NDVI values and DEM values (NDVI= 138.123 + 0.033327 [elevation])

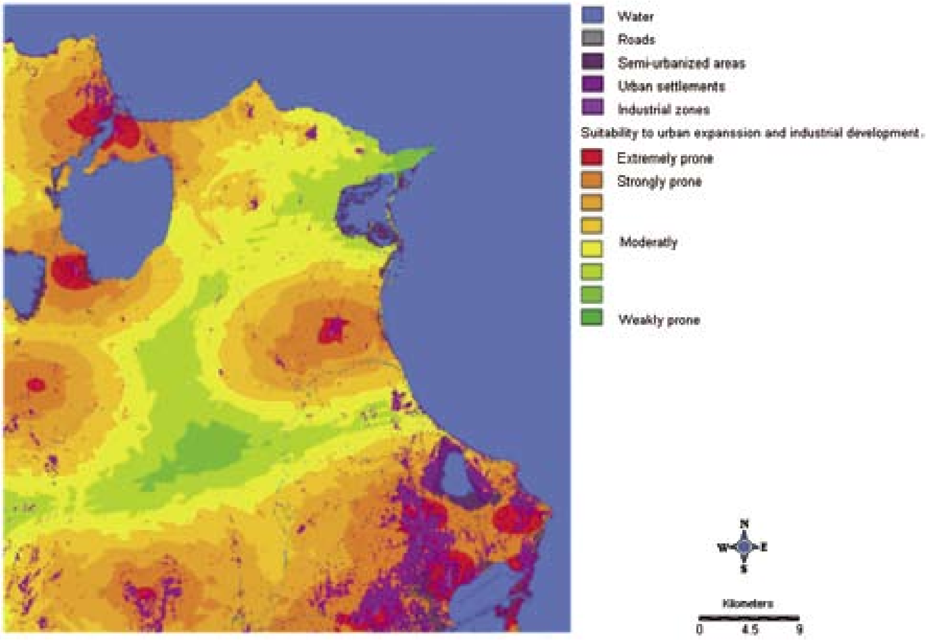

Figure 7q: Suitability map resulting from multi-criteria evaluation showing the degree of susceptibility of each pixel to host industrial areas and urban settlements

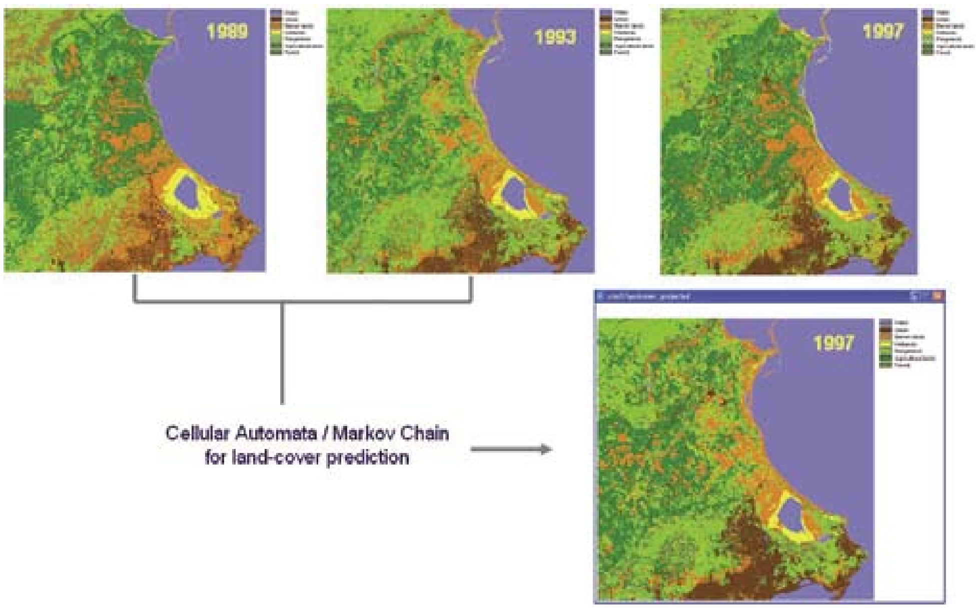

Figure 7r: Testing the prediction model

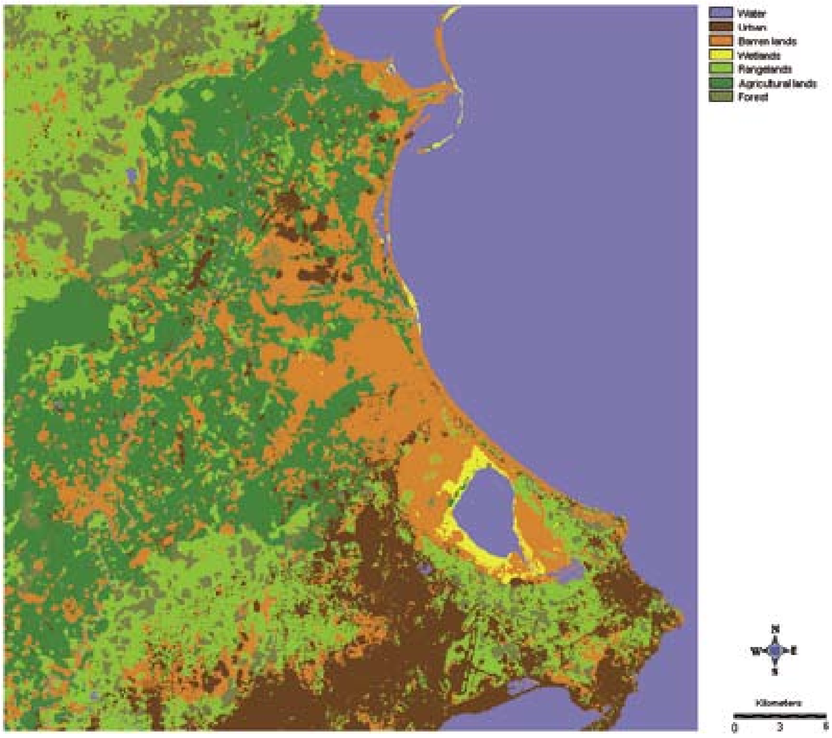

Figure 7s: Prediction of land-cover for 2009

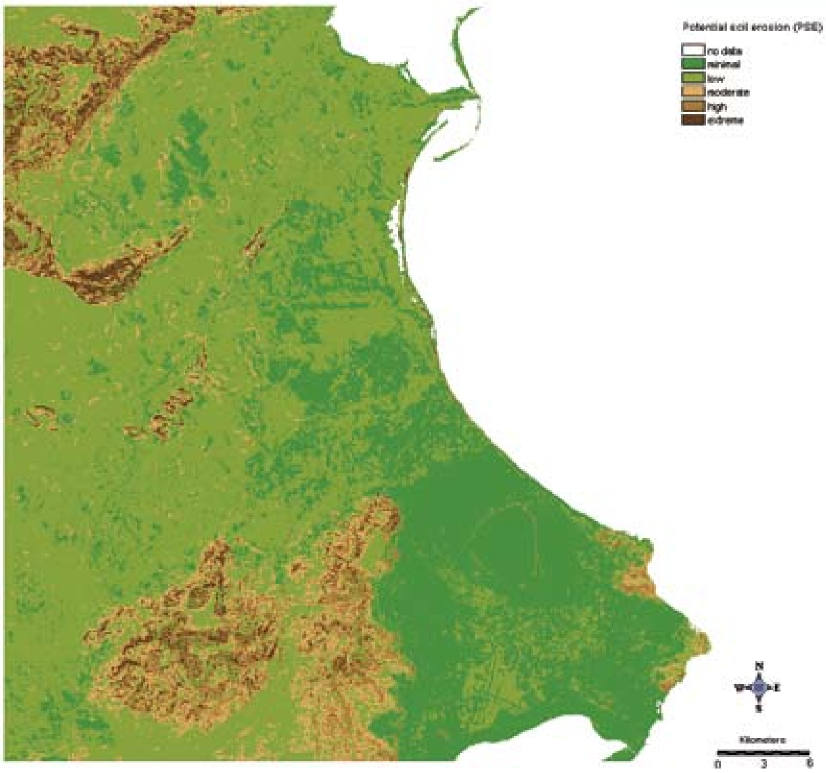

Figure 7t: Potential soil erosion (PSE) map

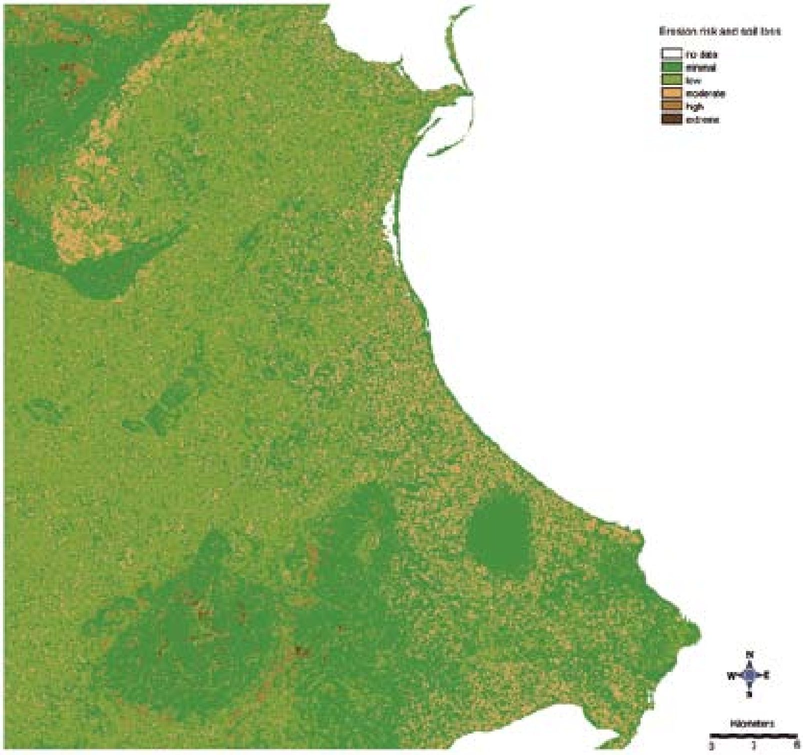

Figure 7u: Erosion risk map using revised universal soil loss equation (RUSLE)

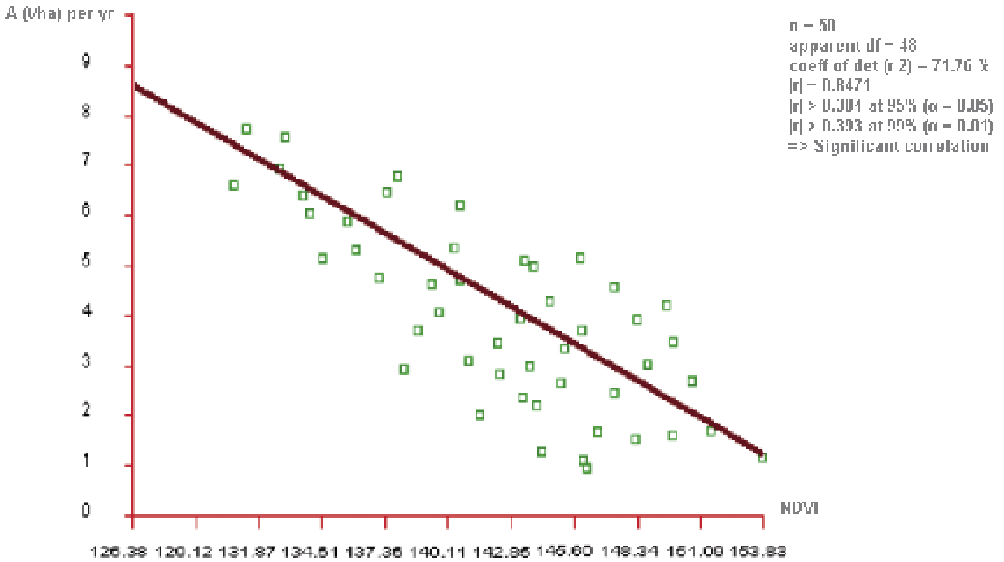

Figure 7v: Simple linear regression between vegetation index values (NDVI) and annual soil loss (t/ha)

8 Development of Environmental Indicators in Turkey: A Brief Outlook to Integrated Coastal Zone Management Indicators

Gülsun Yeşilhüyük

Abstract

Since the integration of environmental concerns into various sectors within the framework of a sustainable development approach, the need for reliable, qualitative and electronically registered data has increased. Furthermore, in the ongoing process of Turkey's accession to the European Union (EU), the country has a number of obligations such as regular reporting to the European Environment Agency (EEA). Turkey has developed the capacity to collect data in paper format. However, it is obvious that there is an increasing need for data electronic registration, in order to enable easier exchange at national and international levels, especially given the EU accession process. The Ministry of Environment and Forestry (MoEF) has conducted a project entitled Institutional Building and Access to Environmental Information Turkey, run through the European Commission's (2002) Financial Programme. The project aims at:

- *Providing access to environmental information to managers and policy-makers and thereby support knowledge-based policy-making which, in the long run, will contribute to a high level of environmental protection;*
- *Providing access to environmental information for the public and thereby raise public awareness of, and interest in environmental issues as a necessary prerequisite for environmental protection;*
- *Supporting Turkish compliance with EU access to Information Directives, reporting directives, reporting obligations related to the Turkish membership of EEA, and EUROSTAT reporting requirements.*

Within the Project framework, an environmental indicators report has been produced to give an overview of international use of indicators and subsequently identify Turkish environmental indicators. According to national and international needs, pool and core environmental indicator sets have been prepared for Turkey. As an Integrated Coastal Zone Management indicator, "bathing water" is being calculated for the whole country, within the proposed pool indicators related with Integrated Coastal Zone Management (ICZM). This chapter explains Turkey's efforts to produce/compute ICZM indicators.

Efforts Concerning Environmental Indicators

Even if several governmental institutions play a part in the collection and preparation of environmental data, the main authority for the production of statistical data is the Turkish Statistical Institute (TURKSTAT). It was founded in 1963, as a technical and scientific institute, with the responsibility for collecting, compiling, evaluating and publishing statistical data on social, economic, cultural and environmental subjects. TURKSTAT has an Environmental Division that publishes statistics on air quality, greenhouse gas emissions, industrial, mining and power plant waste, as well as other solid and hazardous wastes.

The initial studies on environmental data were carried out within the OECD Pressure-State-Response framework. Between 1980 and 1993, TURKSTAT produced a booklet on environmental indicators entitled "*Environmental Indicators for Turkey 1980-1993*". The booklet include a number of indicators for air (5), climate change (4), industry (3), inland waters (4), waste (9), land use (1), agriculture (7), flora and fauna (1), forest (2), energy (6), tourism (1), traffic (1), as well as general indicators (3). A subsequent study was conducted during the preparation of the National Environmental Action Plan (NEAP), which was coordinated by the State Planning Organization between 1995 and 1999. In the process of NEAP preparation, the "*National and International Environment and Sustainable Indicators Report*" was produced with the coordination of the Environmental Statistics Department in TURKSTAT. Proposed indicators for monitoring the NEAP were prepared in 1998. Fifty indicators were defined to monitor the NEAP strategic objectives.

In 2000, the report on "*Turkish Environmental Performance Indicators*" was prepared by the MoEF. It includes several environmental indicators relating to air pollution, agriculture, water and waste management at national level. A subsequent study for the development of sustainable development indicators was developed by TURKSTAT in collaboration with the United Nations Population Fund (UNFPA), in relation to the Johannesburg Summit and Millennium Development Goals. Forty-seven indicators were developed, some of which are Millennium Development Goals. A related website was also established in coordination with the United Nations (UN).

The Euro-Mediterranean Statistical Cooperation Programme (MEDSTAT) aims to fulfil statistical data requirements of Mediterranean countries, as per the Barcelona Convention, and in conformity with the statistical standards. During the first phase, two reports were prepared including *"Environmental Statistics Compendium of Turkey"* and *"Technical Report on Water, Waste and Land Use"*. The updated version outlines the expenditures related to air, land use, waste, water and environment. In the second phase, TURKSTAT prepared the sustainable development indicators upon MoEF input. The indicators developed in the MEDSTAT Project were published in the *"Environmental Statistics Compendium of Turkey II"* in 2006.

In the attempt to develop sustainability indicators, two main reports have been prepared, namely *"Environmental Statistics Compendium of Turkey II"* and *"Institutional Building and Access to Environmental Information, Turkey"*:

Environmental Statistics Compendium of Turkey II

The MEDSTAT programme aims at developing information systems and improving the quality of existing services provided by 12 Mediterranean Partners' statistical systems.[11]

Particular aims of the programme are identifying the needs of users and facilitating the use of data sources in a context of development of the market economy; adopting compatible international and European methodologies, classifications and standards; ensuring compatibility and comparability of statistical data from the Mediterranean Partners with those from the statistical sources of the EU, the EFTA and other international organizations; and developing swift and efficient systems of information exchange in the Region.

[11] http://ec.europa.eu/europeaid/projects/med/regional/medstat_en.htm

In the first phase of the MEDSTAT-Environment (MED-Env I) project (1999-2003), TURKSTAT established cooperation between governmental institutions and EUROSTAT. The report on "*Environmental Statistics of Turkey*" was published in March 2005. It includes 8 chapters, which cover general information, air pollution, land use and forest, solid waste, water resources and uses, water quality, marine environment and environmental expenditure. The marine environment chapter defines the main institutions involved and their specific responsibilities for the management of coastal resources. The chapter gives information on the coastline extent, coast types, main rivers, main coastal cities, coastal population, population density, coastal tourism, main port cities, and the amount of municipal waste water and treated waste water discharged into the sea on a national basis. A political map showing the administrative border of coastal cities is also included.

The second phase of the MEDSTAT project, implemented by the Blue Plan, focused on three topics including air pollutants, biodiversity and the calculation of environmental indicators. "*Environmental Statistics Compendium of Turkey II*", published in 2005, covers land and forest, biodiversity, air pollution, water and wastewater, waste, indicators (sustainable development indicators and environmental indicators) and environmental employment and expenditure by governmental organizations. Further details are available in "*Environmental Statistics Compendium of Turkey II*".

Institutional Building and Access to Environmental Information, Turkey

Within the framework of the Institutional Building and Access to Environmental Information Turkey Project, a technical report was prepared, which identified core and pool sets of environmental indicators, according to the national and international needs. During the preparation of this technical report, the MoEF established a fervent dialogue with institutions actively involved in the project. During the process of identifying indicators, the selection criteria were defined. According to the report, all the proposed indicators were selected to reflect national needs. Consultations with key stakeholders were carried out to ensure that national needs had been addressed. The availability of existing databases was one criterion considered in the selection of indicators. Indicators were furthermore selected to support existing Turkish environmental policies. The selection of the proposed indicators was based on relevant draft indicators as prepared for the Turkish National Environmental Action Plan (NEAP). Major indicator sets used in the European context were analyzed to identify the most commonly used indicators. When national indicators were not available for a specific issue, international indicators were used. The final set of indicators is, therefore, a combination of existing national indicators and existing international indicators.

The indicators cover the following environmental sectors, identified in the NEAP, including general issues (such as number of staff working in the field of environment; economy, population and health), geography, air, atmosphere and climate, water (freshwater and wastewater, coastal water, sea water), soil, biodiversity, tourism, agriculture, forests, fisheries, mining, energy, industry, infrastructures and transport, waste, noise, disasters (national and environmental), culture and cultural heritage, education and public awareness. Focus was made on identifying indicators that could implement the NEAP and might contribute to the development of the *"Turkish State of Environment Report"*. In general, most indicators reflect the country situation. However, for some indicators lack of data at a national level may lead to a temporarily reduced geographical coverage. The geographical aggregation should be considered for individual indicators based on national relevance and data availability.

Table 8.1: Selected sustainable development indicators

Title	Unit	2000	2001	2002	2003	2004	2005
Access to safe drinking water	%	..	..	93,6	90,9	..	..
Loss of agricultural land due to the urbanization	%	..	0,003	..	..	..	..
Exploitation index of forest resources	%	..	..	..	..	..	42
Forest and other wooded land: total area	Million ha	20.7	20.7	20.7	20.7	20.7	21.2
Protected coastal area	ha	170,432	170,432	170,432	170,432	170,432	170,432
Density of the solid waste disposed in the sea	Number/km^2	..	..	..	..	..	..
Existing of monitoring programs concerning pollutant inputs	Boolean	Yes	Yes	Yes	Yes	Yes	Yes
Share of irrigated agricultural land	%	18.4	18.4	18.3	18.6	18.3	..
Industrial releases into water (manufacturing industry)	Mio m^3	425	..	..	..	354	..
Industrial releases into water (thermal power plants)	Mio m^3	1,729	2,003	233	..	2,456	..
Existing economic tools to recover the water cost in various sectors	Boolean	Yes	Yes	Yes	Yes	Yes	Yes
Share of industrial wastewater treated on site (manufacturing industry)	%	31.51	..	..	..	35.82	..
Share of industrial wastewater treated on site (thermal power plants)	%	0.23	0.19	0.29	..	0.11	..
Number of turtles captured per year	Number	..	..	..	..	..	30 (approx.)
Indigenous threatened species-MAMMALS	%	32	..	..	..	..	..
Indigenous threatened species-BIRDS	%	..	..	..	..	..	40
Indigenous threatened species-REPTILES	%	3	..	..	..	..	..
Indigenous threatened species-AMPHIBIANS	%	52	..	..	..	..	..
Total expenditure of governmental organizations on protected areas management	Million Turkish Lira	..	476,586	376,995	402,819	389,048	..
Generation of municipal solid waste	Tonnes/inhab.	..	0.45	0.45	0.46	0.41	..
Generation of hazardous wastes (manufacturing industry)	1000 tonnes	1,166	..	..	..	1,125	..
Generation of hazardous wastes (thermal power plants)	1000 tonnes	..	..	..	..	0.4	..
Generation of industrial solid waste	Tonnes/inhab	0.230	..	..	..	0.227	..
Destination of municipal waste-composting	%	..	0.9	1.5	1.3	1.4	..
Destination of municipal waste-incineration	%	..	-	-	-	-	..
Destination of municipal waste-controlled landfill	%	..	33.0	27.8	28.5	28.8	..
Collection rate of household	%	..	0.81	0.82	0.81	0.83	..
Emissions of greenhouse gases	Gigagrams of CO_2 equivalent	257,628	244,407	248,294	264,413	276,081	..
Emissions of sulphur oxide	Tonnes SO_2 equivalent	1,456.30	1,441.51	1,130.72	884.98	813.17	..
Emissions of nitrogen oxide	Tonnes NO_2 equivalent	944.48	896.64	920.08	972.07	1,028.48	..
Environmental investment expenditure of governmental organizations on air pollution	Million US Dollars	5.44	0.14	0.08	-	-	..
Environmental investment expenditure of thermal power plant on air pollution abatement	Million US Dollars	114.36	42.44	66.35	9.97	4.15	..
Share of agglomerations over 100000 inhabitants equipped with an air pollution abatement	%	47	43	43	43	39	40
Economic impact of natural disasters	% of GNP	0.49	0.28	0.07	0.06	0.06	..
Burnt areas per year	ha	26,352	7,394	8,513	6,644	4,876	2,825
Enterprises engaged in “environment certification” process	%	..	..	..	..	7.7	..
Total environmental protection expenditure by governmental organizations	% of GDP	0.37	0.21	0.20	0.22	0.20	..
Number of Agendas 21 adopted by local authorities	Number	..	..	..	..	..	62

(Source: Environmental Statistics Compendium of Turkey II)

On the basis of national needs and the analysis of the most common topics and indicators used in international environmental indicator sets, a proposal for a **set** of **core** environmental indicators for Turkey was prepared. Indicators were mainly selected from OECD, EEA, EUROSTAT indicator sets and from sustainable development indicators for the Mediterranean Region and/or MEDSTAT-ENV. For each proposed set of indicators, a draft fact sheet was prepared, including information on policy relevance, data providers, and national data flow.

The **pool of indicators** was developed by taking into account national needs for indicators, while at the same time, reflecting international indicator development and the existing Turkish national indicator sets. Comments and requests from TURKSTAT and other stakeholders are reflected in the pool of indicators, which addresses national demands. The criteria for selection were the following:

- They reflect the demands of the country;
- They are of international standard;
- Defined methodologies exist for the indicators; and
- Data are available or will be available in the near future (according to MoEF).

The proposed pool has been designed to consist of both “environmental quality indicators” and “environmental performance indicators”. As it is mentioned in the technical report, the identification of a national pool of indicators should be considered as a process evolving from the need for answers to environmental questions. It was envisaged that the indicators in the national pool should function as a dynamic set of indicators developing over time and according to future MoEF demands. The report is considered by the MoEF a handbook for revising the indicators of the proposed core set. The proposed pool of indicators is considered by the MoEF a sufficient starting point for future work with indicators.

Table 8.2: Proposed core set

Indicator Title	
Climate change/air quality	1. Greenhouse gas (GHG) emissions (1000 tonnes /year) 2. Consumption of Ozone Depleting Substances (ODS) in total and by products 3. Exposure to emission of air pollutants in urban areas, SO2 4. Exposure to emission of air pollutants in urban areas, particulate matter 5. Air pollutants in urban areas, NO2
Biodiversity	6. Threatened species per number of native species 7. Protected areas to biodiversity
Water	8. Total use of freshwater resources 9. Exploitation of total renewable fresh resources 10. Waste water treatment - population connected to WWTP, % 11. Bathing water quality, % in compliance
Land-cover/use	12. General land-cover distribution
Waste	13. Amount of municipal waste generated and collected 14. Municipal waste treatment: incinerated, land filled, composted, recycled
Fishery	15. Fishery production
Transport	16. Freight transport demand by mode and per GDP 17. Passenger transport demand, km travelled/year/GDP 18. Use of alternative fuels for road transport, tonnes and %
Energy	19. Total energy consumption by fuels, tonnes/year 20. Energy intensity consumption (oil equivalent)/GDP 21. Renewable energy as % total energy production
Agriculture	22. Total sales of pesticides, tonnes/year 23. Quantity commercial fertilizers consumed in agriculture, tonnes/year
Environmental expenditure	24. Environmental expenditure by public and private sector, % of GDP

(Source: Institutional Building and Access to Environmental Information Turkey Project, Technical Report on Environmental Indicators)

Integrated Coastal Zone Management Indicators in Turkey

According to studies held by the MoEF and TURKSTAT, bathing water quality is computed at national level. The Blue Flag Campaign is a one year international environmental award and is given to beaches and marinas which satisfy the necessary standards. The Environmental Education Foundation of Turkey (TURCEV) designates which beaches and marinas have the right to display a Blue Flag, on the basis of water cleanliness, environmental concerns, security, safety and services. During peak season, the sea-water analysis is performed every 15 days by the local department of the Ministry of Health and this is funded by the Ministry of Culture and Tourism. Physical parameters, pH, and microbiological parameters are addressed, as defined in the EU Bathing Water Directive (76/160/EEC). All information can be accessed on TURCEV web page (http://www.turcev.org.tr/mavibayrak).

Sustainability indicators related to the coast in *"Environmental Statistics Compendium of Turkey II"* are:

- Protected coastal zones (ha) within the country protected areas;
- Density of solid waste disposed in the sea (number/km^2); and
- Number of marine turtles caught per year.

The protected coastal zones indicator takes into consideration the total area of all protected areas (18,900 ha Natural Park, 16,430 ha Natural Protected Area and 135,102 ha National Park) from 2000 to 2005. In this case, it can be noticed that some protected zones are overlapping. It can also be noted that the number of marine turtles caught is indicated for the Mediterranean coastal area.

Table 8.3: ICZM indicators related with ICZM from the proposed pool set

Title		**Unit**
Geography	Artificial coastline of total coastline	%
	Population density in coastal regions	cap/km^2
	Percent of total population living in coastal areas	%
	Population growth in Mediterranean coastal regions	%
	Population growth in Black Sea coastal regions	%
	Population growth in Marmara Sea coastal regions	%
Water/waste water	Waste water treatment – population connected to WWTP	% in compliance
Coastal waters	Bathing water	(bacteria/100 ml)
Sea waters	Oil tanker traffic in Turkish waters	passing vessels/ year
	Existence of monitoring programmes concerning pollutants	number
Biodiversity	Protected species per total number of native species	
	Protected coastal areas	km^2
	Wetland area,	km^2/year
Tourism	Number of international tourists' overnights	No. per km^2 of coastal zone/ year
Fishery	Number and the average power of fishing boats	
	Fishing production per broad species group	tonnes/year
	Production of aquaculture	tonnes/year

(Source: Institutional Building and Access to Environmental Information Turkey Project, Technical Report on Environmental Indicators)

Conclusions

The indicators are a simple tool that provide simplification, quantification, communication, transparency, effectiveness and accountability, and are therefore recognized to be of crucial importance for the country. They serve to address complex technical information and help experts working in environmental protection, decision-makers and policy-makers alike.

Good management in the production and use of indicators requires a strong infrastructure. According to the *"Technical Report on Environmental Indicators of Institutional Building and Access to Environmental Information Turkey"* project, it is crucial to establish communication and commitment both between and within institutions. Agreements on coordination and responsibilities, as well as issues of international coordination, are also important.

Results of the above mentioned project were finalized and the proposed environmental indicators were tested in a pilot area by MoEF experts. Nevertheless, despite successful outputs, the test highlighted a number of limitations including:

- Lack of effective mechanisms for the exchange of environmental information;
- Lack of compatibility and comparability of data and information absence in databases and information systems;
- Lack of common standards amongst institutions and the use of different criteria for the identification of indicators; and
- Lack of a computerized database system,

In the light of the testing phase results, the MoEF plans to consider a project for the establishment of a Turkish environmental information exchange network for all relevant governmental institutions and ministries in the environmental sector. Necessary arrangements have been integrated into the Law on Environment No. 2872, amended on 26 April 2006, to overcome the identified limitations.

According to the Article 9 of the Law on Environment, the concerned parties are obliged to provide information and documentation, which can be requested by the Ministry or by other competent authorities responsible for inspection. Issues of cost coverage for measurements and analysis are also addressed. In addition to Article 9, the Law highlights the importance of data gathering with a supplementary article which explains that the Ministry is authorized to request public institutions and enterprises as well as legal and real entities all kind of data and information related to environment which may be deemed necessary. These are obliged to provide data without any charge and within the time period specified.

There is a need for strengthening the institutional set-up within and amongst institutions, and a need for environmental databases and an environmental data exchange network in the environment sector to enhance institutional cooperation and to enhance the capability of accessing, querying or reporting environmental data.

Turkish authorities are aware of these necessities and continue to increase the efforts in the ongoing process of issuing environmental data and computing indicators as the efficacy of such exercises was recognized by decision-makers, experts and the public.

9 Progress in Sustainable Development in Morocco

Aziza Bennani and Nezha A. Damnati

Abstract

Ever since its participation in the Earth Summit in Rio de Janeiro, Brazil in 1992, through its participation in the Johannesburg Summit, South Africa in 2002, Morocco worked unceasingly towards achieving the twin objectives of sustainable development and safeguarding the environment. As a result, the country invested in actions aimed at the consolidation of the political, institutional and legal framework of intervention, together with the stakeholders' mobilization and reinforcement of stakeholder capacities. This chapter presents the results of four studies initiated by the National Observatory of the Environment in Morocco (ONEM), namely:

1) *The Moroccan Report on the Environment State (REEM, October 2001);*
2) *The National Test of Sustainable Development Indicators (January 2003);*
3) *The Inventory of National Experts and Human Competences in Environment (April 2003);*
4) *The Database on the Studies, Projects and Achievements in Environment and Sustainable Development Field (2006).*

Evolution of the Concept of Sustainable Development in Morocco

Sustainable development, i.e. development that integrates the environmental dimension with socio-economic development, is often conceived to be the only viable morel for future development. During the past two decades, Morocco implemented economic and social policies characterized by significant infrastructural development, including roads, dams, human settlements (rural and urban) and tourism facilities, with the intentions of reinforcing the economy of the country and of improving the life conditions of the population. However, this vision was largely sectoral in nature, and the environmental dimension was generally inadequately considered, leading to over-exploitation of natural resources and to environmental pollution. The degradation of natural environment in Morocco threatens the country's capacity to pursue further economic growth and absorb the impacts of a fast-growing population. Environmental pollution also has enormous economic and human costs in terms of its health impacts and medical costs. Indeed, it is estimated that the cost of environmental pollution represents 20 billion Dirhams annually (approximately 2 billion US Dollars), which comprises approximately 8% of the GDP.

Approaches and Methodologies Contributing to Sustainable Development

1. State of Natural Resources

This section discusses a suite of indicators which allow a diagnosis of the state of the environment and the impact of human activities on the environment. Morocco has a total surface area of 710, 850 km^2. The population in 2004 was of 29,631,000 individuals, of which 51% living in the urban zone (as opposed to 24% of the population in urban areas in 1982). The overall density is of 38 citizens per km^2. The rate of natural growth is 1.6% per year, and

37% of the population is below 15 years of age. There is a strong concentration of inhabitants in coastal regions; according to 2002 data, the coastal region between Kénitra and Casablanca attracts 37.3% of the Moroccan people, leading to widespread environmental degradation.

In Morocco, as in many other African countries, fluctuations in the GDP are primarily the result of external factors, such as tourism trends, climatic changes, or changes in the oil prices. In 2002, the GDP was in the order of 39 billion US Dollars, with a growth rate of 2.6%.

In the face of environmental problems, Morocco resolutely followed the example of the global community by seeking to manage environmental problems. Such an initiative needs to be based on an appropriate diagnosis of the causes of environmental pollution and needs to be supported by indicators to monitor success. The diagnosis can also be extended to an inventory of human resources and to successful or envisaged achievements in the field of sustainable development. Accordingly, the first report on the Environment of Morocco (REEM), compiled by the National Observatory of the Environment of Morocco (ONEM) had the dual aim (i) of providing knowledge on the state of the environment and environmental information, and (ii) evaluating policies and management programmes. The REEM represents a first initiative based on the combination of the Pressure-State-Response (PSR) indicators adopted by OECD and a number of Mediterranean countries. This model is based on the concept of causality: human activities exert pressures on the environment and modify the quality and the quantity of natural resources (status). In response to these changes, the country must adopt policies and environmental, economic and social measures which, in their turn, act on the pressures.

2. Moroccan Test of Sustainable Development Indicators

The Moroccan Test of Sustainable Development Indicators was carried out by the Department of Environment through the National Observatory of the Environment of Morocco (ONEM), in collaboration with the Blue Plan (Regional Activity Centre for the Mediterranean Action Plan) and the French Institute of Environment (IFEN). The aim of the test was:

- To examine the pertinence of indicators from the Mediterranean Commission on Sustainable Development (MCSD) in the Moroccan context (130 indicators);
- To identify environment and sustainable development priorities for Morocco; and
- To choose indicators that could contribute to the elaboration of future reports on the state of the environment (SoE).

The study carried out allowed the compilation of a list of 65 sustainable development indicators for Morocco, with the participation of all actors concerned. Several Mediterranean countries developed indicators of sustainable development, as per the recommendations of Agenda 21. The first National Report of Sustainable Development Indicators was validated and authored by the National Committee of the Indicators of Sustainable Development (CNIDD) in 2003. This first report is based on the combination of the Pressure-State-Response indicators. The development of a second report was envisaged in July 2007. The approach adopted for the establishment of the second report on the indicators of sustainable development was the DPSIR approach (Driving forces, Pressures, State, Impacts, Responses).

Four chapters were identified by the CNIDD, comprising themes as described below:

Chapter 1: Population and Society
- Demography and population
- Standard of living, employment, social inequality, poverty
- Culture, education and training
- Health and hygiene
- Modes of consumption and production

Chapter 2: Spaces and Territories

- Habitats and urban systems
- Forests
- Rural and arid areas, mountains and back-country
- Sea
- Littoral

Chapter 3: Economic Activities and Sustainability

- General economy
- Agriculture
- Fishery, aquaculture
- Mines, industry
- Services, trade
- Energy
- Transport
- Tourism

Chapter 4: Environment

- Fresh water and waste water
- Soil, vegetation and desertification
- Biological diversity and ecosystems
- Solid, domestic, industrial and hazardous wastes
- Air
- Natural and technological risks
- Sustainable development, actors and policies

At national level, the experiment was considered to be positive. The relationship between sustainable development indicators and indicators relating to the Millennium Development Goals was also of relevance. Of 69 national indicators relating to the millennium development goals, 14 were listed in the list of 65 sustainable development indicators. It was argued that a better integration would have certainly helped to get the most out of the data available through these two processes.

3. Inventory of Human Competencies and Achievements in the Field of Environment and Sustainable Development

The diagnosis of the state of the environment was extended to an inventory of the actors, human resources working in the field of the environment, and to products (in terms of studies, projects and achievements relating to the environment in general, and to sustainable development in particular). The actors and products facilitated the structuring and implementation of knowledge in the field.

Knowledge of National Expertise in Environment and Sustainable Development

This inventory of competences is related to a sample of 650 experts and 270 organizations involved in the following fields:

1) Environmental sciences;
2) Environmental engineering;
3) Environmental impacts and major risks;
4) Environmental management;
5) Environmental economics;
6) Information, education and communication; and
7) Environmental law.

One of the results of this inventory shows that human resources working in the field of the environment in Morocco are strongly concentrated in the two towns of Rabat and Casablanca (45% and 12% of the experts surveyed and 38% and 15% of the organizations surveyed), (Figures 9.1 and 9.2).

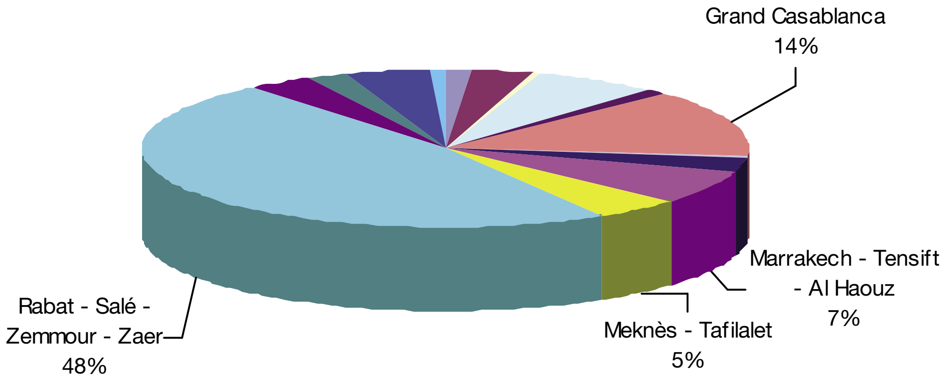

Figure 9.1: Geographic distribution of experts in Morocco

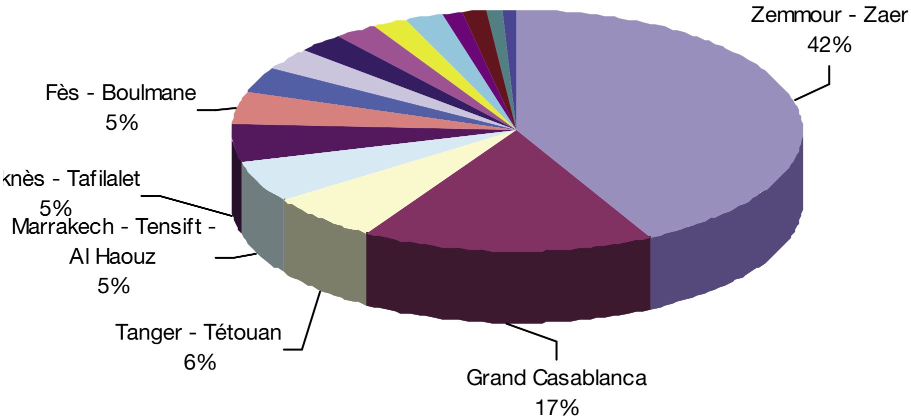

Figure 9.2: Geographic distribution of environmental organizations in Morocco

Database of Projects and Achievements Relating to Sustainable Development

The definition of sustainable development utilized for the purpose of this database was based on an evolution of the concept through 3 stages, as described below.

1) Sustainable development was first defined as a type of development allowing the satisfaction of the needs of present generations without compromising the ability of future generations to meet their own needs (Brundtland Commission 1987).
2) The second stage introduced the concept of integrating social, economic and ecological dimensions (relating to principles 1, 3 and 4 of the Rio Declaration on Environment and Development, respectively).
3) The third stage emphasized the importance of governance, together with other institutional aspects, focusing especially on the importance of public participation in the decision-making process.

The nomenclature of sustainable development adopted for this database of projects was structured in 4 poles, as follows:

Pole 1: Governance and Management

- Policies and strategies for environment and sustainable development
- Institutions (cooperation and partnership)
- Legislation and regulation
- Economic and financial instruments
- Aid

Pole 2: Economic Activities and Sustainability

- General economy
- Agriculture and forests
- Fishing and aquaculture
- Mining and industry
- Services and trade
- Energy
- Transport
- Tourism

Pole 3: The Social Basis for Sustainable Development

- Population and society
- Health and hygiene
- Spaces and territories
- Education and culture

Pole 4: Environment

- Fresh water and waste water
- Soil, vegetation and desertification
- Biodiversity and ecosystems
- Solid, domestic, industrial and hazardous wastes
- Air
- Natural and technological risks

Concerning the products, 490 organizations and approximately 1,000 outputs were analyzed. Key results include the following:

- There is a balanced distribution of work between the four poles of governance, social aspects, economic aspects and the environment;
- Close to half of the outputs (43%) relate to the sectors of water and liquid wastes.
- Natural and technological risks, air and noise are the least studied fields (13%);
- The sea is likewise inadequately studied (with only 7% of related outputs);
- The public sector is responsible for 75% of outputs relating to sustainable development in Morocco;
- Achievements on the ground are limited to 33%;
- Achievements envisaged for 2007 represent 12%;
- The geographic distribution of outputs shows that four areas are well covered: Rabat-Salé, Casablanca, Souss and Tangier, as opposed to areas such as Guelmim and Doukkala.

Conclusion

The Pressure-State-Response model allows analyzing the state of the environment by evaluating pressures it undergoes, and by defining the necessary measures to mitigate degradation. This approach could help all actors to better apprehend inter-relationships between socio-economic activities and ecological components. This should, therefore, contribute to better planning and implementation of protective measures and management actions. The development of the indicators proposed requires systems of observation and continuous monitoring to cover all the parameters and representative zones. This should, in turn, require powerful tools for analysis, standardized methods and adequate human resources.

Based on the analysis conducted, it appeared that resources are presently centralized and approaches are still somewhat sectoral in nature, with primary focus on the environmental component. The attainment of sustainable development depends on the implementation of a pragmatic and concerted approach, based on quantifiable objectives, related to the Millennium Development Goals.

4. Sustainable Development on Moroccan Littoral

Characteristics of the Moroccan Coastline

Morocco is endowed with theAtlantic coastline that extends from Cap Spartel to Lagouira (2934 km), and the Mediterranean coastline which extends from Cap Spartel to Saidia (512 km). Given its considerable demographic and economic significance, this coastal zone constitutes an important attraction pole for nationwide socio-economic activities. Contrary to inland areas, the coastline is characterized by its considerable demographic density and by emerging and sprawling urbanization. The demographic growth registered in this space is often accompanied by diverse forms of sea-shore conquest and control.

Coastline Status

The population on the coastal strip invest in several activities (notably, tourism, the exploitation of mineral resources, agriculture and industry), which are incompatible with the coastal protection measures, and therefore leading to conflicts. The resolution of such conflicts is dependent on an integrative approach. The urban population on the Atlantic coastline has not ceased to grow since the beginning of the century, and the urbanization rate is in the region 54%. It is principally the Moroccan Atlantic coast which nowadays plays the role of the structuring pole of the national economy, given its demographic and economic weight and its role in the organization of the national space. This concentration represents:

- 61% of the urban population in large cities;
- 80% of the permanent workforce in industries;
- 67% of the added-value generated;
- 53% of the tourist potential;
- 92% of foreign trade.

With the collaboration of the European Union and the World Bank, the Department of the Environment set up a Geographic Information System (GIS) documenting soil occupation on the coastline. The data pertains to a total surface of 91 700 km^2, stretching from the Algerian border in the east to the Province of Tiznit in the south, over a coastal strip of 60 km in depth.

Morocco has 13 major coastal areas, within which approximately 147 beaches have been deemed as suitable swimming zones. The average expanse of these beaches, which are frequented by a total of 2 million summer vacation visitors, ranges from 0.5 km to 50 km.

The results of the water quality tests performed in controlled beaches are the following:

- 37% of beaches are of good quality;
- 47% of beaches are of average quality;
- 11% of beaches are momentarily polluted;
- 5% of beaches are of poor quality.

Pressures

The concentration of pressures within a zone that is deficient in adequate management resources and influenced by inadequate regulation, have resulted in the proliferation of several activities which jeopardize the balance of the coastal milieu.

The major impacts of urban development on the environment are the consequences of rapid population growth, an exponential density within urban conglomerations, and the occupation of urban zones which are exposed to landslides, flooding, and other natural hazards. Three important elements have contributed to the amplification of the above impacts:

- Poverty;
- The aggravation of biological, physical, and chemical pollution of waters, and lands to inadequate waste management;
- Insufficient human and financial resources resulting in inability to meet infrastructural requirements and provide basic services.

Urbanization is often the result of expansion along the peripheries of large coastal cities. This ongoing process, which is often uncontrolled, not only enhances the densification of the coastal strip, but also gives rise to planning-related problems and to new forms of environmental degradation. Some coastal regions also have ports, which generally constitute a source of pollution afflicting nearby beaches. Additional impacts result from the extraction of sand from river-beds, or directly from beaches, or through dredging. Such activities persist despite the authorities' efforts to encourage the use of alternative building materials, such as sand produced through the crushing of stone.

Responses

The Moroccan coastline is not safeguarded by any specific legal instruments. Some laws and decrees vaguely refer to coastlines, but none of these specifically target the coastline. The one exception is a circular issued by the Prime Minister, in 1994, and pertaining to tourism development on the coastline. This, however, remains limited in both intent and scope.

Surveillance Programmes

Within the framework of monitoring and control of bathing water quality, the Department of the Environment, together with other departments, have elaborated and implemented a programme of water-quality control in some beaches. Additionally, national campaigns to enhance beach hygiene have been organized, under the effective presidency of Her Royal Highness Lalla Hasna. Such operations are undertaken within the framework of a wider national programme to promote awareness and action for the sake of "A Clean(er) Morocco".

Sustainable Development Profile of the National Littoral

Achievements in the areas of environmental management and sustainable development were characterized at the national level. This exercise was based on a national database based on economic, ecological, social and governance poles, which enabled the identification of 25 relevant fields and 139 topics. A number of achievements to date can be classified under multiple poles, reflecting a positive trend towards integration.

It is evident that, overall, there is more a sectoral than an integrated vision. The majority of efforts are concentrated on the environment pole (335 out of 1,000 achievements), with the social, economic and governance poles having been attributed less attention (165, 214 and 193 achievements, respectively). The most successful integration efforts addressed the social-environment axis (150 achievements), followed by the environment-economy axis.

Comparisons were also made between national level data and data for the littoral. In the latter case, there appears to be more balance between the different poles (25% for environment, 22% for social aspects, 21% for economy and 11% for governance, as compared to 26% for environment, 13% for social aspects, 17% for economy and 15% for governance in the former case). In terms of integration, it appears to be less integrative effort at the level of coastal management. It thus appears that, on the basis of the sample collected, the concept of integrative sustainable development is still lacking at both national level and, even more, coastal management level.

The profiles of achievements along the Atlantic and Mediterranean coasts, indicate an almost perfect similarity between the profile of the national littoral and that of the Atlantic coast, contrary to the profile of the Mediterranean, which presents a marked prevalence of the environment (32%) and social (28%) poles. The poles relating to economy and governance are limited to 16% and 7% respectively. This difference in profile can be explained in several ways. First of all, the Mediterranean littoral is limited to approximately 500 km, contrary to the Atlantic littoral which is 6 times larger (2934km). The nature of land-use is also completely different. The Atlantic littoral is well developed in urban and industrial terms, whilst the Mediterranean littoral has been impacted to a lesser degree due to its more rugged terrain. The situation is, however, changing with the promotion of large-scale initiatives on the Mediterranean coast, relating to harbors and other infrastructures, in addition to tourism projects, possibly contributing to social development and improved standards of living for locals. However, balanced development must also take into account the environmental and governance aspects and the involvement of local actors in the implementation of any project.

Conclusions and Recommendations

Effective change towards more balanced profiles of sustainable development requires political will, in order to implement changes that can benefit present and future generations. Management tools for coastal areas already exist and have proved effective elsewhere. It would, therefore, already be an achievement if such examples from elsewhere were considered a starting point, and similar initiatives were applied at the national level.

Sustainable and productive development of coastal zones in Morocco necessitates a better management of available resources. This requires harmonious integration of different activities within the limited space of coastlines. Cities on the Moroccan coast are the seat of major activities (e.g. fisheries, industries, and tourism) that underpin the economic and social development of the country. It is, therefore, essential to implement management initiatives which, whilst deriving optimal profit from these resources, control any activities which undermine the integrity of the environment and the livelihoods of present and future generations. It is, therefore, necessary to:

- Provide resources for pollution control in order to allow national authorities to deal efficiently with the dumping of pollutants into the environment and to implement regulations that are in force;
- Systematize studies relating to the impact of all products or industrial process on public health and environment prior to implementation of such processes;
- Set up long-term monitoring systems of industrial accidents, along with their effects on the populations and environment;
- Firmly regulate the storage, handling, and transportation of hazardous materials;
- Sensitize and educate the population in order to make each and all responsible for the protection of ecosystems;
- Pre-treat household and industrial waste-waters before re-introducing them into a natural environment.

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Conclusions

Stephen Morse

The chapters in this book have explored various aspects of the development and use of sustainability indicators (SIs). While there are some similarities in the approaches there are also notable differences and the chapters encapsulate both opportunities and problems. Here we will revisit the chapters and briefly explore some of these issues with a view to what they tell us about the wider world of SIs and what the future might be. The issues we wish to explore in greater depth are provided in Table 10.1

Table 10.1: A comparison of case study chapters in terms of four main issues relevant to sustainable development

Study	Participation in SI development	Public/private focus	Visualization of results
Malta	Yes, but limited mostly to government	Public	Pictures, tables, *AMOEBA*
Gozo	Yes, included a number of stakeholders	Public	Pictures, tables
Sardinia	No	Public	GIS, tables
Turkey	No	Public	Tables
Morocco	No	Public	Radar
Tunisia	No	Public	GIS, graphs, tables

Study	Data collection
Malta	Primary: participatory workshops
Gozo	Primary: ecological surveys, participatory workshops, stakeholder interviews
Sardinia	Secondary (and hence there is a limitation of dataset availability)
Turkey	Secondary (published sources, mostly government)
Morocco	Secondary
Tunisia	Primary and secondary

To begin with, all of the chapters in the book are firmly located in the public sector domain and thus provide an immediate contrast with the chapter written by Ms. Amy Townsend. The involvement of the private sector in the case studies is either non-existent or minimal. In the Morocco chapter there is some discussion of the importance of capacity in the field of environment, and this included the private sector. Capacity was found to be concentrated in two towns: Rabat and Casablanca, and the "*public sector is responsible for 75% of outputs relating to sustainable development in Morocco*". In the other chapters, the private sector is really only tangentially evident as a pressure on sustainability; such as tourism, farming or industrial pollution as Mr. Prem summarizes in his chapter. The premise is what Ms. Townsend refers to as a historical vision of business as having "*discordant relationship with* *the natural world via non-sustainable resource acquisition and pollution*". In a microcosm, this is perhaps indicative of the centre of gravity of the wider effort in Sis – essentially a government (national, local, etc.) and multi-lateral (e.g. UN agencies) effort. But as Townsend points out, the private sector has an important role to play, and there is little that can be done unless this sector is fully included. The apparent public and private dichotomy in sustainability and SIs makes for some interesting points of contact between academics, scientists, policy-makers and business. All too often this is portrayed as a conflict – publicly sponsored sustainability experts trying to control the activities of those generating wealth for an economy – but increasingly there is much in common. Businesses themselves have to be sustainable, and while this can be interpreted in very limited sense of financial sustainability, there are moves towards a more enlightened stance; what Ms. Townsend refers to as a "full business ecology". The reasons behind this greening are varied, but indicators clearly have a role even if the practice to date falls short of what is required (they are "*too generic or simplistic*" according to Ms. Townsend).

The second issue highlighted is that of stakeholder participation. As Mr. Morse points out in his chapter, this can be a highly misused term; providing an apparent label of acceptability or kite-mark. But in practice, participation can mean many things. The majority of the chapters can be regarded as expert-driven in the sense that data collection, analysis, presentation and interpretation are all driven by the experts, even if there is an acknowledgement of the stakeholders' importance. In the Morocco chapter, it says that "*balanced development must also take into account the environmental and governance aspects and the involvement of local actors in the implementation of any project*" and in the Turkey chapter, one of the aims of the work being described is to "*provide access to environmental information for the public and thereby raise public awareness of, and interest in, environmental issues as a necessary prerequisite for environmental protection*". But overall, a reference to stakeholder participation is minimal, and indeed arguably is not even required in some cases. For example, the Tunisia chapter describes how satellite data can be employed to assess ecosystem health using various measures of plant cover, such as photosynthetic absorption. The logic here is that "*the indicator value of vegetation for monitoring environmental change is essential for short-term observation but also significant for long-term forecasts*." This is very much an expert-driven process.

Two of the chapters, Malta and Gozo, do describe the involvement of stakeholders in the development of SIs, but the emphasis is different. In the Malta example, the stakeholders are largely government, but also include some NGOs and others. In the Gozo example, the stakeholders are a more diverse group included over two phases – a soft systems workshop and then a set of ranking exercises with affected locals and resource users as well as government, NGOs and the scientific community. The Tunisia chapter does include a socio-economic survey, but this is not so much about helping to derive SIs but a SWOT analysis which highlights issues important to sustainability (soil loss, job creation, housing, etc.). By way of contrast, the Turkey example draws the foundation of its SIs from lists provided by OECD, EEA, EUROSTAT and MEDSTAT-ENV rather than having any local stakeholders' involvement. Instead, the criteria for selection in the Turkey example are stated as:

- Reflecting the demands of Turkey;
- Being of international standard;
- Existence of defined methodologies for indicator assessment;
- Data availability.

These are widely expressed concerns.

All the chapters help raise the important question as to whether stakeholders should be included and if they do, then why, when and how? Should they be a driver of the direction of the assessment from the onset (Gozo, Malta) or a supplement to an essential technical assessment (Tunisia)? The Gozo chapter calls for "*collaborative and complementary processes of expert and stakeholder involvement*" in developing SIs as "*all stakeholders, including scientific and technical personnel, and people with experiential knowledge, have much to learn from each other and much to contribute*", and all chapters in this book imply in one way or another that this would seem the logical way forward. Both experts and stakeholders clearly have roles to play, but the question is: how to engender a partnership? The Gozo chapter provides an example within a research context.

The third issue to be picked-up here is the representation of the results. Again, there is a diverse range of approaches from the use of simple tables through graphs and diagrams such as the Radar and the *AMOEBA* up to the use of GIS and photographs. These all have their relative advantages and disadvantages. Tables are a way of presenting much detailed information in a small space, while graphs and diagrams can present less information but in a more digestible form and allow for easy comparison. The use of GIS allows the reader to make a clear link to a place – a map – as illustrated in the Sardinia and especially the Tunisia chapters. The final example is the use of photographs as exemplified in the Gozo chapter. Included here are photographs of pressures (quarrying) and present state such as the picture of one of the nine sites identified as of high ecological value. SIs have tended to be quantitative beasts; numbers that can be plotted, tabulated and manipulated. The qualitative representation of the state and pressure has received remarkably little attention although there have been calls to include this dimension. Qualitative representations of indicators do have the advantage of resonance with non-experts who may not know what a degradation index of "3.6" means but can recognize physical degradation when they see it.

The forth point is shared by all the examples – the need for data from any source. This may sound the most obvious of all the issues, but it gets to the very heart of the practical use of SIs. After all, if SIs are to be of any use, all they need is to be measured or assessed accurately and routinely, as perhaps exemplified by the Turkey case study. Most of the chapters describe data collection in one place and at one time, rather than a process of ongoing and routine assessment as a feed into policy. The Gozo, Tunisia and Sardinia examples are research projects, and thus the depth and extent of data collection and analysis are perhaps far greater than would realistically be achievable on a routine basis. Research projects provide resource for an intensive period of data collection and analysis, but are not necessarily geared towards maintaining that once the research has finished. For example, the Sardinia chapter makes a case for landscape as a spatial unit for assessing sustainability but with reference to a wider applicability of the proposed methodology refers to "*the lack of truly Mediterranean datasets. The datasets identified so far exhibit high diversity in terms of quality, resolution, and coverage. Although high quality data are available for some limited areas or individual countries, such data are not applicable for the initial task of dividing the Mediterranean coastal landscapes into major regional units.*"

The Morocco and Turkey examples arguably have more of a founding in the practice of sustainable development rather than research, but even here it is not immediately clear how the work described will lead to a sustainable set of SIs. Just how will the SIs become institutionalized in the sense of being routinely assessed (how often, by whom, at what cost?) and, more important still, who is going to use them? The Turkey chapter does address some of the issues here and points sharply to problems of data quality and availability and the suggested creation of a Turkish Environmental Information Exchange Network to help address these gaps.

Unfortunately the history of SI development over the past nearly 20 years has been an exercise almost exclusively centered on the choice of SIs, the methodology of their assessment and how they can be best presented. A host of people have championed their own perspective as the most appropriate way of doing SIs and in the process have criticized other approaches. Debates have swayed between the sort of issues discussed here along with the desirability (or not) of generating single indices, the use of performance league tables, the need to have a solid theoretical underpinning based on systems (whatever they are), the relative roles of international, national and local action and so on. The effect has been a bewildering set of approaches that can confuse even the SI specialist. But, of course, there is nothing wrong with healthy debate and it is important for these arguments to be aired, and as we have seen with the Turkey chapter, it is possible, and indeed necessary, to synthesize and adapt from existing work to local contexts. However, the jump between having SIs and then someone making use of them has been relatively under-explored. Some authors suggest that the process of learning within participatory settings can be a valued outcome in itself and in this context SIs are a currency of negotiation as they allow sustainability issues to be grounded. Others have pointed to the complexity of influences acting upon policy-makers and managers and SIs are but one feed into this and could become over-ruled by other concerns.

The relevant spatial unit for analysis is related to this point of indicator assessment. Mr. Prem makes the case in relation to coastal areas that "*sustainability indices need to be based on coherent landscape units rather than on administrative boundaries*", yet it is noticeable that all the case study chapters are based on nation states (Malta, Tunisia, Turkey, Morocco) or a discrete unit within a nation state (Gozo, Sardinia). Mr. Prem goes so far as to say that "*figures collected at various levels, mainly related to administrative borders such as countries, regions or local communities, can not satisfactorily respond to the question of whether a certain landscape unit is in line with sustainability objectives*". The Sardinia chapter makes a similar point, but widens it in terms of the aesthetic value of landscape thus making it a visually recognizable and resonant unit. But, while clearly sensible, in an objective sense, there is nonetheless a dilemma here. On one hand there are spatial units that can be more logical in terms of ecological, social and economic characteristics (such as landscape units) and thus political boundaries can be an artificial and unnecessary constraint. On the other hand decision-making structures and mindsets, which can be vital to facilitate sustainable development, can be far more in tune with such political borders. The need for politicians to address Millennium Development Goals (Morocco chapter) at national levels obviously overlaps with concerns of sustainability. Thus there is a potential discontinuity between decision-making spaces and sustainable assessment spaces, and the question becomes whether we should compromise on the logic of assessment or whether compromises should be made in helping to make sustainability a reality.

Finally, it has to be reiterated that, while this book is set in one place (the Mediterranean) and time, the chapters do touch upon many aspects of the sustainability discourse and in particular the role of SIs that are, and should be, relevant in many other contexts. Sustainability is about "us" in a global sense. The Mediterranean is a big site, with 21 countries from North Africa and Europe having a coastline on the sea, but it's all too easy to dismiss experience from distant places. After all, what has the Mediterranean experience to do with that of New Zealand or India? The Mediterranean may seem like a long way away, both geographically and culturally. But the Mediterranean provides a historical, present day and future microcosm of the challenges facing humanity and the problems as well as opportunities of handling those challenges.

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