The Sida Marine and Coastal Zone Initiative

Cities in the Coastal Zone: Environmental Threats at Risk

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Concept-paper on Cities in the Coastal Zone: Environmental Threats at Risk

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Foreword

This concept-paper on Cities in the Coastal Zone: Environmental Threats at Risk has been elaborated on request by the working team for the preparation of Sida's Marine and Coastal Zone Initiative, an intended policy programme with plans of action for development of tropical and sub-tropical marine and coastal areas.

The views presented are those of the author, Mr Tim Greenhow (Swedeplan, Stockholm) and are not necessarily shared by Sida.

The working team in Stockholm, September 1997

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Summary

The sub-title of this paper seeks to draw attention to a basic irony in the urbanisation of the coastal zone. The paper describes briefly some of the threats and impacts cities have on the coastal environment. It also draws attention to the hazards that nature imposes on human settlement in these regions. Many of these risks are exacerbated by the manner in which cities are planned, built and managed. History presents a number of cases of coastal cities that have succumbed to natural forces, the more spectacular ones Tyre, Pompeii, and more recently Vestmannaeyjar in Iceland. Others are frequently battered by hurricanes and typhoons. The most famous legendary case is Atlantis, which disappeared beneath the sea according to mythology. More significant perhaps were the cases of Persepolis and Angkor which basically destroyed themselves by mismanagement of the natural environment on which they depended.

Urbanisation can refer to either the concentration of population in relatively small areas closely allied to industrialisation, with the resultant concentration of wealth and "modern" lifestyles. Or it can refer to the adoption of these lifestyles anywhere. Lifestyles that are characteristic of the well-to-do in developing country cities are common in the rural areas of industrialized countries. One over-riding characteristic of urban centres is that their support base is now global, with sophisticated supply lines, but their waste disposal is almost entirely local. A special urban settlement form is the beach resort, a type that will probably become more common as the world progresses to the leisure age.

Urban areas and urban lifestyles have severe impacts on both the abiotic environment (land, air, and water) and on the biotic components of ecosystems in coastal areas. The paper describes in very simple terms some of the functions of ecosystems and how urbanisation affects each of them. It points out that urban development moves in a direction diametrically opposite to that travelled by environmental systems, increasing change through time (dynamics) and decreasing species and environmental diversity (variation) over space. The question is raised as to whether the concepts of urban sustainability and sustainable coastal development are compatible.

Urban impacts on the environment have been addressed for the most part on a sectoral basis, with concentration infrastructural improvements to sanitation and waste treatment. Insufficient work has been done in reducing the root causes or improving the efficiency of resource utilisation.

Integrated coastal zone management has been adopted as a development theme for some years. It is now complemented by the sustainable development ideology, and supported by an emphasis on stakeholder participation and decentralisation. In small rural communities, and working with those directly in contact with resources, this process is time-consuming but often successful. Its application in large metropoli, where contact with basic environmental resources is much more indirect, and where the complex of interests if much greater, is more difficult to imagine.

Local Agenda 21 programmes are being used in middle-sized cities like Dar es Salaam and Durban, to successfully engage the public as well as official agencies in working together, to itemize and prioritise the problems, and then to draw up action plans. Such efforts can also be seen as an important support to the physical planning. Planning is seen as a critical need in coastal zone management.

The paper does not make formal recommendations, but does draw some conclusions regarding trends and needs. The trend is toward greater urbanisation, greater environmental stress, in spite of a (weaker) trend towards greater attention to the problems. What is needed is a combination of more understanding of how the stresses operate, greater institutional coordination together with mobilisation of non-government groups. There needs to be short term attention to meet backlogs and remedial action and to keep up with growing pressures. There is a further need on a medium and long term basis to tackle the serious implications of life styles, an issue that is likely to fly in the face of other pressures encouraging greater consumerism and freer flow of goods globally.

1 Introduction

This paper was commissioned by the Urban Section of INEC, Sida as a contribution to Sida's development of a coastal initiative. It aims to provide a broad conceptual description of urban-environment relationships in the coastal zone. The Terms of Reference are provided in Appendix 1.

Relatively little research has been directed specifically at the total impact of urban areas on the environment, let alone on coastal and marine environments. The majority of studies have looked at particular sectors or resources, such as transportation or water[1]. The situation is changing as researchers look at cities' environmental footprints, in search of models for urban sustainability[2]. Some international assistance agencies have also begun to initiate studies on the topic in developing countries[3]. As city authorities themselves become more aware of the environmental implications of their developments, there is a move to incorporate environmental evaluations and impact assessments in their procedures. Some, like Durban, produce periodic State of the Environment Reports, which try to analyse impacts in a comprehensive manner[4]. Durban is of particular interest for this paper as it is a coastal city within the study region. An excerpt of the report showing cross-sectoral and environmental linkages is attached as Appendix 2.

Many urban impacts are generalized in this paper. Many apply to cities regardless of location. At the same time, the paper tries to draw special attention to those relationships that have particular importance in the coastal zone. In order to give some order to the presentation, a review of basic definitions is given, followed by general descriptions of urban characteristics and environmental functions. A functional approach to environmental description is taken because it offers a relatively straightforward structure within which to discuss urban-environment interactions.

1.1 Regional Scope

The geographical scope of the paper is primarily the coastal zones of eastern and southern Africa and south east Asia, but examples may be drawn from elsewhere in the world.

The two regions differ greatly in a number of ways.

- The geophysical configuration of the two regions are very different. The south east Asian area covered includes a mainland with a relatively complex coastline and two major archipelagoes: the Philippines and Indonesia. By contrast the eastern and southern African coastline is relatively simple, with few islands offshore, most of them small. These differences give rise to very different oceanographic characteristics. Furthermore, many of the Philippines and Indonesian islands have active volcanoes, reminding the observer that this region is part of the dynamic Pacific "rim of fire."
- Population densities in the south east Asian countries treated, with the possible exception of Cambodia, is many times higher than in the eastern and southern African region. This automatically infer a greater pressure on the local resource base. It also provides a population base for much greater urbanisation, both in the sense that more people are available to fill the cities, and in the sense that the rural pressure to migrate is greater.
- South east Asian mainland countries (China, Vietnam, Cambodia and Thailand especially) have a longer tradition of strong political nationhood and of "urbanisation", i.e., concentrated settlements than the African cases. The island nations (Indonesia, Philippines and Malaysia) are more similar in that they incorporate a much greater variety of ethnic and social groupings.
- the south east Asian nations have a much more aggressive approach to economic development, and have greater growth rates than the African counterparts. Since economic development and urbanisation seem to be inextricably inter-related it is not surprising to find a more rapid urbanisation rate in the Asian nations.
- Tanzania and South Africa, if not Mozambique, have a relatively long history of wilderness protection than is evident in south east Asia. National Parks and Reserves have served a variety of political purposes in Africa, and population distribution has permitted the reservation of fairly large areas of wilderness. Be that as it may, there is now a widespread acceptance of the value of wilderness and the protection of natural habitats and ecological systems.

1.2 Some Definitions

1.2.1 The Coastal zone

The definition of coastal zone used in this paper is a relatively loose one. It is specifically not defined in terms of a set distance landwards or seawards of the coastline - whose definition itself is blurred by the tides. The sources of impacts on the coastal eco-systems may be hundreds of kilometres from the coast: these are acknowledged, but are not specifically addressed. Similarly, the marine impacts on the immediate coast may be generated by events far out to sea. These are also noted but not given special attention.

Major river deltas present particular problems for coastal definitions. In south east Asia there a several cases in which major cities lie on deltas some distance from the coast. These cities share many of the environmental problems of coastal cities and are therefore included here. Examples are Bangkok, Ho Chi Minh City and cities in the Pearl River delta of southern China. Some ocean-going ships can travel as far up the Mekong as Phenom Phen in Cambodia, which is located at the up-stream end of the river's delta.

Eastern Africa has only two major deltas, that of the Rufiji River in Tanzania, and the Zambezi in Mozambique. Neither one is heavily settled.

1.2.1 "Urban" concepts

Urbanisation can refer to at least two different concepts. It can be considered as "the geographical diffusion of urban values, behaviour, organisations, and institutions."[5] This is a useful definition when considering issues of lifestyle and aspirations, and physical infrastructure, in the context of the transformation of rural and "traditional" societies in Africa and Asia, especially when considering the growing impact of smaller "modern" settlements along the coast. In developed countries life styles and amenities, such as piped water, electricity, tarred roads, and telecommunications, tend to be much the same in small rural communities and cities. In developing countries rural communities still reflect many of the resource utilisation features of traditional societies[6]. An anomaly occurs in new specialised communities, such as tourist resorts like those on Phuket, Ko Samui in Thailand, Boracay in the Philippines, Batu Feringgi in Malaysia, and elsewhere. These settlements may be smaller in size and population than some "traditional" settlements, but they cause many of the same type of environmental problems as large cities do, if on a smaller scale. This is particularly so within the tourism sector where there is a constant search for "untouched, unspoilt," coastal frontage to exploit and market.

Another aspect is that portrayed by focussing on the urban area, as distinct from its rural hinterland. For this purpose the urban area is "characterized by a concentration of people in a comparatively small area, by a great diversity of related activities with a high frequency of interaction and by a physical form showing a concentration of a variety of built-up and unbuilt spaces."[7] This definition is one that most people would concur with while having difficulty in identifying the true boundary of the urban area.

This in turn raises the issue of cities being defined in terms of their administrative boundaries. Such boundaries provide a spatial framework within which politicians, administrators, and planners can delimit their efforts and responsibilities. It is a neat and tidy approach, but it can give rise to many problems and conflicts.

1.2.3 Sustainability

Sustainability has become a catchword, which like a chameleon, changes its colours depending on the context. It is frequently meant in terms of "environmental" sustainability, though it is increasingly cropping up in connection with social stability, and even long term security of

financial flows. Sustainability should differentiate itself from maintainability, through its implied connection to life. Infrastructure is maintained, life and living systems are sustained.

In many contexts it is difficult to identify exactly what is being, or is to be, sustained. Is it the ecosystem in its current form, is it the major functions of the ecosystem regardless of the specific composition and balance of component species, is it the production of those components of the ecosystem that human society uses (rather than the system as a whole), or is it a particular life style, or even "development" itself that is to be sustained? All living systems are dynamic. If there is a definable urban ecosystem, it is one of the most dynamic inasmuch as technological development is constantly altering the relative usefulness (and hence value) of raw materials available to mankind. In doing so it alters the balance between social groups, and the options open to them. Individuals and society at large are also constantly modifying their aspirations and expectations, their ambitions, their values, and therefore their behaviour. [In this context the concept of "demand management" is very relevant.]

Environmental sustainability should be discussed in the context of scale. This is particularly important when addressing urban sustainability. Villages and small towns exist within the context of a relatively small area and are part of this more limited socio-ecological system. Large cities form a network layer above this level, and are part of a global urban socio-economic-ecological system. They are dependent on a wide area for their support systems, but on the immediate environment for their waste disposal. This is one of the most crucial issues in urban sustainability.

In the context of urban development in the coastal zone sustainable urban development may be incompatible with sustainable environmental management of the coastal ecosystems. Sustaining large urban agglomerations like Bangkok Metropolitan Area, Metro Manila, or Djakarta, will necessitate maintaining sophisticated transportation and communication infrastructure to permit the global trading system that the city is now a part of. Simply to meet the existing aspirations of current residents of the city to achieve a decent standard of living the volume of this trade and total resource use must increase.

It is not plausible to believe that this can occur while sustaining adjacent coastal ecosystems, if by that we mean, to keep them in some form of "natural" conditions similar to their "original" state. (Indeed there is little, if any, "natural" environment left in Bangkok's immediate vicinity.)

In the discussion on sustainability concepts there is one fundamental issue that most will accept whatever other differences they may have. This is that there are environmental thresholds that must not be crossed. To do so entails some type of natural catastrophe from which there is no return. Angkor appears to have met this fate, Persepolis and even Rome may have been close to it. All agree also that we do not know where these thresholds lie, nor is there any assurance that we know how the environmental collapse would demonstrate itself.

1.3 Functional approach

Many different approaches can be taken to the subject in hand. Of these I have chosen to look at the relationships between cities and their coastal environment in terms of their respective functions: cities in their socio-economic functions, ecosystems in their life-support functions, and particularly their functions in supporting human life.

This approach allows one to examine the impact that cities have on environmental life support systems, and the impact that environmental characteristics and events have on cities. It also allows one to look at the role that various management tools, such as physical planning, stakeholder management, and programmes like Local Agenda 21, can play.

2 Short Background on the nature of cities

Humans are social animals so clustered settlements have probably always existed. Towns and larger population centres developed around, or to provide, a number of specialized functions, individually or together, depending on the culture and local situation:

- markets and trading functions, including storage and transhipment functions especially along rivers and coasts;
- processing and manufacturing of natural and agricultural products, including drying, smoking and salting fish, tanning of hides, cloth manufacture, boat building;
- religious functions, connected sometimes with health, often with festivals and social functions;
- security and military functions;
- political and administrative functions.

The specific situation both locationally and temporally would determine which of these functions became predominant. Early empires were spawned by, and then supported, significantly sized cities, many of which collapsed when resource supplies were depleted or supply lines were cut off. Today's major urban agglomerations are even more dependent on vast transportation networks, and therefore vulnerable to their disruption. This is one of the key issues in sustainability of large cities.

As towns and cities grew wealth accumulated in them, and certain segments of the population adopted life styles significantly different from those common in rural communities. But for the greatest proportion of the population, life styles in terms of resource consumption were probably not so different from their rural counterparts, only that townspeople did not produce so much of it themselves. In this regard, towns and then cities began grow away from their resource sources. By depending on resources from a wider region they were less affected by basic production problems (like drought) in any one. By the same token they were less directly concerned by such issues. City dwellers today are even more removed from the natural and agricultural sources of their consumables, and less touched by the environmental issues of their production. This lack of awareness and concern is an issue with regards to the need to change consumption patterns and lifestyles for sustainable development.

Industrialisation led to an even great disparity between urban and rural community life. Cities became the centre of manufacturing and processing. A variety of push and pull factors have since led to a continuous process of rural-urban migration. Industrialisation introduced a whole new dimension to urbanisation, in that it made possible new life styles, necessitated more sophisticated infrastructure simply to supply the most basic life support needs. It also began a process of increasingly rapid change and technological advance. Transport in particular improved in response to provide the raw materials that urban manufacturers sought. With a new global resource basis shipping became critical, and ports as transshipment points grew in importance.

Urban centres have their own internal dynamics. Small, usually specialized communities, such as mining towns, may maintain a narrow economic base, and it may be directly resource related. But growing cities have the tendency to see their internal economic base widen, with a growing proportion of activities geared to supplying and servicing other activities within the city. Less and less of the city's economy is directly linked to the immediate vicinity. The city creates its own artificial environment, The sense of dependence on a resource that must therefore be conserved disappears, and it becomes increasingly difficult to motivate city dwellers to adopt an "environmentally friendly" lifestyle.

Meanwhile other processes occur in rapidly urbanizing centres. Land prices rise, rural immigrants and other poor groups cannot afford residential plots or housing rents. City governments cannot keep pace with the demand for low income housing requirements. The poor are left to find their own solutions either on the sidewalks or in shanty towns in undesirable areas (such as Bangkok's harbour area). To survive they may eventually exploit solid waste tips (as in Manila). Often the poor are relegated to peripheral areas, far from job opportunities, basic infrastructure and social

services. Fuel use tends to concentrate to bio-fuels, wood and charcoal, whose collection and processing may be devastating for the local environment. Cities therefore develop very wide disparities in living standards and life styles. Health status will vary as much. Social tensions increase.

The impacts of urban rich and poor on the environment differ.[8] The wealthier segments of urban society consume more, and produce more waste. The resources consumed may come from great distances and their delivery and intermediate processing put additional strains on the environment. Wastes on the other hand tend to be disposed of locally in quantities usually beyond the carrying capacity of the local environment. Per capita resource use and waste production of the urban poor is by contrast fairly low. However, local impacts may be severe in their sheer numbers, and through the forces that cause them to settle in environmentally sensitive areas, such as steep slopes, mangrove forests and wetlands. The lack of services, especially in waste disposal, leads to serious degradation of the local resource base - land, and water especially.

A new type of settlement is beginning to appear. This is the recreation-based town, whose economy is heavily dependent on transient tourists. This type of settlement will become increasingly common as the tourism, recreation, and conference sectors grow. Coastal areas are a prime locational target for such towns. As specialised settlements they are very narrow in their economic base, and therefore very sensitive to changes in the quality of their environment as well as to the comparative attractiveness of alternative cites. They are therefore susceptible to the tourist marketing forces. Well known cases in the regions under study are parts of Phuket Island, Ko Samui, and Pattaya in Thailand, Georgetown (Penang) in Malaysia, and Boracay in the Philippines. There are no true equivalents on the eastern and southern African coast.

In spite of the negative features, cities generally have higher average incomes than their respective hinterlands, they provide a better quality and range of services, whether social or economic. There is evidence that gender equality is greater in cities than in rural societies, and birth rates are lower in urban centres than elsewhere.

In developing countries it is difficult to differentiate between urbanisation and development. A growing number of researchers now see cities as the motor of economic development in third world countries[9], in spite of the many new problems rapid urbanisation brings.

3 Description of present situation

3.1 Urban impacts on coastal environmental functions

Coastal zones are the meeting point of the four major environmental divisions: fresh water, marine, terrestrial and air or atmosphere. *Homo sapiens* is basically a terrestrial species, but with a great dependence on water and air for survival. Human society has developed on the basis of its ability to utilize resources and functions of all four elemental divisions. Coastal regions provide greatest accessibility to the widest variety of resources. Other organisms also make use of this multiple resource base, leading to a wide range and great number of specific eco-systems in coastal areas.

The environment provides a number of functions. These can be variously described. One listing includes productive, carrier, regulatory (including purification) and information functions. In the accompanying Table these functions are listed briefly, and beside them, the specific ways in which urban development interferes with them.

Table 1: Functions of the coastal environment and urbanisation's impacts on these functions

Functions of the coastal environment	Impact of urban areas on environmental functions

Production functions
• oxygen, carbon dioxide, other gases necessary to life;
• fresh water,
  • for drinking, cleansing, sanitation, irrigation, commerce and industry;
• saline water;
  • some industrial uses;
• biomass;
  • fish, shell fish, and other marine fauna
  • terrestrial fauna; birds;
  • terrestrial, freshwater and marine floral edible products;
  • biofuels: see below
  • building supplies: wood, thatch, reeds, etc.;
  • chemicals & other products, e.g. tannin, dyes, resins, oils, starch, medicines, fibres;
• fuel;
  • biofuels: wood & charcoal, coal, gas, petroleum,
  • non-biofuels: solar, wind, water (gravitational), waves and tides
• minerals:
  • sorting and mixing of sands, clays, gravels;
  • salt, by solar drying;
  • long term production of bio-minerals: limestone, oils shales, chalk, and derivatives (other non-biotic minerals, places under *carrier function* rather than *production functions*).
 	
In the coastal zone productivity is particularly high, as many species can take advantage of the wider variety of abiotic, as well as biotic, resources. Mangroves for example have developed to make use of both saline and fresh water, as well as sediments carried to the coast from inland. Other species have specialised in the utilisation of the inter-tidal zone.
	destruction of productive habitats and ecosystems, through:
	• occupation of land,
	• construction of embankments,
	• drainage and filling of wetland and
	• coastal infill, etc.
	• destruction or alteration of ecosystem components through use of pesticides, herbicides and fertilisers, and other chemicals (e.g. from manufacturing processes, warfare, and spillage during transport of resources such as petroleum products),
	• introduction of exotic species both floral and faunal;
	• development of very special eco-systems, always replacing natural systems, in spite of provision of green spaces; certain birds (e.g. pigeons) and animals (e.g. rats) are particularly adapted to urban life; both private households and institutions introduce exotic plants on a large scale; the global transport network facilitates the spread of animal and plant diseases;
	• consumption of sand, gravel, limestone and other building materials. In many cases sand and gravel are taken from beaches, dunes, or river backs, or areas that may be important groundwater infiltration zones. Tourist resorts also use sand for beach nourishment, often with consequences for beach dynamics and shoreline habitats at a distance from the resort.
	• degradation of habitats through pollution by consumption of fossil and bio-fuels;
	• degradation of groundwater and soil quality by salinisation through the extraction of water from coastal aquifers, the;
	• degradation of the quality of air through pollution;
	• by extension, degradation of the quality of rainwater, through air pollution, with subsequent damage to ecosystems as well as to man-made artifacts;
	• alteration of the micro (and meso) climate: impacts on pollution (particulate matter and chemical composition of the air), radiation (generally less), cloudiness (generally more), precipitation (more), temperature (more); relative humidity (generally lower); wind speed (generally less)[10].

Functions of the coastal environment	Impact of urban areas on environmental functions

Carrier functions in providing
• space and media within which activities occur, such as:
  • basis for biotic components of ecological systems from which man derives living resources: soil, atmospheres, fresh and saline water, climate;
  • land and space on which to build, space that cannot be used by original natural systems simultaneously;
  • land for commercial forestry and agriculture;
  • water retention and flow:
  • reservoirs;
  • aquifers;
  • rivers and canals;
  • communications and utilities:
  • sea and rivers;
  • surface and underground;
  • airspace;
  • recreation and aesthetics:
  • wilderness;
  • water sports, land and air-based recreation;
  • landscapes, seascapes;
• "storage" of abiotic resources: minerals, fossil fuels, water (aquifers, etc.);
• storage of waste products, whether solid, liquid or gaseous, deep ocean sink for carbon and other minerals, compounds, sometimes considered wastes.
	Urban impacts on environmental "carrier" functions include:
	• conversion of land from natural and agricultural land uses to urban uses (this in contrast to the destruction of habitats located on that land); land and space used may preclude other natural ecological uses, and reduce the area's ecological carrying capacity[11];
	• conversion of marine and freshwater areas to "land" by infill, thereby altering the local balance between different abiotic media on which biotic components live[12];
	• alteration of river channels and hydrological systems (roads, canals, river, dams and barrages, creation of artificial water bodies, channelization, groins and sea defences that affect currents)[13];
	• modification of air circulation patters, wind speeds, and carrying capacity;
	• alteration of the balance between infiltration of precipitation, and runoff (in favour of runoff) through increase in proportion of impervious surfaces, severe alteration of local hydrological systems, need for storm drainage systems; also leads to pollution of natural systems as precipitation and runoff accumulate wastes;
	• deposition of wastes, solid, liquid and gaseous through emissions and discharges, often at rates exceeding the environment's ability to process them;
	• alteration or destruction of aesthetically pleasing environments, natural recreational areas;
	• impairment of visibility (through air pollution, and construction of obstructive buildings) and audibility (through noise pollution and raising background noise levels): both have direct impacts on the quality of life;
	• depletion of non-renewable resources: fossil fuels, building materials, metal and non-metal minerals.
	
	• concentration of human habit in cities, and improved productivity practices, may free pressure on carrying capacity elsewhere.

Functions of the coastal environment	Impact of urban areas on environmental functions
The environment has a *regulatory function*, providing buffers, filters and balancing effects on energy and material flows. Examples include • the upper atmospheric ozone layer's protective effect on incoming radiation at ultra-violet wave length, and similar cosmospheric radiation, providing mixing and buffering roles in the gases of the atmosphere (e.g. the oxygen-carbon dioxide equilibrium), • regulating the processes of the hydrosphere (in the water cycle), • maintaining soil genesis and combatting soil erosion by wind and water, • ecological and biological mechanisms that prevent excessive damage by diseases and pests; • processing the products of waste materials • temperature and solar energy distribution through winds, water currents, hydrological cycle • forces towards equilibrium even in altitude, through erosion and deposition (wind and water). In this last respect there are a number of *purification functions*, such as • filtration of dust (and some noxious gases) by vegetation; • cleansing of air by precipitation; • absorption of noise; • absorption and recycling of organic wastes; • binding of heavy metals, toxins, and other elements, compounds. The ocean and many coastal ecosystems provide buffering, filtering and purification functions. The oceans have a major role in temperature regulation, in distribution of energy. Working through marine organisms, they fulfill a significant function as a carbon sink, towards a (dynamic) equilibrium in the carbon cycle. Many organisms in estuaries, mudflats and other benthic communities filter and bind otherwise harmful elements and compounds, processing organic wastes. Mangroves and other coastal wetlands provide filtering and regulatory functions, modifying water flows, sifting out sediments. They provide stabilizing roles, modulating the dynamic coastal processes of erosion and deposition.	Urban impacts on environmental regulatory functions: • destruction of key elements involved in regulation, such as regional and upper atmospheric ozone, through a variety of mechanisms, many directly related to urban activities; • production of pollutants (including ozone) that affect photosynthesis by plants, thereby interfering in the carbon dioxide-oxygen equilibrium; • altering the natural processes in the hydrological cycle through damming rivers for urban water supplies, disruption of river and tidal regimes, whose existence may be crucial to certain species; • collectively contributing to global warming through production of CO_2 and other greenhouse gases in intensive energy use; • disruption of biological systems crucial to pest and disease vector control, and through pest control, and increased organic waste loadings (leading to higher BCOD), disrupting biological scavenger and waste recycling mechanisms; • disruption of the sediment production (erosion), transportation (by water and wind), and deposition processes, by damming, embankments, groynes & similar coastal structures, dredging; • disruption of the purification functions of dust filtration, by removal of vegetation or overloading the system with excessive dust, or by introduction of particles toxic to the purifying fauna; • overloading the capacity of the land, fresh water and marine water ecosystems to breakdown and recycle organic waste products, through inadvertent nutrient enrichment, increase of bio-chemical oxygen demand.

Functions of the coastal environment	Impact of urban areas on environmental functions
The environment provides *information functions* that are less familiar to many people because they are easily taken for granted. These include: • orientation, by which we recognize features, gain familiarity, and relate spatially to our surroundings. The appreciation of nature in relation to many forms of recreation is a sub-set of this function. • educational value of ecosystems is important in individual development; • signalling function alerting the observer to potential danger through monitoring of changes in the environment, or within specific ecological components. • The natural world, when studied in detail, has provided a great deal of knowledge useful to man in the development of "new" substances, materials, medicines and mechanisms. Finally, the environment, in its innumerable and dynamic ecosystems, provides a vital gene pool that is being increasingly understood to be crucial to society's long term survival. [14] The variety of habitats and rich biodiversity of coastal and in shore ecological communities are particularly important. Inasmuch as many toxic substances eventually find their way to the sea, the close monitoring of key species can provide valuable information on the flows and levels of pollutants, alerting observers of the need to take specific action. The dynamism of the coast, the diversity of aesthetic qualities, the myriad variation in recreational opportunities, all contribute to the value of coasts for personal development, for psychological and emotional well-being.	Urban impacts on the environment's information functions: • destruction of natural orientational features and creation of artificial ones, many of which are by contrast temporary, loss of appreciation of natural rhythms leading to temporal disorientation; • creation of stressful environment, which, with labour laws on free time, and available opportunities, encourages a market for recreation out of the city, increasingly in specialised resort centres that have their own environmental impacts; • reduction in opportunities for use of natural systems for personal development, frequently with a loss of appreciation for natural rhythms; • through destruction of habitats and ecosystems, reduction of species, and the potential source of future knowledge of new substances, materials, medicines; • similarly, reduction of the gene pool as biological "information" and the reduction of capacity to meet new biological threats: plant diseases, insect pests, etc.

The specific mechanisms by which the environment fulfills these functions varies. But it is clear that excessive disruption of any of them will be deleterious to man. All of them exist in coastal environments, and all of them are affected by urban activities, though individually to varying degrees. The functions are highly inter-related, and human impacts on them exist as a complex, so that the combined effect is not necessarily the exact sum of individual effects on individual functions.

Coasts are variable along their lengths and dynamic through time. It is not possible to give a full or even general description of the coasts of eastern and southern Africa and south east Asia. In both regions there are stretches of hard, so-called high energy coastline, sand beaches backed by vegetation or by dunes, various types of mangrove forests, coral reef areas, important estuaries and deltas, coastal wetlands and lagoons, mudflats, exposed as well as sheltered coastlines. In each case there are areas with wide and narrow coastal plains. Both are subject to cyclonic weather, although the south east Asian cyclones are more frequent and more powerful in general. The very irregular coastline (on a macro scale) and the numerous island chains in the south east Asian region give rise to a more complex marine circulation pattern than that found off the coast of eastern Africa. The Asian region has had a much longer period of relatively high density occupation by humans, in well organised societies that have also demonstrated skills in shaping their landscape and hydrological systems for productive purposes. These impacts are particularly noticeable in the coastal plains and deltas, where dykes and canal systems have long been part of a sophisticated irrigated agricultural economy.

Coastal areas, especially those around the Pacific Ocean, are subject to a variety of hazards. All of the coasts subject to this paper are humid, at least for parts of the year, and are naturally well vegetated. These conditions have given them a reputation for having high frequency of disease vectors. Cyclonic activity over large water bodies generally lead to severe storms. Coastal areas receive the brunt of their ferocity as they move over land, where they progressively lose their force. Their movement shoreward is usually accompanied by storm surges whose effects may be exacerbated by coastline form, such as in the Gulf of Tonkin. There may also be seasonal variations in currents and current strengths, as in the upper Gulf of Thailand.

Deltas, by nature, are subject to processes of erosion and accretion, often with large fluctuations in water level. They tend to be very fertile and therefore attractive to settlement. They also tend to be subject to subsidence over time, a process hastened by large scale ground water extraction.

Many coastal regions and islands lie on tectonically active geological formations or are volcanic in nature. The Pacific rim is well know in this regard. Vietnam, Cambodia, and Thailand are not noticeably susceptible to volcanic and seismic activity, but Indonesia and Philippines both have active volcanoes.

3.2 Impact of the coastal environment on cities

Cities in the coastal zone are at risk from a number of hazards, some natural, some made worse by human activities. The third group of risks, that are entirely man-induced will not be touched upon here. The natural risks include:

- the basic dynamism of most coasts, in which erosion and accretion are normal processes. The rate of change varies spatially as well as temporally. According to some authors shoreline erosion is increasing, with human interference being a direct and/or indirect factor[15]. Where erosion takes place, urban infrastructure may be threatened. Where accretion takes place, certain urban functions, such as sea-land transhipment in harbours, may be impaired. Beach-related activities and the economies surrounding them may be seriously affected. The response is often an engineering one, as users try to maintain the physical *status quo* (sometimes trying to force nature to fit an ideal image of a coast or harbour) and protect existing investments[16]. Response to erosion may be through sea walls, groins, other forms of stabilisation, or beach nourishment. Response to siltation is generally to dredge, with disposal elsewhere of the dredged material.

Beach engineering is a fairly common practice around sea-side tourist resorts. The result may be to move the damage elsewhere, and often to make it worse.

- Seawater flooding, cyclones, storm surges, tsunamis. Some areas are particularly susceptible to cyclones. The northern half of Vietnam, much of the Philippines, and southern China including Hong Kong, and parts of Indonesia lie in a cyclone belt. The severity of storms varies. Such storms are often accompanied by storm surges that raise the level of sea water higher than normal. Tsunamis are basically unpredictable before some submarine event occurs and is recorded, but the impacts depend on a variety of factors including the depth and character of the offshore sea bed[17].

  Coastal areas that are low lying are vulnerable. Where mangrove forests have been replaced for agriculture, aquaculture or settlement, there is no natural protection and sea defences are usually constructed. Combinations of cyclones, storm surges, and high tides heighten the risk of breaches or serious over topping of these defences. Flooding with saline water leads to damage to property, degradation of soil resources, salinisation of groundwater, and can lead to loss of life.

  The higher the value of properties being protected by sea defences, the greater the protection level that can be justified and afforded. It is generally cities that have the highest level of asset value and that can warrant the high expenses incurred in protection. However, no sea defences can give total protection. In particularly severe storms damage to these high value assets will occur and the costs will be concomitantly high.

  In many, but not all, instances, the preservation/conservation of a belt of mangrove vegetation, can play an important role in sea defence. Mangroves are not impervious, and will not totally hinder water moving landward. But they can significantly reduce the force of waves on the land, and permit the construction of less costly berms as the impermeable barrier. Such barriers must be designed in such a way that their presence does not lead to the demise of the mangroves. Well managed, they provide a defence component that can itself be economically productive.

- Freshwater flooding: this may result from river flooding or directly from rain. Low lying cities in high rainfall levels are subject to the threat of this type of flooding. Parts of Haiphong, for example, are frequently flooded by rainfall runoff.

  This is a typical natural hazard whose effects are made worse by man's actions. Deliberate construction on flood plains increases risk of damage. Furthermore, cities, by their nature, increase the proportion of impervious surface and therefore the proportion of rainfall that must be disposed of through runoff. The presence of buildings reduces the runoff area, channelling the rainfall to streets and other open spaces. If inadequate storm water drainage systems are not present flooding is inevitable, with resultant costs in damages to properties and disruption of economic activities.

  The risk of flooding and the problem of surface runoff disposal is further heightened by land subsidence. Subsidence not only creates particularly low elevation areas, it also causes damage to drainage systems rendering them ineffective. When subsidence leads to levels that lie below groundwater level, river level or sea level, pumping is required - an additional cost. Bangkok faces this type of problem.

  Rivers in the regions are subject to large seasonal flow volumes. In delta regions it may be considered natural that flooding occurs annually. Urban centres in deltas must protect themselves from such events, and do so by engineering efforts to stabilize river banks, construct dykes, and by-pass flood ways. Again, concentrated investments in cities can justify the economic costs involved in building and maintaining such controls, but they are not 100% secure.

- corrosive damage to metal and building materials by air-borne salts from the ocean. This is beyond the corrosion caused by air pollution. Special treatment of materials is required in coastal areas against such salt corrosion, and in some cases other materials must be used.

- wind damage associated with storms: coastal storms are frequently accompanied by high winds. It is a well established fact that such winds reduce in intensity as they move in over land masses. Therefore, deliberate settlement along the coastline will automatically raise the probability of wind damage, and the cost of extra measures to counter such damage. It is these winds that drive storm surges. The winds themselves can cause major damage, as witnessed in Hurricane Andrew in Florida, and similar events elsewhere. Apart from appropriate building techniques there are no equivalent communal defences comparable to those used to combat flooding. However, the widespread clearance of trees and coastal forests, exacerbates the risk of damage by increasing exposure.

- Land subsidence: many, though not all, sedimentary coastal plains have a tendency to subsidence. This is particularly true of deltas, although delta systems will receive replenishment if upstream flows are not hindered (the construction of the Aswan Dam on the Nile is believed to be a significant cause of the subsidence of the Nile Delta and erosion of the coastline eastward of it). Land subsidence will lead to structural damage to buildings and infrastructure. The damaged infrastructure can lead to other problems such as flooding from broken water supply systems, leakage from broken sewerage mains, etc.

  Subsidence can be severely and rapidly aggravated by excessive extraction of ground water. This leads to compaction of water bearing aquifers, which in many cases cannot be made to recover their uncompacted form. Where such extraction and compaction is deeper than construction pilings, such pilings will not protect their buildings from settlement and damage. Bangkok, Jakarta, and Hanoi all have documented evidence of subsidence. Subsidence can also be due to tectonic activity, as can a relative and regional sea level "rise."

- sea level rise: this is a global issue that remains the subject of debate. The majority of researchers now believe that global warming will lead to a rise in sea levels, and in some regions to an increase in the number and intensity of storm activity. The implications for coastal cities, especially those that are already subject to flooding, are obvious. Many researchers believe that man's activities and patterns of energy utilisation contribute significantly to global warming trends. Cities, as the prime engines of modern industry and commerce, are heavily implicated in this respect.

3.3 Implications

The implications of the interaction between urban growth and the natural environment in the pursuit of sustainable development are several.

- urban development, as one instrument in human interference in the natural world, progresses in a direction opposite to those processes normal operative in the natural ecosystem[18]. Urban growth leads to:
  - increase in the dynamics (changes in time) within the environment, particularly with regard to the abiotic elements of ecosystems;
  - decrease in variety in the environment, in this respect with particular regard to the biotic components (species). Although city dwellers introduce many exotic species, these cannot be regarded as stabilizing components of the local ecological system, and often need to be sustained artificially.

  It is this dichotomy that will make efforts to achieve environmentally sustainable cities particularly difficult.

- environmental resources entice development, whether trade and transportation, tourism and recreation, fishing, or agriculture. These lead to additional activities related to product

manufacturing and processing, commercial and social services. Not all uses can occur in the same place and time, so that conflicts over use arise;

- this leads to the need for methods of conflict analysis and resolution, as well as for the need to regulate the use of the resources. Usually this is done through institutional mechanisms, whose interactions also need to be ensured;

- urban impacts on coastal environments are serious, and must be addressed, not only for the sake of sustainable development and environmental conservation, but because many of these impacts reinforce and exacerbate natural hazards, raising their severity and the probability of their occurrence; some urban impacts on the environment, direct and/or indirect, may be beneficial;

- environmental hazards must be taken seriously, and are usually countered through regulations (to reduce exposure to hazards or limit potential damage), and infrastructural responses. These tend to be expensive, but for cities may be well justified economically in view of the value of the assets being protected.

- health and safety issues may be important in tropical coastal cities where disease vectors may find appealing habitats, water and air quality are reduced, and fragile environments such as steep hillsides are encroached upon.

- integrated management approaches are needed to address the very complex inter-relationships that occur across sectoral administrative boundaries; this integrated management needs appropriate tools and processes to ensure success.

The need for integrated coastal zone management has been acknowledged for some time, even if the explicit incorporation of urban development issues has not always found a place in such considerations. What then are the possibilities and hindrances encountered in bringing them into the picture more actively?

3.4 Potential and constraints to incorporating urban issues in sustainable coastal resource management

There are both difficulties and opportunities for incorporating urban centres in sustainable coastal resource management. At one level it is imperative to include urban issues in the process. At another level, the specific types and particularly scales, of issues are such that treatment of large urban centres in coastal zone management programmes must use other approaches. Large metropolitan centres like greater Manila, Jakarta, or rapidly growing coastal centres in southern China, have impacts on a scale, where the present approach would give overwhelming attention to urban demands or exclude them altogether. Also, many such cities have already altered the environment so fundamentally that even remedial action will establish ecosystems that are only a shadow of their former selves, if at all like them.

Some of the potentials and constraints that need to be addressed in this discussion follow:

- Conceptually, sustainable use of natural resources is closely allied to principles of local management. Decentralised management of relatively small areas allows resource users to participate in decisions that affect them directly. Large cities today draw on the global market for their resources, and many urban citizens are hardly aware of where the goods they consume come from, nor of the environmental costs involved in their supply. Therefore the application of sustainability principles to the large urban agglomerations that are forming in south eastern Asia (and elsewhere) may be quite different in practice from those applied to adjacent non-urbanized coastal areas.

  Large cities stand to gain from global moves towards free trade, as this will feed their cosmopolitan demands at lower costs. Free trade on a global scale will have many negative

impacts on the environment generally, and since most such trade will be channelled through cities (especially coastal ports), on urban and coastal environments in particular.

- Population growth generally, and concentration of population in coastal regions in particular, automatically places greater burdens on local eco-systems in all their functions. Many traditional societies on small islands have special social and medical means of maintaining populations within the limits of their resource base[19]. Even if per capita resource utilisation is low, the total will continue to grow. Apart from the occurrence of growth, the rate of growth puts further strains on the capacity of institutions to keep pace with the needs of the additional consumers of resources and producers of waste. Here there is a significant difference between the eastern and southern African coastal belt and the south east Asian. As noted earlier, south east Asian nations are more populous in the first place, and have a much higher urbanisation and growth rate. This suggests that the African nations have a greater breathing space to cope with the issues. They have other problems, however.

  In areas around large coastal cities, the scale of the urban impacts, particularly in land provision for low income groups, and waste disposal, but also in terms of storm water drainage, and water provision, are formidable. Costs for infrastructure to cope with such large (and growing) problems can be a serious constraint to any corrective action.

- Even if population growth were to cease immediately, the demand for resources would continue to grow because of expectations, and exaltations by authorities to adopt "modern" consumption patterns. The media, with full consumer support, continues to hold up the aspirations of the *Dallas* and *Baywatch* lifestyle. Even in Sweden the public is encouraged to increase consumption in order to stimulate Swedish production and solve the unemployment problem.

  This message has greater chance of success currently in south eastern Asia than in eastern Africa, because the national economies are in "better" shape. There is no doubt that equivalent aspirations exist in Africa. Such aspirations re-enforce attitudes and behavioural tendencies away from sustainable life styles.

  The preachers of sustainability appeal to the current generation to moderate or even reduce its consumption levels for the sake of future generations. It is clearly evident from history, however, that children who start out with greater material wealth and social standing have advantages over those who do not. There is therefore an almost biological drive urging the current generation to do as well as possible materially so that their children will have a greater chance of survival in the admittedly bleaker future. This works like a temporal 'tragedy of the commons' principle. Changing attitudes, behaviour patterns, and life styles will need a major effort in developing countries if it is to have success. It will be particularly difficult (but also much more imperative) to win this battle in the cities.

- Several types and levels of ignorance hinder the acceptance of decision-makers and the general public of the need to alter life styles and consciously seek sustainable development patterns.
  - the remoteness of the urban dweller from the source of the raw materials s/he consumes leads to a certain unawareness of the impact of his/her consumption patterns. This has already been mentioned. The removal from contact with the natural resource base is less with new urban migrants, and those who still depend on some rural support system. In African urban settings many households retain this contact because of the inability of the formal money sector to supply all their needs, even among relatively high social positions. In the Asian countries treated the poorer segments of urban society are also more aware in this sense. Whether or not this leads to more environment-friendly behaviour depends on many other factors, such as access to decent land for settling, affordable fuels other than wood and charcoal, etc.
  - sustainable utilisation of ecosystems implies a knowledge of the limits and carrying capacities of those ecosystems. It also implies a knowledge of the specific impacts of pollutants on the systems' viability. Although great progress has been made in this field, there remains a great deal of ignorance, and many specific eco-systems have not been studied at all. To some extent

this problem can be circumvented by applying the cautionary principle of resource utilisation, but even this will not ensure long term sustainability.

- There are several institutional issues that hinder progress towards sustainable development and resource management[20]:
  - sustainable development presupposes integrated approaches. In many countries sectoral authorities, and administrative hierarchical levels, compete with each other as much as, or more than, they cooperate and coordinate efforts. Efforts to integrate can be threatening for some institutions and individuals[21]. Even with good will, coordinating several agencies, often with overlapping responsibilities alongside gaps in coverage, is difficult;
  - there are cases lack of legislation for some resources, overlapping legislation, or conflicting legislation;
  - difficulties in enforcement of policies and regulations resulting from: inadequate numbers of enforcement agents, ignorance on the part of enforcement bodies as to what constitutes an offence, limitations in the prosecution process, meaninglessly low penalties for offences once convicted;
  - failure to adequately address environmental issues in a meaningful way in development plans;
  - difficulties in implementing those plans that have been adopted: this may be due to financial constraints, lack of legitimacy, or failure to secure sufficient political will for implementation;
  - financial and manpower constraints in monitoring;
  - competing priorities in utilisation of available manpower (equivalent in practice to inadequate numbers of qualified personnel);
  - overlapping administrative jurisdictions with a common problem: this is a variation on the coordination theme, in which neighbouring jurisdictions may have differing or even opposite priorities;
  - lack of personnel may hinder the implementation of desirable decentralization plans.

On the positive side it can be argued that:

- if the ultimate goal is to provide all citizens with a good standard of living, the most per capita cost effective way to do so is within well managed urban centres; it is more feasible to arrange cross subsidies in the provision of water, sanitation, electricity and drainage services to low income groups in the city than elsewhere;
- cities do encourage trends to lower birth rates, and therefore to a relative long term reduction in the total burden on earth's resources;
- the palpable deterioration of the urban environment (air quality in particular) can galvanise popular support for meaningful programmes against pollution; Local Agenda 21 can also be a channel through which to encourage low level participation and start the process of change;
- there is a growing awareness in the cities of south east Asian countries of environmental issues, and financial institutions are supportive. The Asian Development Bank has a particularly active environmental programme.
- within the international trade sector, first world consumers are able to put pressure on producers to use environmentally friendly processes, and avoid harm to threatened species; the use of ISO 14001 certification, and other certification systems as marketing devices, especially for export-oriented firms, can put pressure on private sector actors to improve their environmental consciousness and performance. Since many such companies are located in large coastal cities (because of export orientation) there can be a positive accumulated impact. The active participation of a few such companies can also be used by authorities as examples of what can be done, thereby supporting their enforcement efforts.
- with regard to resort towns, there are now a number of successful examples of good design and management in the south east Asian region[22] and eco-tourism is beginning to appeal to a growing number of travellers.

3.5 Application of physical planning in achieving sustainable development

In virtually all of the cities encountered along the relevant coasts of Africa and south east Asia the issue of "unplanned settlement" receives blame for social, economic and environmental short-comings. Up-grading and/or resettlement are usually more costly in both short and long term than

proactive planning. The causes underlying the growth of spontaneous, non-formal, usually poor settlements may be many and complex, from land tenure problems, to actually lack of layout designs, shortage of finance, statutory rigidity surrounding real property formation and title registration, non-affordability of available land, or other causes.

Lack of planning is also specifically blamed for problems surrounding early pleasure resorts such as those on Phuket and Penang, and Boracay islands.[23]

Because they are usually illegal and do not exist on urban structural plans, they usually have no infrastructural or social services. Water supply, drainage, sanitation, solid waste control, access difficulties are lacking. On the other hand there may be pirate connections to existing water or power supplies, that affect those who have legitimate right to them. Introducing network services after settlement occurs implies many costly disruptions, removals, adjudication procedures, etc.

Comprehensive and integrated physical planning can be one of the most versatile and useful tools in environmental management. As with any tool its success is dependent largely on the user and the framework within it is to be applied.

There are several aspects that are included in the use of the term physical planning in the paper. Physical planning as used here includes:

- a spatial dimension that addresses WHERE activities are to take place; this also operates at several scales, from plot coverage and orientation, to national settlement strategies;
- a topological dimension: locational relationships between features, an aspect that is closely linked to the first factor; the spatial dimensions should be determined in consideration of nearby activities and features; this is what gives cities their particular form and "cityscape;"
- a temporal dimension, which address WHEN activities should take place, e.g. in the phasing of development; but it may also include more general rules about when heavy traffic can flow or disturbing activities can take place, e.g. no motor-boats in lagoons during nesting season, etc.;
- a description of WHAT the activities or features are meant to be or become, including an indication of impacts through time and space;
- an operational dimension which identifies WHO should undertake or be responsible for certain activities, and HOW they are to operate; it may also address the financial aspects of implementation or maintenance;
- a justification for the proposals, answering the question WHY a certain development or activity should be allowed or encouraged; this should rest on a series of clear goals and objectives of the planning work, which in turn should reflect the views of stakeholders and relevant legislation; elements of an impact assessment should be included to indicate what alternatives were considered, and why the selected one was chosen;
- a methodology that presents how the work was done; here, it should be clear that stakeholders have participated in the planning;

Several of these characteristics have an implicit integrational attribute to them. They require participatory approaches, the require consideration of other factors, adjacent activities and features, and can address issues of the rate of change. By the same token, the natural environment ought to be considered throughout the planning process.

Physical planning, with natural resource and environmental conditions as starting points can:

- produce designs (and include management provisions) that protect and preserve sensitive ecological areas and habitats, as well as avoiding hazardous areas, like flood plains;
- arrange activities relative to one another to reduce total environmental impacts, at several levels (national, regional, local); one specifically encouraging development is the interest in "ecological industrial estates" and the growth of industrial ecology as a discipline[24];
- plan in such a way as to allow cross-subsidisation and ease future upgrading of, network infrastructure for low income residential areas;
- incorporate specific designs to encourage public mass transport systems, and discourage excessive private vehicle traffic in downtown areas;
- address issues of phasing to fit financial schedules, as well as social imperatives;

- reduce risk of hazardous events, by analysing probabilities, designing against risk;
- design to encourage and facilitate recycling of grey and storm water, and to facilitate on one and the protection of important infiltration areas, and on the other, control of runoff in favour of infiltration;
- design for open space systems, so-called green infrastructure, in such a way as to support natural eco-systems, create pleasant living environments and improve the environment's regulation/purification functions.

Because of the complexity of the system tools and approaches are needed to manage the process. Technically geographic information systems are superb tools for this. They can be used not only in planning, but in implementation, monitoring, assessment, and revision. Systems analysis and the development of models that reflect the interactions of component parts and reveal functional details should also be used, and can also be aided by GIS and other information management systems. If environmental issues are to be addressed it is in this context that they are particularly important.

Participation can be used to ease the burden of work, but is often seen as an additional load. Delegation and decentralisation of responsibilities, as part and parcel of the participatory approach can be used in circumstances where integration and coordination can be ensured. Attention given to planning the planning programme can save time, in delegation certain data collection and analysis functions to appropriate individuals or agencies with the right expertise.

In this regard local Agenda 21 can provide a supportive model for addressing both participatory approaches and environmental concerns. Used properly as grass-roots level it also has the advantage of identifying those issues which have priority for a select group or neighbourhood, as distinct from those issues that must be addressed at a higher, more comprehensive level. For example, grassroots inputs to detail plans affecting individual families, will arouse their interest in participation, far more that appeals to contribute to metropolitan-wide structure plans. The type of participatory approach adopted must fit the particular goals, levels, and scales of the exercise. Strategic [environmental] impact assessment[25] is a useful tool to apply to local, as well as comprehensive, plans even if these have been based on an environment-friendly approach.

3.6 Experiences hitherto

Time does not allow a comprehensive or in-depth review or analysis of experience gained thus far specifically in urban growth management in coastal zones.

Integrated coastal zone management, under various names, has become a well accepted concept, and in the Asian-Pacific sphere has very strong support within the Asian Development Bank, as well as among other international assistance agencies[26]. Since the popularisation of sustainable development concepts at the Rio UNCED conference, the two concepts have become closely aligned. The ADB has its own slight variation in propagating for Economic-cum-environmental planning and development.

Research in coastal zones receives attention through a number of programmes, both bilateral and multilateral. The urban aspects, treated as a whole, of the impact on coastal zone environment appears not to have received significant attention. There is also a question as to how well the findings of other research efforts fits into the needs of the type of planning that is required, or finds its way to planners and managers.

Development banks have been and continue to be important financiers of major urban "environmental" projects. Most of these focus on water supply, sanitation and waste management, and there are efforts in housing finance[27]. While these are important sectoral inputs with benefits to the environment, they often lack a true integrated setting. This is beginning to change.

Urban physical planning exists in all the affected countries. Legislation differs, as do operational structures. With few exceptions the city planning and engineering departments are not able to keep

abreast of the task, this being particularly difficult in the very large and rapidly growing cities. There are also institutional problems with overlapping, conflicting or missing jurisdictions. In some cases, administrative boundaries have led to difficulties in coordinating plans, such that plans made in one jurisdiction have severe implications for a neighbouring one, but no discussion is held in early stages to mitigate conflicts.

Progress has been made in reducing negative environmental (and to some extent social) impacts of tourist resort projects through improved regulation and control of existing resorts, and through improved design of new ones. This is particularly true in the south east Asian region[28] where much more care is being given to tourism impacts.

Other major efforts are being made to address the by-products of certain basic urban functions and supply lines. One of these is in the field of oil spill contingency planning, for both harbours and entire coast lines. This work requires the compilation of inventories on ecological systems, and setting values on them, followed up by establishing measures for their protection. Urban harbours are particularly important because of the risk of spillage in oil transfer. Here technological methods are well advanced and it is a matter of implementing operational systems and maintaining them.

Mozambique is receiving World Bank assistance in planning and rehabilitating a number of coastal cities; Sida has supported rehabilitation of the port of Beira, Finland has assisted Nacala, in northern Mozambique. This is a considerably smaller city, but it provides a positive demonstration of a severe erosion problem caused by unplanned settlement being successfully resolved with public participation in a resettlement project[29].

All of the countries covered support the concept of environmental management and accept the importance of integrated coastal zone management. City planners are also increasingly aware of the need to consider environmental issues other than water quality and sanitation problems. However, capacity to respond adequately is usually lacking. The introduction of new computer technology and use of geographic information systems is sought after for urban planning[30], but expectations of its value are likely to be diminished due to failure to understand the time, effort, and finance involved in developing such systems to the point where they are valuable.

BITS supported the Thai Office of National Environment Board to install a GIS for managing and developing coastal and marine resources. This system has been further developed and is used throughout the country. However, it was designed for Provincial level, rather than specifically for urban centres. Its value will lie in monitoring and planning environmental impacts of settlements at the Provincial (Changwat) level.

The emphasis on technical tools is fairly typical, and there is no doubt that these tools will become useful. However, there are other institutional and personnel difficulties that these tools will not overcome. In most of the countries, for example, there is a growing acknowledgement that decentralisation of decision-making and planning is necessary for good resource management. One of the key constraints is the provision of qualified manpower to fill the necessary posts. Perhaps more important than simply providing support to training and decentralisation, is the need to get existing institutions to establish and build upon networks and linkages[31] to break down the current sectoralised approach to complex problems.

The practical application of integrated approaches has not proved straightforward. There can be difficulties ensuring that relevant actors do become involved, for a variety of reasons. Structural and institutional divisions exist not only at local and national level, but even internationally. Non-government and government bodies may be suspicious of each other, sectoral authorities have their mutual "territories" to protect, and international aid agencies also exhibit rivalries[32]. Even within agencies there are shortcoming regarding coordination of inputs[33]. And where well integrated plans may be adopted, implementation is usually sectoralized again, so that individual components begin to lead separate lives.

The goals of cross-sectoral coordination and decentralisation can be partially achieved by the back door, through the use of NGOs, CBOs and the Local Agenda 21 process. Focussing attention on programmes that have wide public support and involvement can force government bodies to cooperate, but care must be taken to avoid the damage that can be done by institutional rivalry. Experiences in Dar es Salaam and elsewhere illustrate the importance of offering something for everyone, and avoidance of the impression that one institution is trying to manipulate others to gain credit, prominence or to achieve its own hidden agendas[34].

The ADB has financed a project titled **Coastal and Marine Environmental Management in the South China Sea** (RETA 5552). This project focussed on two areas of south China, three areas of Vietnam and one of Cambodia. In all areas covered urban and industrial waste management was found to be inadequate for current populations, and all urban areas were experiencing rapid growth.[35] Sanitation and waste water treatment are serious problems whose resolution in major cities is very expensive.

4 Conclusions

Urbanisation of the coastal zone continues, and it does so at an increasing rate. In the regions addressed, there is growth in both large cities and specialized resort settlements. With this increased urbanisation, and the continued global industrialisation, comes a higher risk for natural and anthropogenic hazards in the coastal zone. The probabilities that natural catastrophes and accidents will occur are becoming greater, and the consequences in terms of loss of life and damage to property are being significantly increased because of the concentration of investments in these areas.

Protection of the abiotic environment (land, water and air) from encroachment and degradation is essential if the biotic components of the coastal ecosystems is to survive with any measure of diversity. Degradation of the abiotic base by city growth and functional processes is accompanied by direct impacts on the biotic elements. The direct role of city growth in environmental degradation should not be seen in isolation from other impacts, such as the commercialisation of fishing, acquaculture, agriculture and coastal forestry, a significant portion of which is stimulated by urban consumer demands.

Also fundamental to the sustainability of the coastal ecosystem is a better understanding of those systems, their utilisation, and how these utilisation patterns affect the systems and are themselves affected by development, commercialisation and urbanisation. In line with this type of research, there needs to be more discussion towards a sharper definition of what is to be sustained: current systems including their structures and component species, system functions regardless of specific species composition, or some other definition.

Effective short term protective measures must address costly investments in sanitation and waste management; medium and long term programmes must focus on changing consumer behaviour and urban life styles. The urbanisation of life styles will spread to non-urban areas as rural dwellers seek to improve their living standards, so programmes proposed should be broad-based.

More than ever before there is a need for integrated physical planning as a tool in the context of comprehensive and integrated coastal zone management. Technological tools such as GIS should be more effectively used, and approaches that apply system analysis and impact assessment should be adopted, not only for individual project proposals but for larger integrated plans and programmes. Physical planning itself should be grounded in sustainable environment thinking. The current shortfall in qualified personnel and the persistent institutional problems continue to demand a high priority. Heavy emphasis should be given to realizing true cross-sectoral coordination and cooperation[36]. Capacity building and training should give more weight to these issues, and to methods of inter-institutional working.

These problems can be ameliorated to some extent by different approaches that mobilise the competence, interest and energy found in the private sector and general public, through non-

government and community-based organisations and Local Agenda 21 programmes. Local Agenda 21 programmes can be used as platforms for establishing and consolidating inter-sectoral efforts. These approaches are useful also in generating some financial support, both locally and internationally.

Finally, a reminder is needed in consideration of coastal zone management: the distinction between the resource and the resource user should be strengthened, and the conceptual basis for sustainable development should be focussed on management of the user as a key to conserving the resource. That the user should be an active and important participant in the management design process, as well as in execution and monitoring is self-evident.

Notes.

1. For example water, at the Second international environmental symposium of the Royal Netherlands Land Development Society, whose proceedings were edited by H. Hengeveld and C. de Vocht, 1982 in **Urban ecology**, Vol 6, Nos 1-4, as a special issue on the role of water in urban ecology.

2. For example: Richard Stren, Rodney White, and Joseph Whitney, eds., 1992 **Sustainable Cities: Urbanization and the Environment in International Perspective.** Westview Press, Boulder, Colorado; William E. Rees, "Ecological Footprints and Appropriated Carrying Capacity: What Urban Economics Leaves Out," **Environment and Urbanization**, Vol. 4, No. 2 (October 1992), pp. 121-130; Carl Folke, Jonas Larsson, and Julie Sweitzer, 1995. **Renewable Resource Appropriation by Cities,** Beijer Discussion Paper Series No. 61, Beijer International Institute of Ecological Economics, Stockholm.

3. As an example, see U.S. Agency for International Development (U.S. AID), 1992. **The Impact of Urbanization on Natural Resources: Tetouan, Morocco.** U.S. AID, Washington, D.C..

4. Durban Metro Council, 1996. **State of the Environment and Development Report of the Durban Metropolitan Area.** Durban Metro Council, Durban, South Africa.

5. Friedman, J. 1973. **Urbanisation, planning and National Development.** Sage Publications, Beverly Hills, California.

6. Generally obvious, but also confirmed in the literature. See Ian Douglas, "Human Settlements," in **Changes in Land Use and Land Cover: A Global Perspective**, William B. Meyer and B.L. Turner II, eds. (Cambridge University Press, Cambridge, U.K., 1994), pp. 154-155.

7. A definition adopted by the Second International Environmental Symposium of the Royal Netherlands Land Development Society, held in Amsterdam 27-31 August, 1979. Quoted from: **Urban ecology**. Vol. 6 Nos 1-4, July 1982 (Special issue on the Role of Water in Urban Ecology). pg 12.

8. See for example Jorge E. Hardoy, Diana Mitlin, and David Satterthwaite, **Environmental Problems in Third World Cities** (Earthscan, London, 1992), and Gordon McGranahan and Jacob Songsore, "Wealth, Health, and the Urban Household: Weighing Environmental Burdens in Accra, Jakarta, and Sao Paulo," **Environment**, Vol. 36, No. 6 (July/August 1994).

9. For example Nigel Harris, 1989. **Towns: the mainspring of economic development in Third World Countries.** Paper presented to International Meeting on Cities and Economic Development held in Lille, France, November 6-10, 1989.

10. H.E.Landsberg, 1961. "City air -better or worse" **Proceedings of the Symposium on Air over Cities.** Robert A Taft Sanitary Engineering Centre, Technical Report A62-5, pp 1-22, cited in H. Hengeveld and C. de Vocht, (eds) 1982 **Urban ecology**, Vol 6, Nos 1-4. pp 53.

11. The cities of south east Asia are the focus of the rapid economic development taking place there. Population growth of these cities is high so that pressure on land resources is intense. In the mid nineteen eighties it was calculated that the physical size of urban areas in the developing world generally would double in the last two decades of the century (United Nations Centre for Human Settlements, **Global Report on Human Settlements 1986** Oxford University Press, Oxford, U.K., 1987, p. 130.). Over 475,000 hectares of arable land is estimated to be converted annually to urban uses in the developing world (U.S. Agency for International Development (U.S. AID), **Urbanization in the Developing Countries,** interim report to Congress (U.S. AID, Washington, D.C., 1988), as cited in Euisoon Shin *et al.*, **Valuing the Economic Impacts of Environmental Problems: Asian Cities,** Urban Management Program Discussion Paper, draft The World Bank, Washington, D.C., 1994, p. 3.).

    Loss of high quality agricultural land has at least two other side effects. This land's productivity must be compensated for elsewhere, often on less productive land. In Ontario, Canada, for example, the loss of one hectare of high quality agricultural land to urban uses requires three hectares of prairie land to compensate for the productive loss (World Resources Institute in collaboration with the United Nations Environment Programme and the United Nations Development Programme, **World Resources 1994/95** Oxford University

Press, New York, 1994, p. 162). Spatial compensation will only occur if other unused arable land is available, in which case there is an additional conversion of natural land to agricultural use. Furthermore, the agricultural products must come from farther afield with additional environmental costs due to transport (energy and pollution)(Donald W. Jones, "How Urbanization Affects Energy-Use in Developing Countries," **Energy Policy**, Vol. 19, No. 7 September 1991, p. 622.). From the viewpoint of the rapidly growing city the loss of agricultural land may not be particularly serious, because of its lower value relative to urban uses (Janis D. Bernstein, **Land Use Considerations in Urban Environmental Management,** Urban Management Programme Discussion Paper No. 12 . The World Bank, Washington, D.C., 1994, p. 26). An alternative to spatial compensation is to fundamentally and artificially modify the productivity of poorer land by increasing inputs such as fertilizers, water, and other control chemicals. This has other cost and environmental implications.

12. Hong Kong and Singapore have experienced spatial constraints due to their island and topographic status. In Hong Kong land claimed from the sea accounts for more than 25% of the total urban land area, destroying most mangroves and fundamentally altering the coastal habitats (Brian Morton, "Pollution of the Coastal Waters of Hong Kong," **Marine Pollution Bulletin**, Vol. 20, No. 7 1989, pp. 312-313). Singapore has added 6,000 hectares to its urban land area in the past three decades by filling along its coast line. This amounts to ten percent of its total area (Chia Lin Sien, **Singapore's Urban Coastal Area: Strategies for Management**, Association of Southeast Asian Nations/United States Coastal Resources Management Project Technical Publications Series 9. The International Center for Living Aquatic Resources Management, Manila, Philippines, 1992, p. 17.). Industrial nations have a long history of similar activities. Haikkou, in Hainan Province of China, saw its built up area grow from 22 km^2 in 1987 to 37 km^2 in 1994 (EVS Environmental Consultants, 1996. **Coastal and Marine Environmental Management for Hainan Province, Peoples Republic of China**. ADB RETA 5552, ADB, Manila. pp. 20).

13. H. Hengeveld and C. de Vocht, (eds) 1982 **Urban ecology**, Vol 6, Nos 1-4. And M.B.McPherson (ed.), 1974. **Hydrological effects of urbanization. Report of the sub-group on effect of urbanisation on the hydrological environment.** Studies and Reports on Hydrology No. 18. UNESCO Press, Paris.

14. National Physical Planning Agency, 1977. **General Ecological Model. Part 3 of the series General Physical Planning Outline. Study Report 5.36.** NPPA, Ministry of Housing and Physical Planning, The Hague.

15. E.C.F. Bird, 1976. **Shoreline changes during the past century.** IGU, Melbourne, and 1985, **Coastline changes**, Wiley-Interscience, London, as referred to by R.W.G.Carter,1989, **Coastal Environments.** Academic Press, London. p.434.

16. See Dr. J. Pethick, "Natural Change" in M.G. Barrett, (ed), 1992. **Coastal zone planning and management.** Proceedings of the conference "Coastal management '92: integrating coastal zone planning and management in the next century, organized by the Institution of Civil Engineers, at Blackpool, 11-13 May, 1992. Thomas Telfor, London. Pp 49-63.

17. For a discussion of the impacts of cyclones, typhoons, tsunamis, and other coastal hazards, see R.W.G.Carter, 1989. **Coastal environments**. Academic Press, London. pp. 529-559.

18. H. Hengeveld and C. de Vocht, (eds) 1982 **Urban ecology**, Vol 6, Nos 1-4, pp 94-102 and National Physical Planning Agency, 1977. **General Ecological Model. Part 3 of the series General Physical Planning Outline. Study Report 5.36.** NPPA, Ministry of Housing and Physical Planning, The Hague.

19. The author has personally worked with resource issues on small islands in the Pacific. In virtually all discussions on resource management, explicit emphasis was placed on population control.

20. For a synthesis of institutional constraints in Vietnam, China, and Cambodia, see Peter J. McNamee, "Synthesis of coastal and marine environmental management issues in the South China Sea," in ADB, 1995. **Coastal and Marine Environmental Management Proceedings of a Workshop** ADB, Manila. pp. 2-11.

21. The threatening aspects in coordinating working approaches is specifically raised by Graham Alder and A.G.Kyessi, 1995. **Case studies on the Local Agenda 21 Process: Dar es Salaam United Republic of Tanzania.** ICLEI.

22. See Poh Poh Wong, " Coastal and marine tourism in the Asian and Pacific region: experience and impacts," in ADB, 1995. **Coastal and Marine Environmental Management Proceedings of a Workshop** ADB, Manila. pp. 204-235.

23. Ibid. pp 207ff.

24. Some sources include: L.W.Jelinski, T.E.Graedel, R.A.Laudise, D.W. McCall, & C.K.N. Patel, 1991. **Industrial ecology: concepts and approaches.** AT&T Bell Laboratories, Murray Hill. And Stephen V.Dunn, 1995. **Eco-industrial parks: a common sense approach to environmental protection.** US EPA, Washington D.C. and R.A.Frosch & N.E.Gallopoulos. 1989. **Strategies for manufacturing.** *Scientific American.*

25. There is value to assessing social and economic impacts as well as environmental ones.

26. The ADB has produced a number of guidelines and handbooks, many of them geared towards environmental impact assessment, but also on economics-cum-environment.

27. ADB's monthly project listing virtually always includes major infrastructural projects in sanitation. March 1997's issue of **ADB Business Opportunities**, Vol 19, No 3, p 13 lists a $150 million project to "accelerate implementation of environmental protection projects in Thailand, with priority given to cleaning the lower Chao Phraya River Basin in the Bangkok Metropolitan Region. The project will provide wastewater collection and treatment facilities in the north and west areas of BMR and will introduce private sector participation in the sector for the first time in Thailand." Without wishing to denigrate Sida's efforts in coastal zone management, one can compare Sida's entire contributions to coastal management through the years 1990-96 (less than $12 million) with the cost of this one project. This shows the scale of the investment problems being faced by major coastal cities: the project meets only a small portion of Bangkok's needs. The same issue of **ADB Business Opportunities** indicates approval for the second phase of the Coastal and Marine Environmental Management in the South China Sea project ($2,7 million).

28. There is a good description of both bad and good in Poh Poh Wong, " Coastal and marine tourism in the Asian and Pacific region: experience and impacts," in ADB, 1995. **Coastal and Marine Environmental Management Proceedings of a Workshop** ADB, Manila. pp. 204-235.

29. See Satu Ojanperä, 1994. **When people have to move away: resettlement as a part of erosion control in Nacala, Mozambique.**. Ministry of Environment, Helsinki Finland, and Nacala City Council.

30. Sida has been approached, for example to finance a GIS in Makati greater Manila. See an evaluation of the proposal: Swedeplan, 1996. **Assessment of Project Proposal Geographic Information System for the City of Makati, Metro Manila, Republic of the Philippines.** Swedeplan and Sida (INEC), Stockholm.

31. One conclusion reached by Wolfgang Hillebrand, Dirk Messner, Joerg Meyer-Stamer, 1994. **Strengthening technolgocial capability in developing countries Lessons from German Technical Cooperation.** German Development Institute. Berlin, pp 2 and 37.

32. Ibid. pp 38-39. The authors are straightforward in their criticism of the "competition and lack of coordination" among donors.

33. A point made clearly by Agneta Nilsson, 1996, **Sida-stadia kustrelaterade projekt 1990-1996.** Sida, Stockholm

34. Graham Alder and A.G.Kyessi, 1995. **Case studies on the Local Agenda 21 Process: Dar es Salaam United Republic of Tanzania.** ICLEI. pp. 7-8.

35. Reports prepared by EVS Environmental Consultants, 1996. **Coastal and Marine Environmental Management for Ha Long Bay, Socialist Republic of Viet Nam; Coastal and Marine Environmental Management for Minh Hai Province, Socialist Republic of Viet Nam; Coastal and Marine Environmental Management for Hainan Province, Peoples Republic of China; Coastal and Marine Environmental Management for Guangxi-Zhuang Autonomous Region, Peoples' Republic of China.** ADB RETA 5552, ADB, Manila.

36. This comes across clearly in the available Local Agenda 21 eports produced by ICLEI, but also in workshops and conferences on ICZM, such as GEF/UNDP/IMO, 1996, **Enhancing the success of integrated coastal management.** Report of the main findings from the International Workshop on Integrated Coastal Management held in Xiamen, Republic of China, May 24-28, 1996. p. 9.

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