Coastal tourism, environment, and sustainable local development

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Editors

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? How do societal drivers impact on coastal areas and ecosystems?

? How does policy relating to the management of coastal resources and activities play out in this context?

? What tools and approaches are needed to improve coastal management and decision making?

These are the main streams of inquiry that have guided the collaborative research by three Indian and four European institutions,[1] supported by EU DG XII's programme of cooperation with developing countries (INCO-DC). An interdisciplinary collaboration, it aims to integrate environment and development issues across disciplines and to bridge the divide between natural and social sciences, building on each other's strengths and constraints.

Societal drivers and coastal ecosystems are the two main parameters studied to examine aspects of change and sustainability on the coast. Considering the expanse of the 'canvas' of issues, the focus is on what contributes most to the variations observed. To help make this decision, an expert workshop comprising coastal planners, researchers, and activists was convened in 1999. Looking beyond the accepted primary drivers of population growth and migration, this workshop identified the following five dominant development drivers of the Indian coast.

1 Industry
2 Tourism
3 Port activity
4 Urbanization
5 Intensive agriculture or aquaculture.

[1] Tata Energy Research Institute, National Institute of Oceanography, Goa University, Universidade Nova de Lisboa, Laboratorio Nacional de Engenharia Civil, Instituto Cartografic de Catalunya, and Universita Degli Studi di Trieste

Of these, this project has focused on three—(1) tourism, (2) agriculture/aquaculture, and (3) industry. This book reports on coastal tourism.

The question of sustainability is particularly appropriate in the context of coastal tourism, which is an activity at the interface of humans, land, and water.[2] In this research, we are not directly engaging in the debate on sustainability. While we have the broader concerns of sustainability in mind, our focus here is on *environmental* sustainability, by which we mean a path of tourism development that lasts, in that it does not stress the health of the coastal ecosystems of interest, in terms of their ability to provide humans with the goods and services that are required for their continued well-being over time (Costanza, D'Arge, de Groot, *et al*. 1992; Jacobs 1997; Munasinghe and Shearer 1995). We do, however, fully acknowledge that environmental and social sustainability cannot be seen in isolation, and that a focus on the interactions between society and nature requires us to conceptualize sustainability in relational terms (Becker, Jahn, and Stiess 1999). We believe that a focus on 'sustainability' ensures a concern with examining not only the pros of but also 'what is going wrong, has gone wrong, and can go wrong as a result of selected development paths. Such a focus reminds us to monitor and evaluate the impacts of development policy on the resource base that will sustain future well-being, not necessarily in hundreds of years in the future, but in the next few decades' (Atkinson, Dubourg, Hamilton, *et al*. 1997).

The coastal ecosystems considered in this research are sand dunes, coastal vegetation, coastal aquifers, land cover, and marine and estuarine waters. These are also the ecosystems that are typically stressed by development activity in Indian coastal areas[3]

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[2] The concept of sustainability and sustainable development has been much discussed in literature (Pearce, Barbier, and Markandya 1990; Pezzey 1993; Munasinghe and Shearer 1995; Atkinson, Dubourg, Hamilton, *et al*. 1997; Becker and Jahn 1999). The literature reveals a concern with three issues—(1) equity across and within generations; (2) importance of the environment to humans, as a constraint to economic activity in terms of the biophysical limits that it can pose as well as a contributor to human well-being; and (3) a concern with the poor and the disadvantaged, both with regard to intragenerational equity and to protection of the environment for future generations. Sustainability thus requires attention to the domains that support or influence human health and well-being—economic, social, and environmental.

[3] The other sensitive ecosystems are coral reefs, not included here, as they are uncommon on the Indian mainland coast to which this exercise is restricted.

(Rajagopalan 1996). These ecosystems are particularly vulnerable to socio-economic driving forces, as they are often considered 'expendable' in the path of increased development, without recognition of their protective and other societal roles.

The representative location used to understand change and the processes of change is Goa, an international coastal tourism destination. Within Goa, an area that experiences intense tourism activity – the Baga watershed within which it is located – was selected to imbue the study with an ecosystem approach. To enable a connection with the estuarine environment, the study area was extended to include Nerul, another small watershed. The study area thus comprises the Baga–Nerul watersheds (Figure 1).

The focus of inquiry was to understand why tourism located itself here, the nature of this localization, how it came to appropriate local resources, and what the implications of this appropriation have been for coastal ecosystems, such as water and land. Since the study aims to provide policy direction, the research goes beyond explanations and understanding to a focus on what needs to be done to improve the society–nature interactions in the context of coastal tourism.
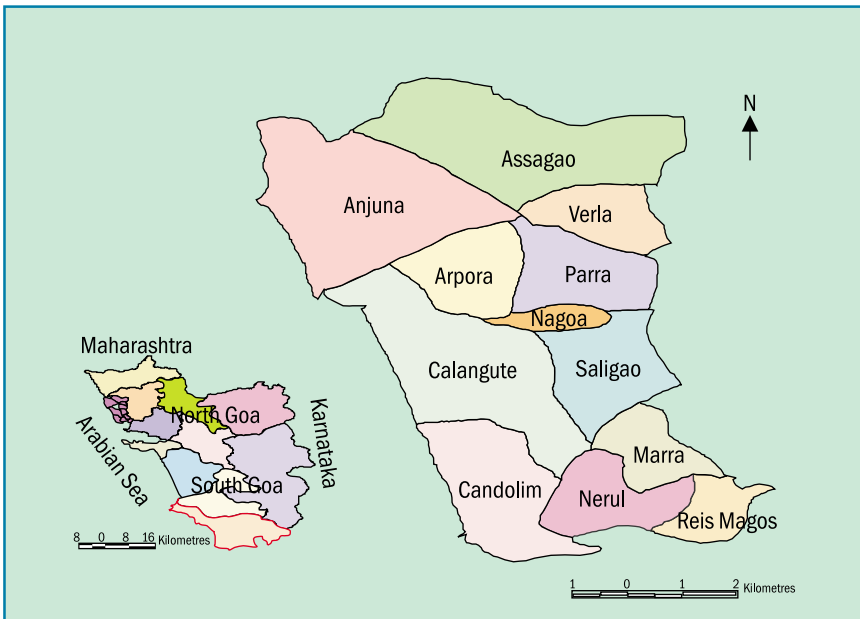

Figure 1 The study area in Goa

Chapter 1

Ligia Noronha
TERI

Introduction and overview

Six reasons are offered to explain why the coast provides an inter-
esting and unique site for understanding the complexity of the
linkages between social and natural systems. Coastal tourism offers
a rich arena to examine the interplay of human activity with eco-
systems, through an assessment of the nature of consumption
involved. It has, as its central attributes, the triad of sun, sea, and
sand. Certain seasonality accompanies this form of tourism, given
that access to sea and sand is limited in the months of rain. This
'seasonality' shapes the choices made in the tourism industry.

Society organizes its production and consumption choices
depending on the activity that is possible during the period. Plan-
ners, however, do not realize or sufficiently appreciate this 'nature
dependence' and promote tourism that neglects the supporting
ecosystems. Coastal ecosystems must be protected not only for the
more general functions that they perform in terms of support to
human well-being but also because they provide the goods and
services required for activities based on the coast. Impairing them
will impact adversely on the economic activities that utilize
them—implicitly or explicitly. A classic 'golden goose' predicament
results, where the resource is flogged until the activity cannot be
supported any longer. The societal implications of this pheno-
menon are also serious. Tourism can push out other prevalent
activities, result in changed skills of the local populace, and effect a
change in priorities.

The planning and management of coastal tourism can be im-
proved through more careful understanding of social and ecological
systems and their linkages, with a view to ensure a development that
'lasts', not only for tourism but also for the host destination. The
patterns and relationships of ecosystems and/or variations at the
watershed level are identified, and explained by identifying variables
located at both higher (coastal, district, state, or above) and lower
(village and household) levels than the watershed (Figure 2).

The chapter suggests a framework for an integrated analysis of
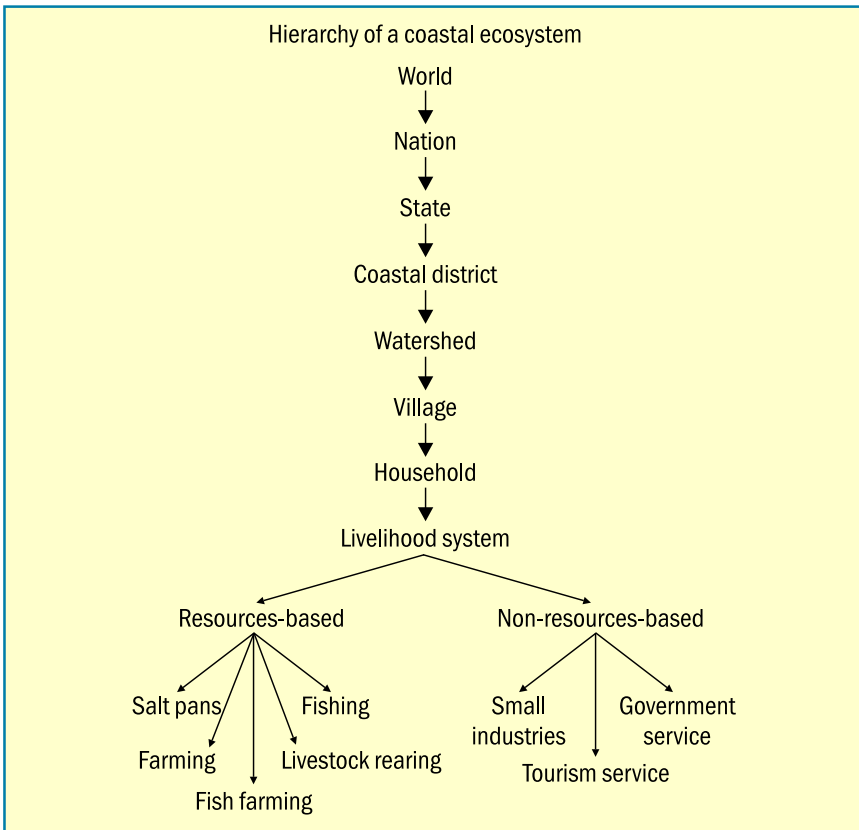social and ecological dimensions of development activity in coastal

Hierarchy of a coastal ecosystem

World
↓
Nation
↓
State
↓
Coastal district
↓
Watershed
↓
Village
↓
Household
↓
Livelihood system

Resources-based   Non-resources-based

Salt pans   Fishing   Small   Government
                                    industries   service
Farming   Livestock rearing
                                         Tourism service
       Fish farming

Figure 2 Hierarchy of a coastal ecosystem
Source Adapted from Conway and Barbier (1988)

areas, combining policy-relevant components, such as Driver–Pressure–State–Impact–Response, with others focused more on explanations, such as population–consumption–environment (Figure 3). Using this framework will enable a clearer understanding of the context within which impacts occur, reasons for their occurrence, and possible alternative routes to pressures created by the drivers.

This chapter suggests that society can adopt a tourism development path that 'lasts' by being less homogenous and uniform in its orientation, less concerned with creating conditions available elsewhere, and more participatory in orientation. The main constraints to such diversified paths in the local and state contexts seem to emerge from the 'room to manoeuvre' available to states in making socially, economically, and environmentally sustainable choices.
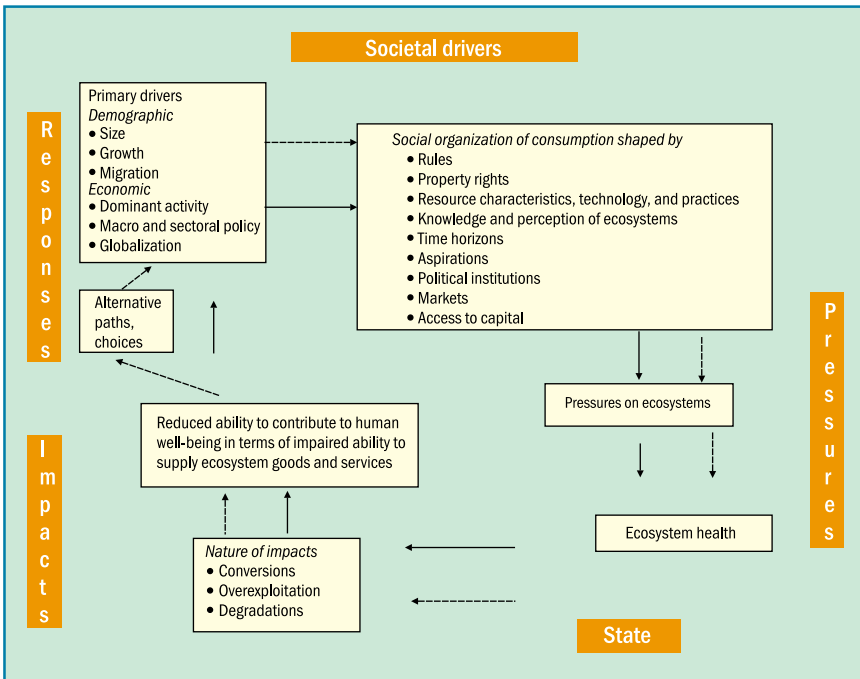
Figure 3 A framework for an integrated analysis

Chapter 2

Nelson Lourenco and R Jorge
Universidade Nova de Lisboa

Tourism: nature, spatial dimension, and driving force

Tourism is currently among the world's largest industries and fastest growing economic sectors. It is estimated to have generated 3.5 trillion dollars and almost 200 million jobs globally in 1999 (Burke, Kura, Kassem, *et al*. 2000). Tourism activities are responsible for employing three per cent of the global workforce; if indirect/informal jobs are considered, this share rises to eight per cent (UNEP 2002). According to the World Tourism Organization, the year 2000 saw approximately 697 million international tourist arrivals worldwide (WTO 2002). The expected global growth of tourism and the increasing reliance of many developing countries on this sector as a major employer and contributor to local,

regional, and national economies highlight the imperative to pay special attention to the relationship between environmental conservation and sustainable tourism.

Spatial and socio-economic impacts of tourism have been quite significant in some regions, causing changes in the economic structure, stimulating some sectors and displacing others. Tourism creates pressures on different domains—natural resources and environment, the built environment, and hospitality and cultural resources.

A host of socio-economic conditions lead to the development of tourism, both national and international. Such development is accompanied by many conflicts, for instance lobbying for real estate expansion versus the protection of agricultural, forest, and natural spaces from tourism activities, which frequently trigger significant changes in existing flora and fauna. The impacts are also considerable—environmental, sociocultural, and economic, particularly in coastal areas and rural destinations. Impacts of tourism activity can alter the biophysical environment in different ways, consume natural spaces and agrarian landscapes, and throw into disarray spatial distributions of population, labour, and income.

India has had a mixed experience in this sector and its share of global tourism is not very high. It does possess all three vital attributes of coastal tourism – sun, sea, and sand – which are complemented by the pull of India's age-old 'mystique'. It is thus an amalgamation of nature and culture that attracts foreign tourists to India, especially Goa, Kovalam, Mahabalipuram, Kanyakumari, and other locales dotting the southern Kerala coast.

Goa emerged spontaneously as a tourist destination in the 1960s, its unique selling points being its natural coastal beauty, its cosmopolitanism, its rich history, and the warmth of its people. The state administration perceived this as a viable development option. Numerous secondary resources – accommodation venues, restaurants, shopping centres, transport systems, and recreation facilities – have been set up to cater to the influx of tourists from across the globe. This infrastructure has impacted on the existing social, economic, and environmental dynamics of Goan society. Some of the tourism-related influences discussed in this chapter will be taken up at length in subsequent chapters, with special reference to the project study area.

Chapter 3

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TERI and Universidade Nova de Lisboa

Baga–Nerul watersheds: tourism, local stakes, and transformations

Many development specialists and governments advocate and promote tourism for its potential to generate local employment and opportunities. What is the extent and nature of active involvement of local households in a typical tourist destination? This chapter assesses local stakes and their implications for tourism policy. In an investigation into the degree of 'localization' of tourism and its social bases, which prompt the need to support it, the following related activities are observed in the study area (Figure 4).

1 Owning or operating a hotel, restaurant, shack, or shop
2 Renting out rooms in one's residence
3 Hiring or owning a taxi (car or motorcycle)
4 Selling goods and services (laundry, garbage collection, entertainment, etc.)
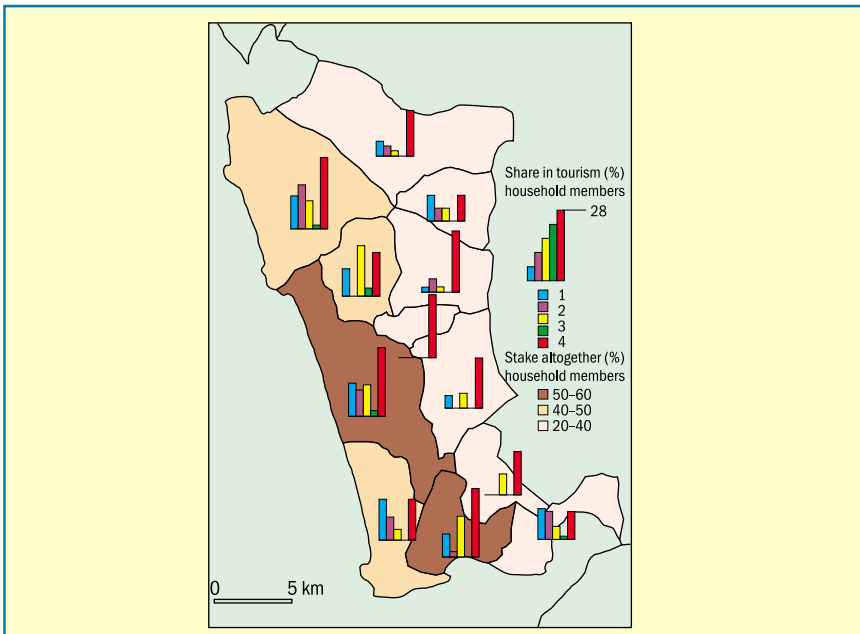5 Others (being employed in hotels or restaurants).

Figure 4 Stakes in tourism by study villages

What traditional activities are displaced by tourism? Are some activities displaced more easily than others, and why? What are the characteristics associated with people's stake in tourism? Quantitative analysis reveals that education, gender, and age are important determinants of this stake. It is mostly young people that are involved as also those with a low level of education. It is notable that the locals engaged are neither especially accomplished nor professionally trained in the hospitality trade or visitor care or alternative skills that they could exploit to further their careers if this industry declined locally.

The strategy to attain a socially relevant development policy must incorporate the following components.

- Attention to shifts in occupational distribution to prevent complete loss of those activities that have longer and more secure time spans
- Attention to the education, training, and skills imparted to the youth of local communities
- Attention to the type of training needed for quality coastal tourism
- Examination of the implications of local involvement in tourism, in relation to the functioning of local panchayats.

Chapter 4

S Kazi and S Nairy
TERI

Resource-use patterns in the tourism accommodation sector

The accommodation type that emerges, is supported by policy, and is developed in a tourist destination is important, as it contributes to the creation and sustenance of the destination's image. The characteristics of a tourism accommodation sector include resource-use patterns and waste generation and disposal mechanisms. The accommodation sector, although part of the industry's supply side, clearly reflects the tourists' demands, which are influenced by several factors such as motivation to travel, socio-economic profile, and place of origin. These factors contribute to the evolution of the sector's typical features, resource consumption patterns, and disposal mechanisms, which variously impinge the

economic, social, and environmental domains of the tourist destination.

To enable a comparative analysis of the above parameters, hotels in the study area are categorized (on the basis of tariff structures) into low, middle, high, and luxury budget hotels. Analysing likely implications across these categories, based on a set of selected indicators, reveals that luxury budget hotels do well in the economic and environmental domains but fair very poorly in the social domain. On the other hand, low budget hotels perform the best in the social domain and lower in the economic and environmental domains (Figure 5). However, the performances can be improved through various measures.

Figure 5 Comparison of accommodation types using indicators
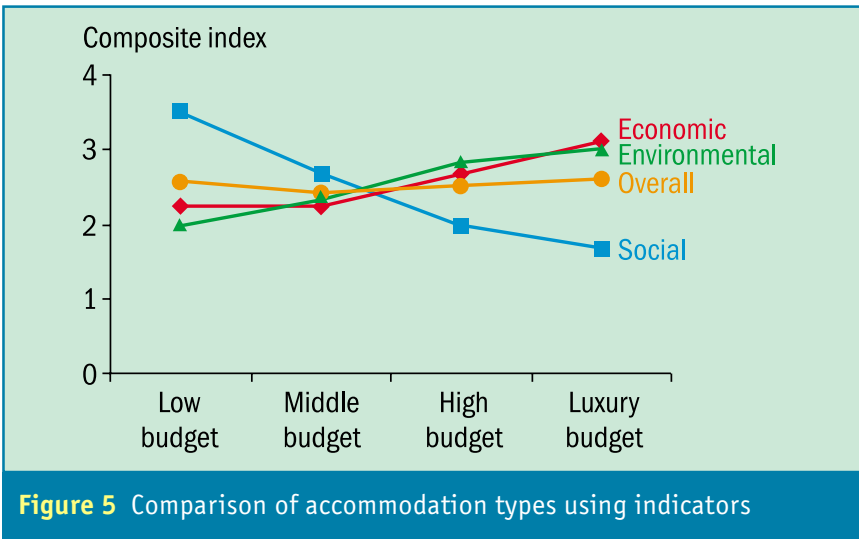
Such a comparison provides tourism planners with an efficient planning tool, based on an in-depth comprehension of trends specific to each type of hotel. Bearing in mind the image that they want to project for the destination and the trade-offs possible across the three domains, planners and decision-makers can arrive at the type(s) of accommodation to be developed.

Chapter 5

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Land cover patterns

In this chapter, the indicator value of vegetation with respect to land use and economic development is tested. Analysis of satellite imagery helps define land cover types and also facilitates the documentation of major natural and human-induced changes in coastal land cover in successive years (Figure 6).
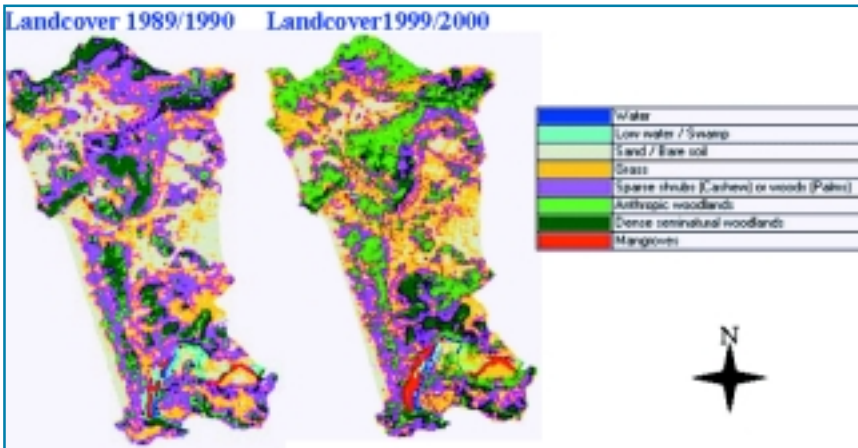

Figure 6 Changes in land cover patterns from 1989/90 through 1999/2000

After such definition, computerised GIS (geographical information systems) were deployed to process large volumes of data on land cover types—referenced geographically from multiple sources. Analysed in terms of vegetation cover by NDVI (Normalized Difference Vegetation Index) and their pattern distribution in the landscape, the different land cover types were characterized by majority and fractal dimension of NDVI (Figure 7). The LAI (leaf area index) – calculated for woodland vegetation by hemispherical photography – was correlated with the NDVI. A good linear correlation was found between the two parameters and regression was used to extend the LAI to all woody areas of the study sites. In the same analysis for the administrative units (villages), both fractal dimension and NDVI were correlated with population density of different years.

Correlation between variations of population density and NDVI reveals that, in general, high population density produces low NDVI. (Some exceptions can be explained by land-use and socio-economic variables.) The chapter concludes that vegetation is an excellent ecological indicator of human impact. It can yield useful parameters to characterize administrative units, using an ecological lens.
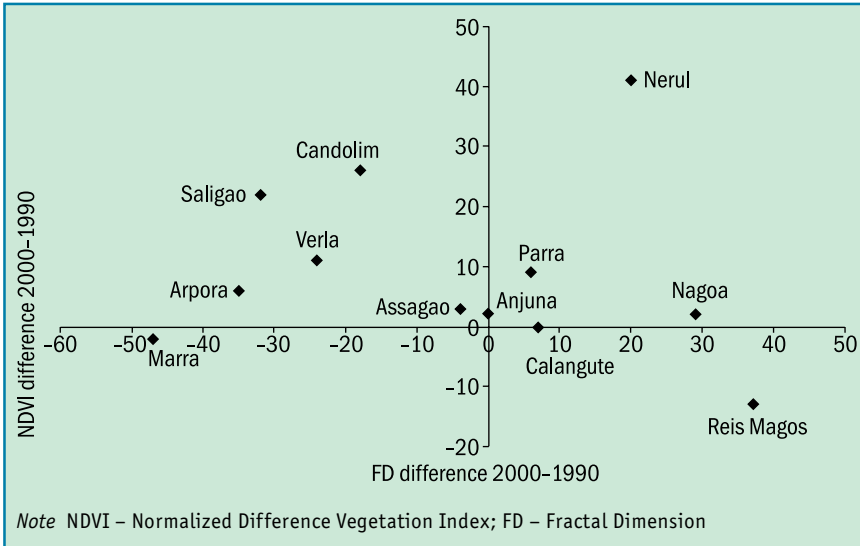

Note NDVI – Normalized Difference Vegetation Index; FD – Fractal Dimension

Figure 7 Study villages based on the relationship between the fractal dimension and the NDVI values (differences over 1999/2000)

Chapter 6

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Mangroves and dune vegetation: changing patterns in a tourist region

Attempts to 'beautify' an area to make it appealing to tourists often come at the expense of the local vegetation, which is often undervalued. The entire vegetation of the Baga–Nerul watersheds can be classified into three types.

1 Inland vegetation
2 Coastal sand dune vegetation
3 Mangrove vegetation.

Chapter 5 may convey improved greenness in the study area over the last 10 years but this may be misleading. The green cover shown by the satellite images does result from social forestry of *Acacia* and preservation of mangroves (under India's conservation policies). However, other than this, what appear to be highly vegetated coastal areas are actually the artificially landscaped hotel campuses. These comprise ornamental, avenue trees (like *Polyalthia* and *Casuarina*) that are planted by uprooting the natural vegetation, which, in the past, had been useful to the local community and added to local natural beauty.

None of the coastal areas under study possess the rich sand dune flora characteristic of an undisturbed beach. The status of dune vegetation in tourism villages has been deteriorating as compared to that in the developing or non-tourist villages (Table 1). Interactions with elders from the coastal area also reveal that a number of fruit-bearing trees, which were present 20 years ago, have now disappeared. Some isolated specimens are spotted in private compounds.

Table 1 Comparison of the status of dune and inland vegetation in tourism villages and developing or non-tourist villages

Name of beach	Number of species found	Percentage species diversity	Grading
Mature tourism villages			
Candolim	12	20	1
Calangute	11	18	1
Baga	11	18	1
Anjuna	9	15	1
Vagator	7	11	1
Developing or non-tourist villages			
Reis Magos	75	78	4
Marra	83	87	5
Saligao	53	55	3
Nagoa	82	87	5
Parra	67	70	4
Arpora	88	92	5
Assagao	90	94	5

Note Gradation scale 1 > 5, where 1 – totally affected and 5 – not affected

Total number of species – dune vegetation (53), inland vegetation (94)

Whereas tourists are attracted to Goa mainly due to its natural beauty, efforts to homogenize and produce 'similarity' in tourism destinations destroy the diversity of natural vegetation, with adverse long-term consequences for the industry and the region.

Chapter 7

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National Institute of Oceanography

Landform changes from remote sensing data

Coastal tourism is typically accompanied by developments along the coast – on sand dunes, cliffs, promontories, and sandy beaches – with possible implications for coastal processes and, eventually, for human activity located on the coast. National coastal zoning policies, designed as appropriate safeguards, are in place but often not enforced strictly. Noticeable changes in coastal landforms are observed in the study area, mainly in the tourist belt between Sinquerim and Fort Chapora. Exceptions are certain pockets where tourism activity was on a smaller scale.

This area is juxtaposed with Morjim, which is situated slightly north of Fort Chapora and where tourism has not been as intense but is gaining popularity. A comparison of Morjim's 1970 aerial photographs with 1999 satellite images reveals little alteration of the landscape over the last three decades—the geomorphic and natural features are largely undisturbed. However, going southwards, River Chapora's mouth has narrowed significantly and is getting shallower due to heavy siltation.

Another pocket at Vagator (to the south) shows largely unaffected landform but the Anjuna tourist beach has narrowed down, with habitats and developmental structures moving closer to the shore. The open spaces seen in aerial photographs of Vagator – taken in the 1970s and also in 1989 – have almost disappeared in the 1999 satellite images. The Anjuna beach shows one completely degraded sand dune system and another about to disappear completely.

The headland at Baga was almost uninhabited in the 1970s and 1980s. It is now covered with concrete structures and its tidal creek is being reclaimed at a swift pace. There a was thriving salt

pan industry in the southern part of the Baga stream in the 1960s and 1970s, which has been reclaimed in a very haphazard manner for constructing tourist accommodations, road networks, and amusement parks. This has resulted in the obstruction of free tidal flow and the creation of water pools, promoting algal growth. Towards the south, the course of the Nerul river has actually shifted southward since 1965. Ascertaining the cause for this would require detailed studies. The width of Sinquerim to the Baga beach stretch is getting narrowed and flattened, as sand dunes are razed and built-up structures creep closer to the shoreline. Sandy spaces are giving way to cemented parking lots and dune vegetation is being destroyed recklessly.

Tourism-related development is indeed taking a heavy toll of the natural beach ecosystems by destroying sandy spaces, diminishing dune vegetation, and reclaiming land. Alternate erosion/accretion phenomena are noticed all along the shoreline. Further studies are needed, however, to investigate the relative contributions of natural and/or anthropogenic causes to the observed changes.

Chapter 8

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Laboratorio Nacional de Engenharia Civil and Goa University

Assessing groundwater vulnerability of the Goa case study area

Concepts of aquifer vulnerability and their mapping are important inputs in planning sustainable use of groundwater. Among the several methods for evaluating aquifer vulnerability and potential for pollution is the DRASTIC index developed by Aller, Bennet, Lehr, *et al.* (1987). The DRASTIC index measures the vulnerability of the aquifer based on its intrinsic characteristics. These are static and beyond human control. The index corresponds to the weighted average of seven values corresponding to seven hydrological parameters.

1 Depth to water table (D)
2 Net recharge (R)
3 Aquifer material (A)
4 Soil type (S)
5 Topography (T)

6 Impact of the unsaturated zone (I)
7 Hydraulic conductivity (C).

   High values of the index correspond to high vulnerability.
The minimum value is 23 and the maximum is 226.
   Both the standard DRASTIC and DRASTIC pesticide methods
were applied to the unconfined aquifer in the study area to pro-
duce the final DRASTIC aquifer vulnerability maps. The map of
aquifer vulnerability index for the standard method shows that the
normal DRASTIC index ranges from 140 to 199 in most parts,
indicating medium to fairly high index of aquifer vulnerability
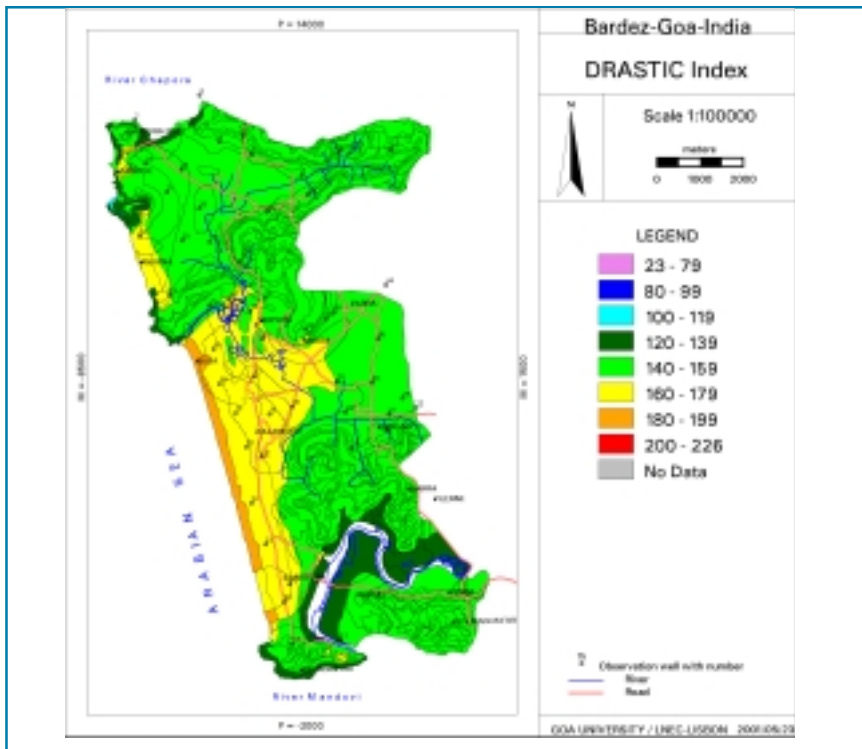(Figure 8).

Figure 8 Mapping aquifer vulnerability using DRASTIC

   The pesticide index map shows that the aquifer vulnerability
index ranges from 155 to 229 in most parts, indicating medium to
high vulnerability of aquifers to pollution. Areas with high aquifer
vulnerability index, when compared with aquifer water quality,

were found to be highly polluted by bacterial and heavy metal contaminants. This fact validates and encourages the utility of DRASTIC in identifying probable contaminated areas. Based on the hydrogeological knowledge of the authors and study of the maps, it is quite evident that DRASTIC can be conveniently used for mapping aquifer pollution vulnerability in India.

This exercise has, therefore, clearly shown that apart from precise data, it is vital to have in-depth knowledge of hydrogeological aspects and processes of the study area because all the seven DRASTIC parameters are interacting and interdependent variables.

The finding that aquifers are fairly highly vulnerable to pollution – both under normal conditions and after pesticide application – reinforces the demand to plan their protection judiciously. Groundwater along this coastal belt has undergone biological contamination mainly due to sewage disposal by both the hotel and domestic sectors. The rapid drainability of aquifers – evident in the observed groundwater fluctuations and very high groundwater recharge rates in the study area – may serve as a respite against aquifer pollution but only during the three or four monsoon months. In fact, it may hinder the groundwater sustainability through the year.

The study area also has evidence of an emerging water market to support tourism and the associated construction industry—a development that can exacerbate the area's groundwater vulnerability. The water business is conducted mainly by three categories of persons—(1) those that own wells, (2) those that own tankers, and (3) those that own both.

Certain questions must be addressed in the context of the growth of water markets.

- If water from a private supplier is of inadequate quality, resulting in health problems for the consumer, can the supplier be held responsible? Is s/he accountable under the present consumer law?
- Will the growth of the water business (expected to increase in future years) continue without accounting for revenues?
- Do suppliers of tankers and water charge rational rates? If not, who will rationalize these rates and when?

Chapter 9

Kalidas Sawkar, P Vethamony, M T Babu, Caroline Dias, Analia Mesquita, Blasco Fernandes, Shubha Moses, Padmavati M, and Sushant Naik
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Measuring, modelling, and grading the health of water bodies in a tourism-dominated region

The tourism-dominated watershed area in North Goa has a contiguous stretch of marine water bodies—the open sea between Sinquerim and Chapora; the three estuaries of rivers Chapora, Mandovi, and Nerul; and a small stream under tidal influence at Baga.

The present study involving seasonal (pre-monsoon, monsoon, and post-monsoon) monitoring does not show any polluting influence of tourism-related activities on these water bodies. A marked increase in values of BOD (biochemical oxygen demand) was observed at certain stations during the main fair-weather (post-monsoon) sampling period, but these occurrences appear to be due to some episodic release of biodegradable organic matter in the marine environment. Such high values of BOD did not recur during the monsoon and pre-monsoon samplings at these or other stations. The marine waters all over the sampling sites are very well oxygenated at all the seasonal observations.

Other important parameters, such as nutrients and pH level, show typical estuarine and near-shore characteristics without any undue influence from tourism activities. Metal values for cadmium, lead, and mercury in a dissolved state in water as well as in sediments show nominal presence without any indication of polluted waters. The biological parameters also indicate good water quality with the presence of normal coastal and estuarine biota. Interestingly, no important changes were observed during the monsoon land run-offs; possibly the watershed area was too small to observe any marked impacts.

No decadal changes have been observed in the water quality from 1988 through 2001, during which period tourism has increased manifold as an industry in the study area. It can be concluded from the present work that there is no noticeable ill-effect due to tourism-related activities on near-shore water quality in the study area. Water quality of the Mandovi-Zuari estuary has also been studied using the MIKE21 hydrodynamic water quality

model. Measured currents and tides are used to validate the model-simulated currents and tides. Measured data on dissolved oxygen and BOD is used for analysing water quality. The model results and recent measurements showed that the waters of the estuary are unpolluted with an average BOD of 1.0 mg/l. The effect of urban sewage could be seen only within an area of 200 sq. m around the discharge location.

This chapter also contains a section on grading of the water quality criteria to indicate the levels of pollution of a water body, based on the classification method of the Central Pollution Control Board of India (Figure 9). Five parameters crucial for health of the waters are marked with either a 'tick' or a 'cross' and then totalled. Zero crosses indicate zero pollution, which then increases from 1 to 5 based on the number of crosses. Numbers 1 to 2 indicate presence of pollutant though on a smaller scale; 2 to 3 indicate increase; 3 to 4 indicate pollution and number 5 indicates very heavy pollution; waters with crosses 3 to 5 are unfit for any human use. This table on a scale of 0–5 can be colour-coded. With proper symbols, it is also possible to disclose the kind of pollution that would be encountered in the water body. This can also be used to compare – at a glance – different stretches of one or more water bodies at different geographical locations.

Figure 9 Grading marine water bodies around the study area by level of pollution

Chapter 10

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National Institute of Oceanography

Bacteriological quality of creeks and marine water bodies in North Goa: ecosystem upkeep perspectives from tourism-related activities

Keeping tourism-related activities in the fore, several relevant bacteriological parameters were studied in depth in North Goa's aquatic ecosystems. Total bacterial abundance and activity for sewage-indicator bacteria and a select set of human pathogenic bacteria were quantified during three different seasons. It is evident that coastal and freshwater ecosystems in North Goa have not been unduly contaminated.

Table 2 Socio-economic and ecological drivers of change associated with tourism-related developments, under three different scenarios

Tourism-related activities	Scenario								
	Business-as-usual			Globalization			Sustainable and participatory		
	2001	2011	2021	2001	2011	2021	2001	2011	2021
Land requirement (hectares)	328	448	567	345	476	506	345	422	445
Number of hotels	844	1157	1457	841	1160	1233	744	954	1003
Tourist arrivals (× 1000)	270	369	469	270	369	396	270	332	348
Water requirement (cubic metres)	1393	1900	2412	1294	1923	2208	1418	1742	1696
Sewage generation (cubic metres)	1100	1501	1902	833	1230	1414	825	1012	1003
Solid waste generation (kg/day)	2062	2812	3562	2063	2847	3374	2164	2656	2801
Sewage indicator bacteria (number/litre)	IAL[a]	AA[b]	AA	IAL	BA[c]	BA	IAL	BA	BA
Risk of human pathogens	L[d]	M–H[e]	VH[f]	L	L	L;S[g]	L	L;S	L;S

[a] within allowable limits; [b] above allowable limits; [c] below allowable limits; [d] low; [e] moderate to high; [f] very high; [g] low and safe

Source Mehra and Sreekanth (2002)

Except in the monsoon, the quantum of coliform bacteria – *Escherichia coli* and *Vibrio cholerae* – and many other human pathogenic bacteria was well within the limits acceptable for tourist recreational activities such as bathing, fishing, surfing, and the like. Using the socio-economic drivers of change developed by Mehra and Sreekanth (2002), it is postulated that under the BAU (business-as-usual) scenario, there will be increased sewage contamination and thus imminent threats to aquatic ecosystems, thus rendering them unsafe and unusable for recreational activities, which are popular among tourists (Table 2).
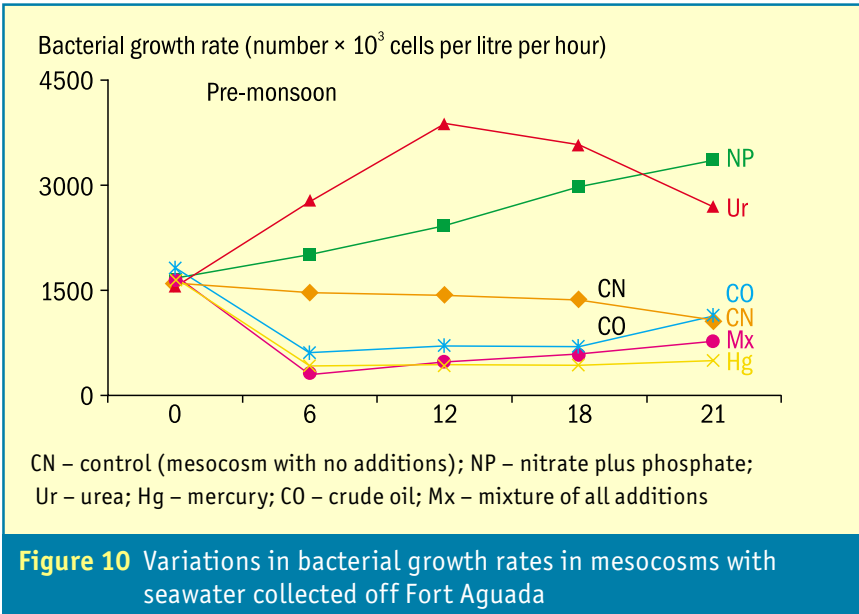
Chapter 11

N Ramaiah, Azra Ansari, Anita Sadhasivan, Sushant Naik, and Kalidas Sawkar
National Institute of Oceanography

Assimilation potential of water column biota: mesocosm-based evaluations

This chapter presents a generalized picture of various aspects of assimilation by native biota and underscores the importance of safeguarding the environment from excessive discharge of nutrient-rich effluents, even though they are non-toxic.

It reveals the findings of mesocosm experiments, conducted to evaluate the assimilation potential of water column biota (bacteria, phytoplankton, and zooplankton). Bulk water quantities from coastal locations, characterized by intense tourist activity, were brought to set up mesocosms during pre-monsoon, monsoon, and post-monsoon periods. Six different conditions – with organic nutrients (urea), inorganic nutrients (nitrate, phosphate), and toxic chemicals (mercury, crude oil) – were simulated to examine the responses of biotic components to altered situations. Several relevant parameters were monitored through the three seasons (Figure 10).

Results of the study suggest that the native biota cannot utilize nutrients beyond certain limits even in a non-toxic, unpolluted condition. Also, toxic chemicals are far more deleterious in combination than individually.

Figure 10 Variations in bacterial growth rates in mesocosms with seawater collected off Fort Aguada

Chapter 12

Ligia Noronha and S Nairy
TERI

Changing uses, ecosystem valuation, and perceptions: the case of *khazans* in Goa

Coastal tourism has a spatial dimension, as chapter 2 discusses. The study area witnesses a marked spatial impact on the *khazan* lands—managed agro-ecosystems modified from coastal wetland areas, especially mangroves. This paper examines ecosystem valuation as it relates to *khazan* lands in Goa, a typical tourist destination. As argued elsewhere, the diversity of use of these lands is being reduced because of competing interests, and homogenization is on the rise (Figure 11). This is due not only to tourism, but also the changes in political, social and legal institutions over time (Noronha, Siqueira, Sreekesh, *et al.* 2002). The hypothesis here is that these systems in Goa are disappearing, not only because of the above factors but also because of an inadequate appreciation of the social value of such systems and the functions and services performed by them.

This chapter investigates this hypothesis by exploring three conceptions of the importance of these ecosystems in terms of the services they provide.

1 The 'general assessment', obtained from scientific literature on the ecosystem type
2 The 'location-specific assessment', provided by local ecosystem experts, who have intimate knowledge of the system
3 The 'local perceptions', captured through a survey of village perceptions.

The paper suggests that *khazan* land conversion is occurring for a number of reasons, one of which is because they are currently valued only for their space attribute. People are gradually losing awareness of the various other uses of *khazans* and ignoring the diverse services and goods they support. Alternative options are considered without prior systematic valuation of such uses and services. There is a tension between social and individual valuation that needs further research. Whether it is possible to change the trend and catalyse better-informed decisions by reawakening the old wisdom remains to be seen.
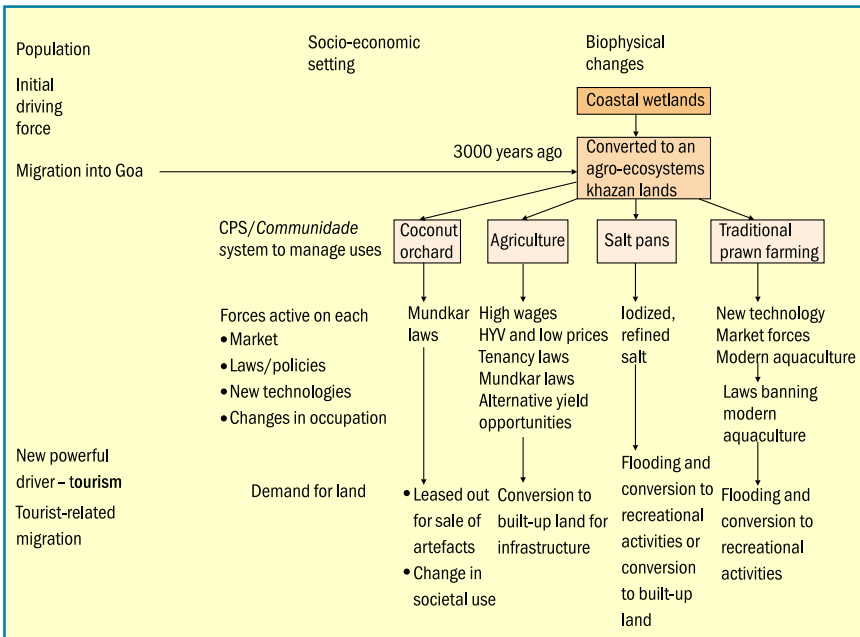

Figure 11 Homogenization of coastal ecosystems: the case of the *khazans*

Chapter 13

Meeta Mehra and V Sreekanth
TERI

Modelling environmental loads from tourism

Human activities impact the local environmental and natural resources base, often beyond the regenerative or assimilative capacity of the local ecosystem. Extending the framework of Ehrlich and Holdren (1974) that allows quantification of the relationship between population, environment, consumption, and technology, this chapter delineates key linkages between socio-economic drivers and impacts on the coastal environment, with a focus on tourism activity. The modelling of socio-economic dynamics is illustrated by focusing on North Goa's Baga–Nerul watersheds district, which supports extensive tourism activity. The analysis distinguishes the 'mature' tourism villages from those where tourism growth is 'developing' or which provide support to the tourism villages.

It evolves numerous plausible 'What if?' scenarios, charting out alternative growth paths and future states of the environment (Figure 12).

1 The BAU case considers the continuation of existent patterns of growth and resource use and practices of waste handling and disposal.

2 Two variations of the BAU scenario are constructed.

   2a Alternative I assumes lower demand for natural resources, owing to improved end-use efficiencies.

   2b Alternative II considers improved waste management and disposal practices in all sectors.

3 Two structurally different paths of tourism growth are examined.

   3a 'Globalized' tourism develops under the influence and control of transnational firms, entailing lower growth and more efficient resource-use patterns.

   3b 'Participatory' tourism involves slower growth compared to the BAU or the 'globalized' scenario, lower and more balanced resource-use patterns, and a multi-stakeholder approach to decision making with respect to tourism.
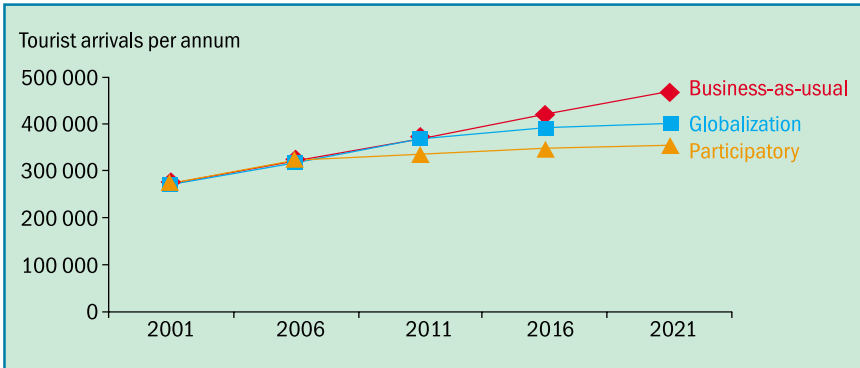
Figure 12 Growth of tourist population in three scenarios

Drawing upon data from the primary survey, secondary information from various censuses and government documents, and stakeholder responses, the pressure on the coastal environment is projected for the 20-year period of 2001–21, largely in terms of requirement of land and water and generation of solid and liquid waste (Figure 13).
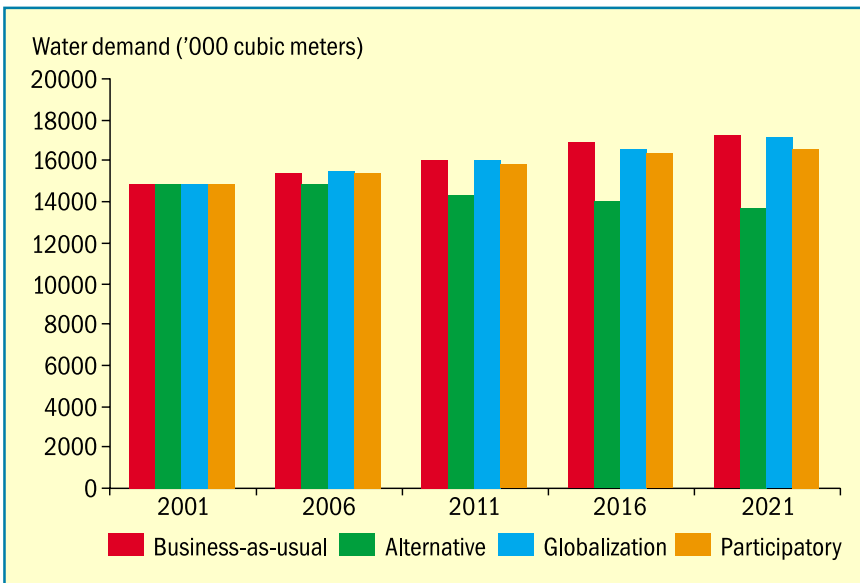

Figure 13 Comparison of water demand across scenarios

It is found that, in the case of some resources, the continuation of prevailing trends could translate into outstripping the ecosystem's carrying capacity, while a digression from the BAU path could translate into small to significant reductions in environmental loads.

Chapter 14

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Applying optimization models to satisfy water needs of tourist infrastructures in the Goa case study area

Environmental sustainability requires that groundwater be extracted safely, while minimizing risks of salt-water intrusion. Based on available hydrogeological and socio-economical data, two different optimization models are developed, as considered appropriate for the Bardez context. These are structured to consider all the hypotheses underlying the solution of the problem and to allow computation of the optimal solutions to satisfy (potential) water resource needs of tourist infrastructures along the coastal zone of Bardez.

The first model makes it possible to find the best possible location (of wells) that will provide a given amount of flow.
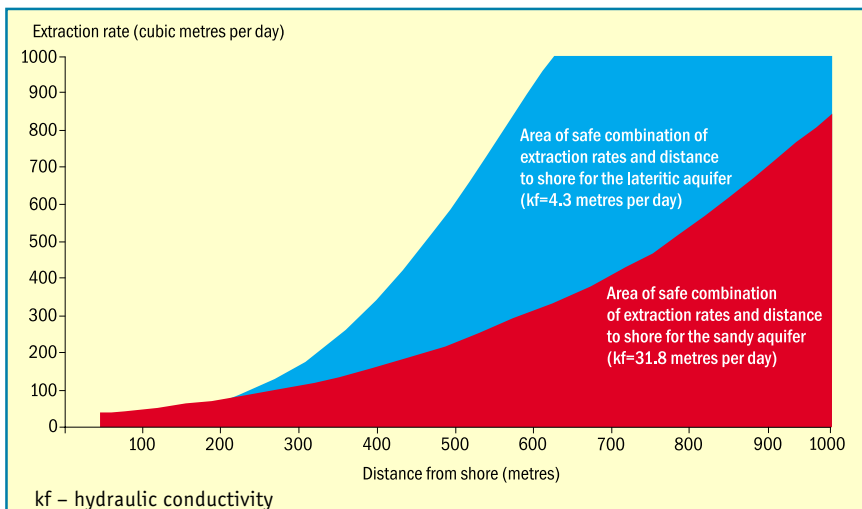

Figure 14 Area of safe combination of extraction rates

The second model points to the best location that will provide a given amount of flow to supply a tourist hotel, whose location is pre-defined. The models include objective functions representing cost minimization in well installation, protection, and operation and laying of pipe networks to carry water from the wells to the hotel.

The following questions influenced the optimization procedure.

- How is it possible to find the optimal placement for supply wells?
- Which are the most important parameters to be considered?
- How important is the number of wells and their distance to the hotels, taking into account the cost of coastal zone land, service pipes, and running expenses?
- What is the relationship between the extraction rate of the wells and the risk of salt-water intrusion?
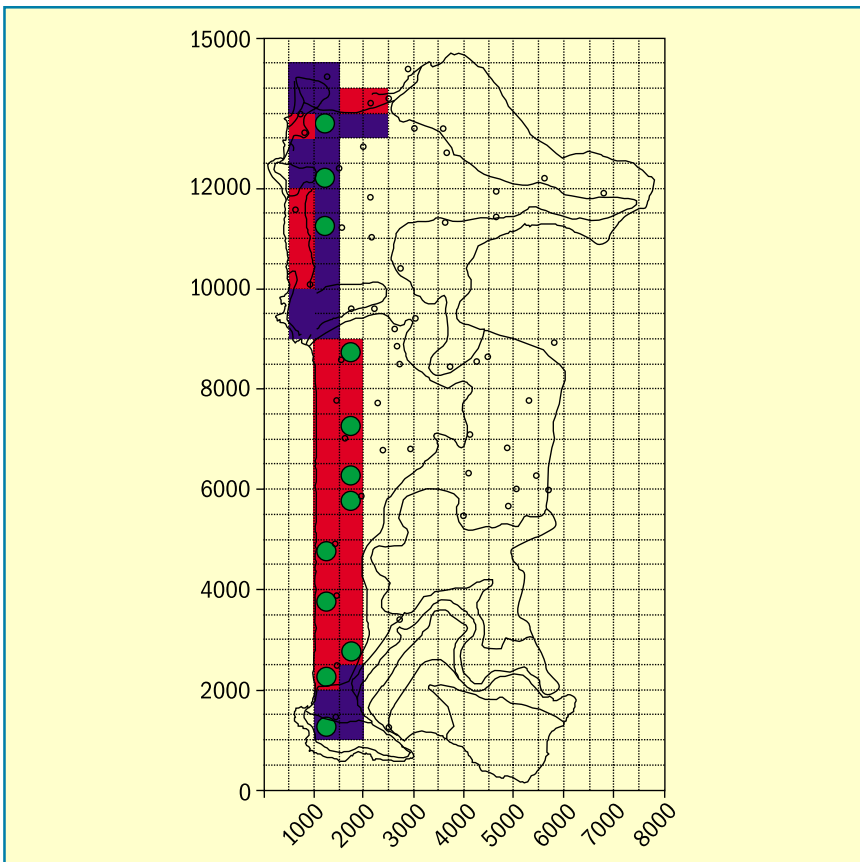- How is it possible to minimize this risk?

Figure 15 Example of an optimal solution

Taking advantage of the potentialities provided by the groundwater flow model developed for Goa, the chapter has addressed the development of safe extraction rates of coastal zone pumping wells—existing and those necessary to meet future needs (Figure 14). The optimization models have been applied to two exploitation scenarios, with the results indicating the best solutions for the case studies (Figure 15).

Chapter 15

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Predicting land cover change due to tourism

Projections of land cover change can be formulated according to different possible scenarios, which can be simulated at any time through GIS. While transition matrices can help estimate the probability of change of a land cover type, it is not possible to locate the expected changes. In order to accurately predict such changes, Cellular Automata and Markov models have been used in combination in a GIS context.

The vector and raster images of the Goa study area were used to run the Cellular Automata/Markov change land cover prediction procedure in Idrisi (CA_MARKOV). This innovative procedure includes multi-criteria evaluation in the Cellular Automata model to calculate the suitability that a pixel can belong to a certain land cover type. The probability of transition between two different land cover types is thus weighted by suitability. Given a raster map, if the probability of change from Type i to Type j is Pij, then the pixels that will change more easily from i to j will correspond to those with higher suitability with respect to j in the proportion Pij.

Application of CA_MARKOV to land cover maps of 1990 and 2000 gives the predicted land cover for 2010. The results reveal that, in the study area, hill forests and mangrove forests would increase if the momentum of the ongoing implementation of the environmental protection policy were sustained. What would decrease is the tall woody vegetation around the villages, in favour of bush vegetation (Figure 16).
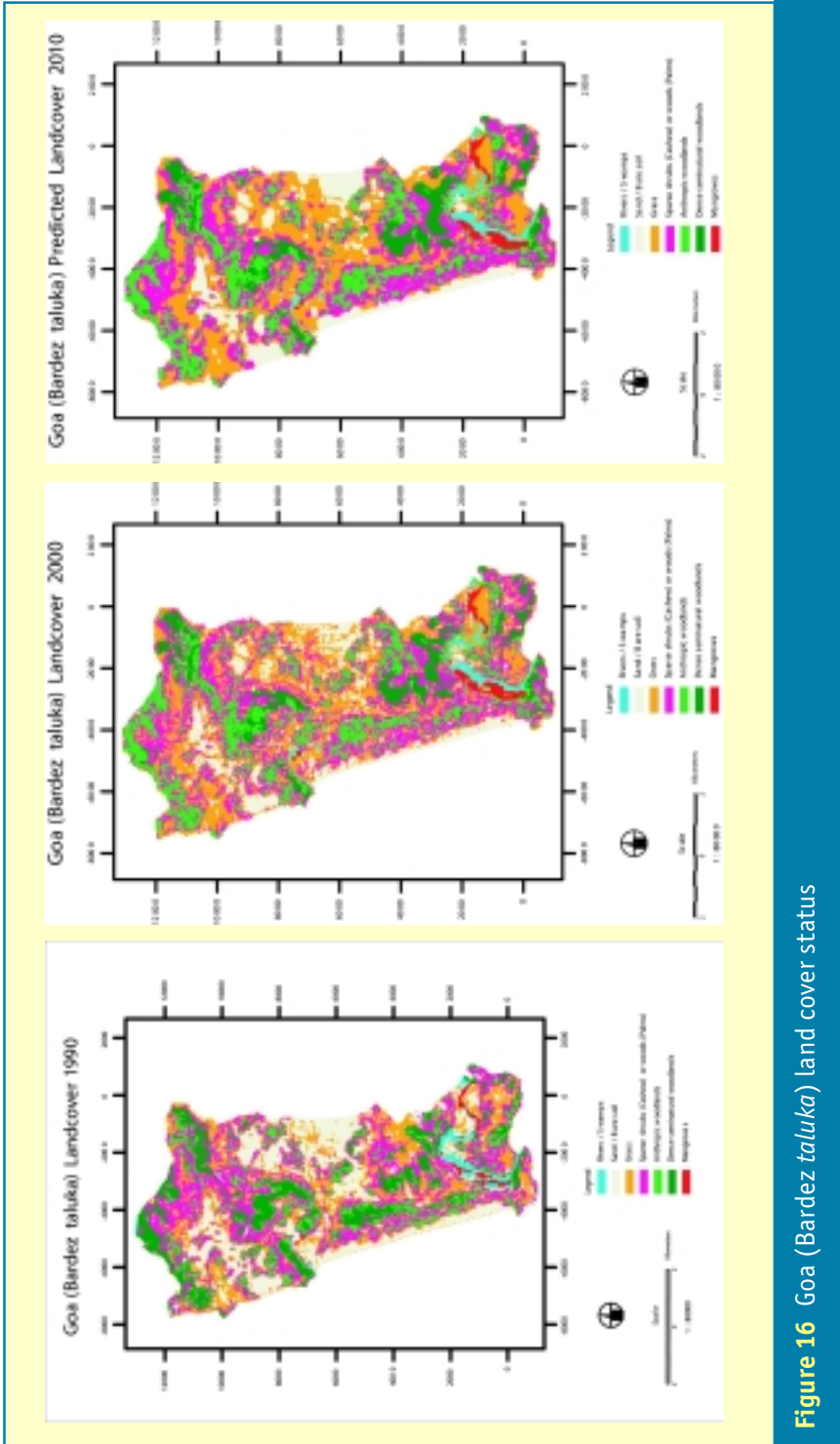
Coastal tourism, environment, and sustainable local development

Figure 16 Goa (Bardez *taluka*) land cover status

Chapter 16

Ana Lleopart and J Marturi
Instituto Cartografic de Catalunya

Spatial integration of environmental and socio-economic data

It is not possible to develop studies to analyse and model the interactions between human activities and the environment without taking into account the geographic location and the spatial relations that are set up. For tackling the challenges to sustainable coastal development, it is necessary to possess knowledge of a set of elements that have a geographic component, like location of most vulnerable zones, pollution, land-use demands, deforestation, or population movement. This chapter describes spatial integration in the case of the Goa study area.

The diversity and complexity of the spatial information under consideration calls for its integration on a system, which guarantees efficient management. GIS provides the capability for storing, managing, and analysing such data; it has developed into the ideal tool for studies of territorial management and sustainability. The bases for spatial integration are the definition of a common geographic framework for all data records and the establishment of the suitable geographic component for each record.

As coastal areas are populated and exhibit dynamism with continuous territorial change, no accurate topographic database was available. To obtain an actual cartographic database of the area, a new approach was developed, based on the use of a high-resolution, geo-coded satellite image as the main reference. Satellite image series are systematic, continuous, and frequently updated sources of spatial information. For the purpose of this project, the panchromatic images of IRS-1D were selected. Taken in 1999, these images have a 5.8-metre resolution and cover an area of about 600 hectares in Goa, going from 500 metres of the water coastal strip, through the beaches, and to the associated drainage sub-basin. The interpretation of the infrastructure and other identifiable elements on the images is a useful and quick way to compile an updated topographic database.

Information on the population nucleus, the communication net, the beach areas, and the hydrographical net was compiled.

Only in the case of information related to administrative boundaries and contour lines, which is not possible to acquire/actualize in this way, it was compiled from existing documents. All this data (images, topographical information, and administrative boundaries) constitutes the GCD (Goa Cartographic Database) and the appropriate working scale would be around 1:50 000 (Figure 17). This makes possible the spatial integration of all the thematic data sets in a homogeneous manner. A coherent integration including all biophysical, social, and economical data sets, this represents the actual environmental conditions and socio-economic pressures.
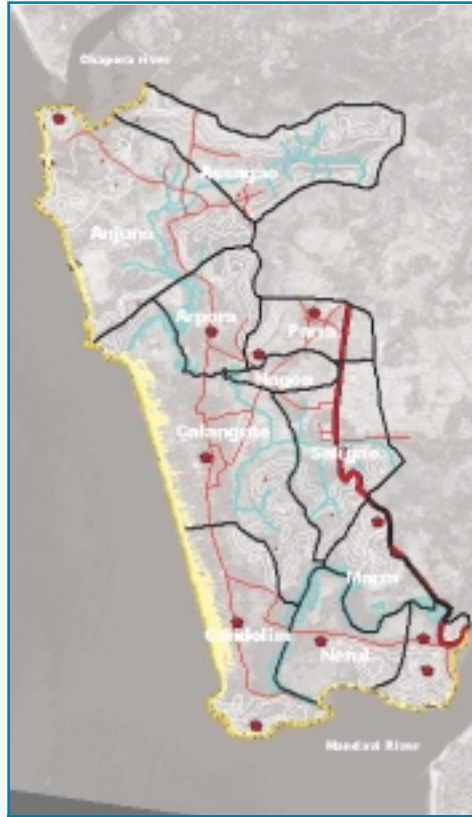
Figure 17 View of the contents of the Goa Cartographic Database

Chapter 17

Ligia Noronha and S Kazi
TERI

Building scenarios to address stakeholder concerns: description of a process

The concept of sustainability is contestable and disputes over which components should be included and which excluded are to be expected. Relative weights attached to the components of sustainability of different systems will depend on the viewpoint of the stakeholder. How can the benefits of tourism be distributed

amongst stakeholders, especially local communities, more equitably? What is the ideal way to further the objective of safeguarding the long-term interests of the tourist destination rather than the strategic interests of any particular stakeholder?

Resolving such issues requires the adoption of a multi-stakeholder perspective on sustainability to strike a balance between various positions through a process of negotiation. Indeed, a more democratic resolution is possible by acknowledging the concerns of various stakeholders. In arriving at alternative scenarios of future tourism development paths, this project imbibed different stakeholders' concerns and views about the key drivers of tourism (Box).

What according to you, as a group, are the key driving factors that would impact tourism in Goa and shape in it in 2011 and in 2021?

Respondents from industry
- Infrastructure choices
- Distribution of benefits
- Type of tourist products offered; diversification is essential
- Competition from other destinations
- Need for unique selling point and an image
- Involvement and transparency with host population
- Safety issues
- Security issues
- Waste disposal issues
- Policy consistency
- Role of NGOs

Respondents from community
- External value of the rupee
- General Agreement on Trades and Services rules and implication for local ownership
- Suppression and ignoring the ills – cultural and other – of tourism to avoid fallout on trade
- Increased local stakes in tourism emerge for lack of alternatives rather than out of choice
- Reactive, post-facto rather than proactive government policies
- Increasingly deskilled youth
- Influence of the Internet
- Neglect of host population in policy choices

Respondents from government
- Arbitrary government policies
- Increased planned dependency on tourism as a sector
- Centre–state relations
- State and local government management of tourism activity
- Effectiveness of rules
- Enforcement of rules and regulations

Responses towards more sustainable development of Goa's coastal tourism require that the related economic, social, and environmental impacts be taken into consideration. To incorporate

these into possible responses, stakeholder groups were identified and involved in building future scenarios for tourism in Goa. Three scenarios were developed—(1) business as usual, (2) led by global industry, and (3) participatory (Figure 18).

This research supports the view that involving local stakeholders in identifying futures is a good way forward to aid policy making for a development activity such as tourism, as it involves local goodwill as an essential attribute of the destination.
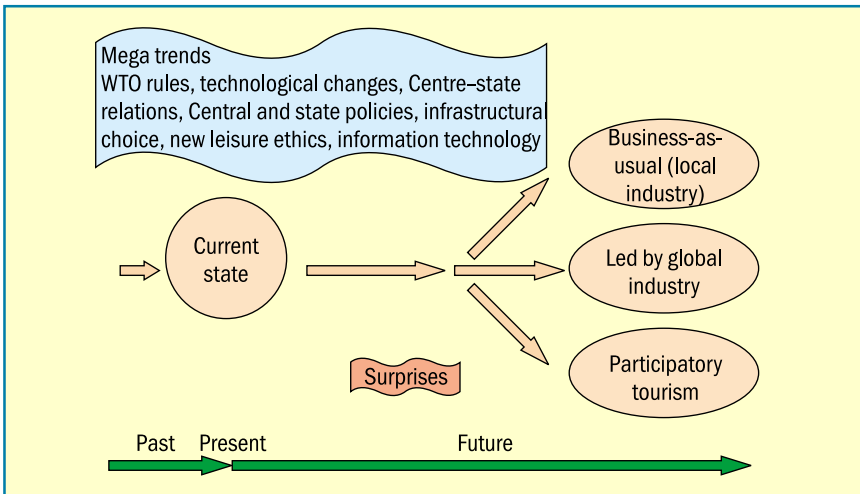
Figure 18 Scenario dynamics
Source Adapted from Ruskin and Kemp-Benedict (2002)

Chapter 18

Joao Paolo Lobo-Ferreira, Bas Krijgsman, and Adiveppa Chachadi
Laboratorio Nacional de Engenharia Civil and Goa University

A new methodology for delineating well-head protection areas

An analytical solution for designing the limit of the ellipse-shaped 50-day groundwater protection isochrones is not available. An empirical solution, with the following input parameters, was developed to estimate the three radii of an ellipse-shaped protection zone.

- Hydraulic conductivity
- Effective porosity
- Aquifer thickness
- Gradient of regional groundwater table
- Extracted volume of water.

The output comprises three maps indicating the extension of (1) the upstream protection distance, (2) the downstream distance, and (3) the one perpendicular to these. Applying this methodology, exemplified in this chapter for the case study area, it is possible to design the required well-head protection zones, without the need of studying each well individually.

The three radii of the needed protection area have been calculated for three different seasons—(dry) summer, wet, and (dry) winter. The differences in inputs between the seasons are the saturated thickness and the hydraulic gradient, both depending on the varying water levels. This could cause a difference in the calculation of the protection area, depending on the seasonal data used.

A comparison of the results obtained for the three seasons does not reveal significant differences per season regarding the dimensions of the 50-day travel time protection areas. In applying this methodology, one should always try to estimate the *maximum* 50-day distance, i.e. the one possible to occur in any season.

Theoretically, if calculating the upgradient protection distance, one should use data (if available) of a season or year that creates the highest hydraulic gradient and has the highest extraction rates or the smallest aquifer thickness. The opposite is the case of the downgradient protection distances concerning the effects of the hydraulic gradients, therefore making the data selection more complex. In the Goa case study, however, using data from different seasons did not result in considerable differences in outputs, which does not mean that this will always be the case (Figure 19a, 19b, and 19c).
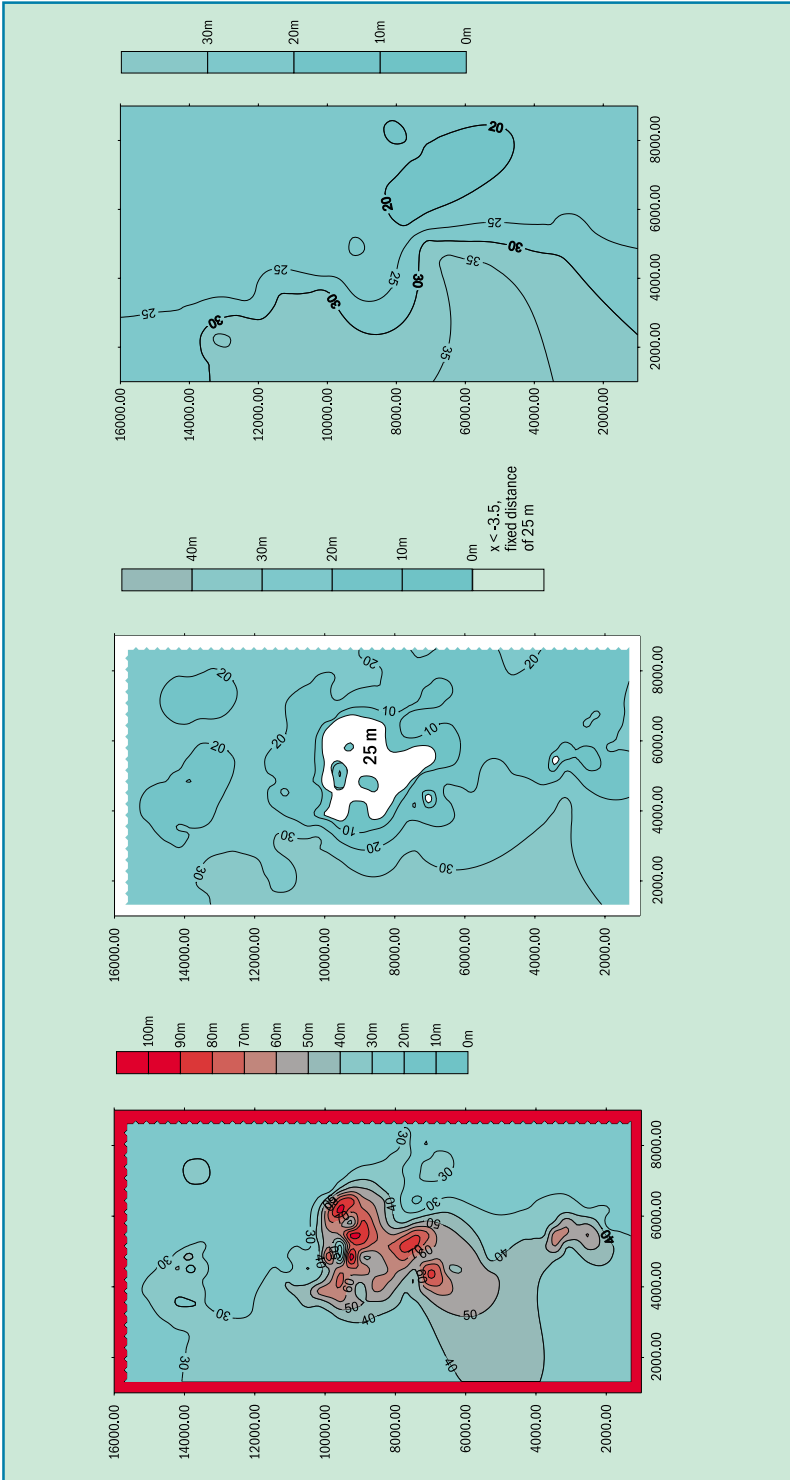
Coastal tourism, environment, and sustainable local development

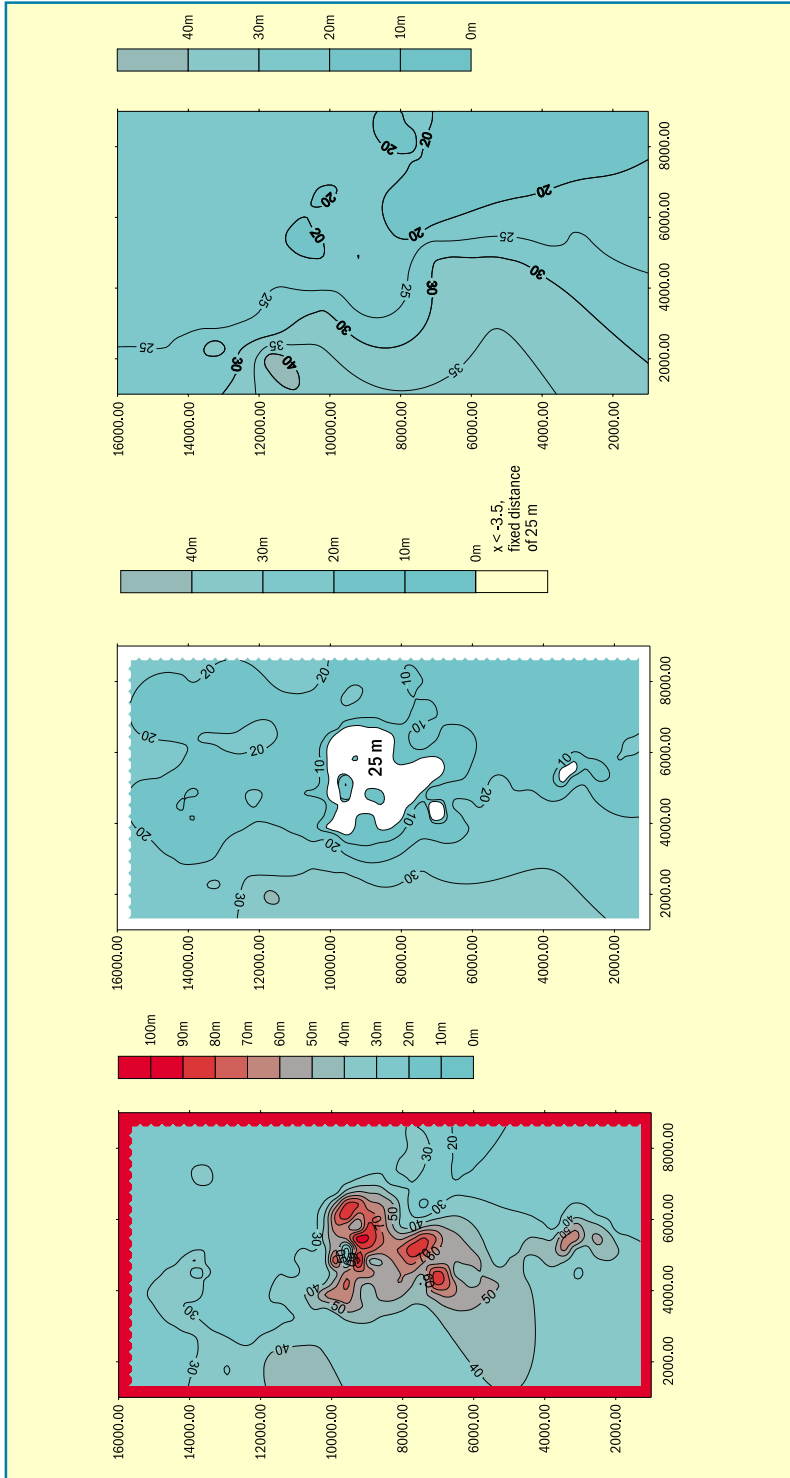
Figure 19a Upgradient protection distance

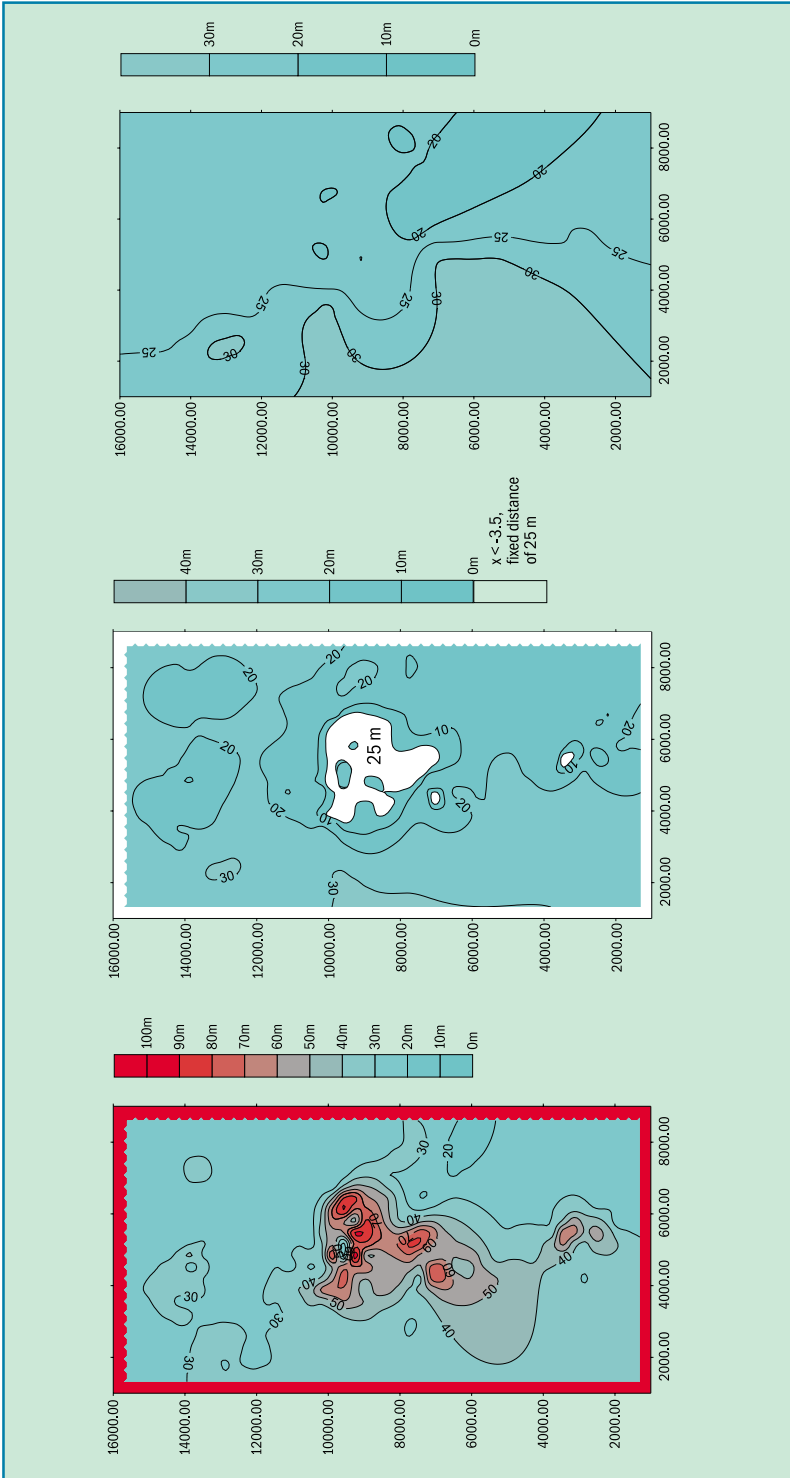**Figure 19b** Downgradient protection distance

Figure 19c Protection distance perpendicular to direction of flow

Chapter 19

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TERI

DPSIR indicators for a tourism destination

To monitor and manage sustainability, tools are needed for raising awareness about pressures exerted by human activity on the local environment. Indicators are useful tools for identifying key aspects of a system and monitoring its progress towards enhanced sustainability.

In this chapter, the DPSIR (Driver–Pressure–State–Impact–Response) framework is used to develop indicators for the domains where most changes are observed—economic, social, and environmental. The changes in indicator value over a time period reflect the changes in the state of the domain concerned. Major issues associated with indicator development are those of scale, both spatial and temporal. Spatial issues refer to geographical domains/areas such as individual, household, village, *taluka*, district, state, national, regional, and global. Temporal issues refer to time. Once a baseline is set at a particular time, the indicators need to be monitored at intervals.

The information collected and analysed earlier on what is happening in a typical tourism destination – Goa's Baga–Nerul watersheds – is used to develop indicators related to human activity in tourist destinations (Table 3). These indicators provide information that relates to particular issues typical of tourism dentations and that may be of relevance to other parts of India. The question of how tourism impacts a tourist destination can be examined in two ways.

1 Subjectively, by getting stakeholders – tourists and the local community–to evaluate how satisfied they are with the conditions they find in the destination.
2 Objectively, by assessing according to some given measure, the conditions found in a destination.

This chapter develops both objective and subjective indicators in order to get a holistic picture of the tourist destination.

Table 3 Indicators of societal driving forces and pressures from resource use

Issues	Indicator Type	Results based on data from study area for 2000	Policy relevance	Functional relationship to ecosystem vulnerability
Social				
Population movements in-migration, out-migration, seasonal in-migration	Driver	Low migration (Net Migration Rate >< 1.5% per annum)	Employment available Unemployment/environmental stress Availability of jobs	Vulnerability ↑ as in-migration ↑
Density of population	Driver	High > 500/sq. km	Population pressure and stress on ecosystems	Vulnerability ↑ as density ↑
Urban settlements	Driver	High > 40%	Population pressure and stress on ecosystems	Vulnerability ↑ as congestion ↑
Tourist arrivals	Driver	High	Stress on ecosystems	Vulnerability ↑ as numbers ↑
Accommodation for tourists	Driver	High	Proxy indicator showing stress on ecosystems, land conversions	Vulnerability ↑ as numbers ↑
Tourist satisfaction	State	Medium	Indicator showing response from tourists to the level of involvement and attention of industry	Vulnerability ↑ indirectly as satisfaction ↑
Industry satisfaction	State and impact	Medium	Indicates industry satisfaction and indirectly future of the activity	Vulnerability ↑ as industry investment ↑
Host satisfaction	Response	Good (high)	Indicates involvement of community in the activity	Vulnerability ↓ as positive community response ↑
Human resource training for quality tourism	Response	Low	Awareness of interactions of tourism with other domains	Vulnerability ↓ as human resource training ↑
Use of locally produced materials	State	Low	Improved multiplier effects	Vulnerability ↓ or ↑ depending on environmental practices
Economic				
Occupational shifts; Movements across economic sectors	Driver	Primary to tertiary	Degree of urbanization, modernization	Vulnerability ↑ as less attention is paid to resource base

Contd…

Table 3 Indicators of societal driving forces and pressures from resource use *(contd…)*

Issues	Indicator Type	Results based on data from study area for 2000	Policy relevance	Functional relationship to ecosystem vulnerability
Household earnings	Impact	Rs 5291[1]	Command over goods and services	
State revenue earned	Impact	Rs 1 580 000[2]	Importance of the activity and future policy support	Vulnerability ↓ or ↑ depending on environmental policy
Foreign exchange	Impact	Rs 208 crore[3]	Importance of the activity and future policy support	Vulnerability ↓ or ↑ depending on environmental policy
Environmental				
Land-use change changes in distribution of land under various activities	Impact	From productive resource base to built-up area	Highlights: productive, protective, speculative use of land Reduced diversity of use for land	Vulnerability ↑ as diversity ↓
Daily withdrawal of ground water	Pressure	309 lit./room/day	Availability of water	Vulnerability ↑ as groundwater balance ↓
Consumption of water	Pressure	617 lit./room/day	Availability of water, waste of water	Vulnerability ↑ as consumption ↑
Solid waste generation	Pressure	0.92 kg/room/day	High consumption of materials, need for disposal sites	Vulnerability ↑ as waste generation ↑
Waste water generation	Pressure	487 lit./room/day	Implications for ground and surface water if sewage is untreated	Vulnerability ↑ as waste generation ↑
Corporate green practices	Response	Medium	Sustainable resource use and less resource degradation	Vulnerability ↓ with ↑ corporate green practices
Consumer awareness	Impact	Medium	Good environmental practices	Vulnerability ↓ with ↑ consumer awareness
Political and legal				
Government initiatives	Response	Satisfactory	Direct links with policy	Vulnerability ↓ with ↑ good policy initiatives
Certification schemes	Response	Low	Indicates environmental awareness and practices followed	Vulnerability ↓ with ↑ certification schemes
Judicial interventions	Response	Satisfactory	Conflict resolving mechanism	Vulnerability ↓ with ↑ good judicial interventions

[1] Survey by TERI and Universidade Nova de Lisboa, 2000; [2] The revenue earned on account of tourism activity by the state of Goa is apportioned to the study area by using the share of tourist arrivals to the study area; [3] TERI estimates for the study area

Coastal tourism, environment, and sustainable local development

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Sustainability and decision tools for coastal areas

A region's sustainable development involves all the systems integrated on it, each with multiple conflicting objectives and without any clear hierarchy. Modelling the system necessitates the use of advanced analysis tools; GIS is selected considering the geographic scope of the components involved (Figure 20).

The management of sustainability is focused on the existing demand of natural resources by human activities. The competitive demand for these resources and their allocation creates a conflict between environment and human needs. The feasible solutions defined by sustainability are based on negotiations—trade-offs between various objectives, without maximizing single objectives but finding an efficient and acceptable balance between the stakeholders' requirements and resource availability. It is thus necessary to define and quantify the trade-off between the conflicting objectives, determined by resource availability and socio-economics.
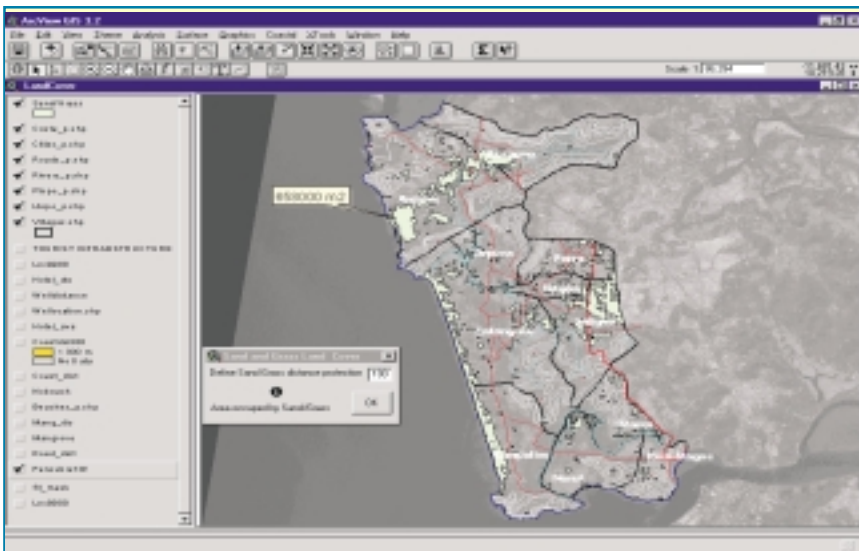

Figure 20 Goa study area: sand protection and area occupied

The decision process needs to take into account the goals and, thereafter, establish and evaluate alternative solutions. Due to the system's complexity, it is not possible to rank the various solutions on any single criterion. Decision analysis techniques come into play as a result. Decision analysis could be defined as a systematic and logical set of procedures for analysing complex and multi-objective decision problems. These techniques are based on focusing the attention on the objectives of the decision situation and encouraging the examination of the trade-offs between conflicting objectives, so as to integrate the processes in a logical manner and produce a meaningful solution.

Taking Goa as an example, a set of tools to help decision makers on sustainability management of coastal areas is designed, defining tourism as the main driving force, and water and land availability as natural resources. The tools could be classified into three main groups.

1 **Visualization tools**
   By visualizing the entire available data in the spatial database and making it accessible on the same interface, these tools allow in-depth knowledge of the coastal zone and give valuable support to the social agents for the analysis of sustainable tourism development.

2 **Spatial analysis techniques**
   Based on GIS functionalities to manipulate spatial data sets, these tools are focused on the establishment of spatial relationships between socio-economic data sets and water and land resources.

3 **Advanced analysis modelling tools**
   Supported by GIS modelling capabilities, mainly with advanced statistics and raster modelling capacities, these tools use defined indicators related to environment status and socio-economic pressures.

Chapter 21

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TERI, Universidade Nova de Lisboa, Laboratorio Nacional de Engenharia Civil , Instituto Cartografic de Catalunya, University of Trieste, National Institute of Oceanography, and Goa University

Managing coastal tourism: perspectives from India and the European Union

The chapters compiled in this book have the following main objectives.

- To analyse and discuss how societal forces and pressures, through the prism of tourism, are driving change in coastal ecosystems
- To specify the types of tools, methods, and approaches that can be used to measure and monitor impacts of tourism on coastal ecosystems
- To suggest ways to improve the management of coastal tourism to alleviate the vulnerability of coastal ecosystems to stress.

The case study in Goa has been used to bring out the issues and concerns, using a combination of the DPSIR framework with a population–consumption–environment framework in order to strengthen both the explanatory and policy value of the study.

Returning to the central question that we started out with— 'How are societal drivers, in particular tourism, impacting coastal ecosystems in our study area?' Three types of potential impacts are observed from human activity in Goa, with different implications for ecosystem health. However, some key variables of influence can be identified for each type of impact.

1 Land conversions

Variables   population and population movements, demand arising from remittance income, demand from tourism, lower personal dependency on the ecosystem, insufficient knowledge of ecosystem values, lower personal as compared to community valuation of ecosystems, short time horizons, zoning rules and need to pre-empt their enforcement, changes in legal rules with implications for management regimes, local politics and power configurations, political economy of the state, rent-seeking activities relating to construction

2 Groundwater exploitation

Variables increased demand from population growth (host and tourist), lack of policy to regulate access and use, technology of extractive equipment, economic activity, insufficient attention to system's attributes, development of a water market to service tourism

3 Degradation of beaches and dunes and their vegetation

Variables Population, user behaviour, rule enforcement, technology of waste management, short time horizons.

Our study suggests that globalized tourism is contributing to and providing a major impetus to the homogenization of ecosystems in the study villages. However, this is not the result of tourism alone, but also of changes in local political, social, and legal institutions over time, such as capital inflows in the form of remittance income, democratic institutions, new tenurial laws, and changes in common property systems. In the case of vegetation, tourism seems to have greened the area, while reducing the diversity that existed. What this suggests is that the ecosystem functionality is being reduced and with this the options for diversified rural livelihoods are also diminishing. An increased reliance of local people on tourism and tourist incomes is observed. Whether this path of social and economic development is more sustainable or less will depend on whether it is generating new opportunities, capabilities, and skills that will lead to improved functioning and well-being of the local population. That would be the subject of another study.

Instead of a path that would provide the tourist a more 'variegated experience' and also allow diversity to continue, the chosen tourism development path seeks to reproduce for the international tourist his/her home conditions and, for the domestic tourist, conditions that emulate the West. When tourism was less packaged – in the sense that it catered to the discerning tourist looking for a different kind of experience – it created far less impacts on the ecosystem. However, with modern mass tourism and the goods and services being developed to cater to it, tourist villages are orienting themselves towards producing more homogenous outputs.

The research also studied Indian policy that relates to the management of resources on the coast more generally and its

working in the context of a coastal tourist destination. Since almost all problems encountered in coastal policy fall into three major domains of coastal policy problems – relating to (1) resource-use conflicts, (2) resource depletion, and (3) pollution or resource degradation – policies for coastal development must be sensitive to these three problems.

In the absence of an integrated holistic approach to policy making and the failure to link the process of policy making with the substance of policy, the resultant outcomes are inferior when viewed within a sustainability framework. We take the view that in development that is closely connected with or has implications for ecosystems and involves a resource that has multiple uses and users, as most coastal activities do, the effectiveness of policy might benefit from the notion that different kinds of coastal problems require different kinds of policy regimes.

European policies do hold lessons for countries such as India, as the political system is one of many nations under a common umbrella with innovative principles such as subsidiarity and integration, which underlie environment and regional planning activities. India's federating states can gain an insight into the concept of common but differentiated responses from EU's experience in coastal management. More stakeholder-sensitive policy making for coastal tourism may improve the situation on the ground by creating better incentives to shape behaviour. The chapter ends with suggestions on what needs to be done to move towards more sustainable tourism.

References

Aller L, Bennet T, Lehr J H, and Petty R J. 1987
DRASTIC: a standardized system for evaluating groundwater pollution potential using hydrogeologic settings
Washington, DC: United States Environmental Protection Agency
[Report number 600/2-85/018]

Atkinson G, Dubourg R, Hamilton K, Munasinghe M, Pearce D, and Young C. 1997
Measuring Sustainable Development: macroeconomics and the environment
Cheltenham: Edward Elgar Publishing Limited. 252 pp.

Becker E and Jahn T. 1999
Sustainability and the Social Sciences: a cross-disciplinary approach to integrating environmental considerations into theoretical reorientation
London and New York: Zed Books Ltd. 336 pp.

Becker E, Jahn T, and Stiess I. 1999
Exploring uncommon ground: sustainability and the social sciences
In *Sustainability and the Social Sciences: a cross-disciplinary approach to integrating environmental considerations into theoretical reorientation,* edited by E Becker and T Jahn, pp. 1–22
London and New York: Zed Books Ltd. 336 pp.

Burke L, Kura Y, Kassem K, Revenga C, Spalding M, and McAllister D. 2000
Pilot analysis of global ecosystems (PAGE): coastal ecosystems, p. 63
Washington: World Resources Institute. 77 pp.

Conway G R and Barbier E B. 1988
After the green revolution: sustainable and equitable agriculture development
Futures, December 1988. p. 651

Costanza R, D'Arge R, de Groot R, Farber S, Grasso M, Hannon B, Limburg K, Naeem S, O'Neil R V, Paruelo J, Raskin R G, Sutton P, and van Den Belt M. 1992
The value of the world's ecosystem services and natural capital
Ecological Economics **25**: 3–15

Ehrlich J P and Holdren P R. 1974
Human population and the global environment
American Scientist **62**: 282–92

Jacobs M. 1997
Sustainability and Markets: on the neoclassical model of environmental economics
New Political Economy, **2** (3): 365–85

Mehra M and Sreekanth V. 2002
Modelling environmental loads for North Goa
New Delhi: Tata Energy Research Institute
[TERI Working Paper No. 6, April 2002]

Munasinghe M and Shearer W (eds). 1995
Defining and Measuring Sustainability
Tokyo and Washington, DC: United Nations University and The World Bank

Noronha L, Siqueira A, Sreekesh S, Qureshy L, and Kazi S. 2002
Goa: tourism, migrations, and ecosystem transformations
Ambio **31**(41): 295–302

Pearce D W, Barbier E, and Markandya A. 1990
Sustainable Development: economics and environment in the Third World
Cheltenham: Edward Elgar Publishing Limited

Pezzey J. 1993
Sustainable development concepts: an economic analysis
[World Bank Environment Paper No. 2]
Washington, DC: The World Bank

Ruskin PD and Kemp-Benedict E. 2002
Global Environment Outlook Scenario Framework [Technical report of United Nations Environment Programme / Division of Early Warning and Assessment]
Nairobi: United Nations Environment Programme

Rajagopalan R (ed). 1996
Voices for the Oceans: a report to the Independent World Commission on the Oceans
Madras: International Ocean Institute. 207 pp.

UNEP (United Nations Environment Programme). 2002
Impacts of Tourism
Available online at <http://www.uneptie.org/pc/tourism/home.htm>, last accessed on 16 October 2002

WTO (World Tourism Organization). 2002
Tourism proves as a resilient and stable economic sector
[News releases, June 2002]
Madrid: WTO. 6 pp.

This booklet is a road map to an upcoming multi-authored volume, which explores the interface between social and environmental issues relating to coastal tourism. That coastal tourism is highly dependent on nature is not sufficiently understood. This results in an emphasis on promoting tourism without attention to the supporting systems and a classic 'golden goose' problem can ensue. The societal implications of this phenomenon can be serious as tourism can push out other prevalent activities, result in changed skills of the local populace, and effect a change in priorities. This suggests the need for cross-disciplinary perspectives to measure and monitor impacts and manage a coastal tourism that 'lasts'.

The upcoming volume is among the products of a research project entitled 'Measuring, monitoring, and managing sustainability: the coastal dimension', supported by the European Union's INCO-DC programme over the period 1998–2002. It has involved three Indian and four European institutes. The contributions reflect a range of disciplines, including sociology, economics, biology, chemistry, hydrology, geography, and botany. The objective is to highlight (1) the interface between social and environmental issues in a coastal tourism context, (2) the issues that need to be considered in planning and managing for coastal development within a sustainability framework, and (3) the need for coastal policy making to be more stakeholder-sensitive.

This road map provides a synoptic account of the analyses, results, and decision tools developed to measure, monitor, and manage coastal tourism developments along sustainable paths to be detailed in the volume, expected in early 2003.