CHAPTER SIX

SUSTAINABLE DESIGN MODELING

6.0. INTRODUCTION

The sustainable development approach has become an important guide to many communities that have found that traditional approaches to development are creating, rather than solving, societal and environmental problems. Where traditional approaches can lead to congestion, sprawl, pollution, and resource over consumption, sustainable development offers real, lasting solutions that strengthen our future. Sustainable development provides awareness and guidance in a time when consumption has overshadowed human connections to natural systems. It counterbalances the damaging effects of human activities in which sustainable use attempts to minimize ecological costs so that the system will continue to function indefinitely within an acceptable limit of change.

A basic premise of sustainable development is that built environment must be developed and function within the ecosystem of the natural environment and its processes rather than separately. The study's "Sustainable Design Model" (SDM) provides a framework in which designers and lanners can use resources efficiently, and establish a compatible built environment that strengthens local economy, enhances social life, and helps to create healthy environments.

The purpose of this research is to develop a "Sustainable Design Model" that incorporates the broader concepts of sustainable development practices with carrying capacity aspects in the process of planning, designing, constructing, and operating coastal tourism developments. A "Sustainable Design Model" in contrast to traditional models of development is a strategy by which communities seek development approaches that benefit and preserve local environmental quality. It is future oriented, holistic, interconnected, nonhierarchical, and participatory. It involves considering people's relationships with the environment, and the current generation's responsibilities to future generations (USDE, 2000). A SDM of beach resorts is presented as a guide for strategic decision-making and as a forecasting tool to facilitate the implications of future decisions on carrying capacities linked to sustainability principles. It provides as a tool by which the sustainability of a destination can be defined and measured. The information generated by the SDM can be used to identify which areas are in decline and need assistance to maintain current levels of sustainability; which areas are able to sustain themselves socially and economically; and which areas are changing environmentally.

6.1. SUSTAINABLE DESIGN GOALS

Tourism development is tied to sustainability in that it requires that the physical built environment be carefully sited, designed, constructed, and operated in a way to avoid/minimize potential negative impacts on natural and cultural resources. Tourism development should be balanced with resource conservation; promote equitable opportunities of tourism experiences; and support both nature conservation and economic growth. Sustainable tourism development focuses on preserving and incorporating indigenous natural and cultural resources rather than creating an artificial environment. The prime economic, social, and environmental objectives of sustainable tourism are to achieve tourism and recreation experiences within acceptable limits of change to the environment. A model of sustainability should include a three-pronged approach that secures the economic, societal, and environmental health of a region. Each of these approach components is discussed in more detail below.

6.2.1. Economic Goals

The economic dimension of sustainability involves productivity, resources consumption, economic activity, basic services, and employment. A sustainable economy should involve the efficient use of resources; combat poverty; change over-consumptive lifestyles; minimize wastes; provide job opportunities; avoid economic activities that encourage the continued belief of endless resources; promote self-efficient economics that pertain to the site level; rationalize management and operation decision policies; and maximize the economic benefits of natural and cultural resources in both the short- and long-term. It is important that sustainability decisions are economically feasible to users, designers/planners, managers/owners, and other decision-makers to encourage the use of sustainable practices.

6.2.2. Societal Goals

Consideration of the social well-being of a community may include establishing goals in education, training, equity, community, tradition, beliefs, culture, governance, health, justice, and the overall quality of life. Social/cultural sustainability endeavors to enhance social relationships; reduce crime; promote community pride; strengthen community identity; encourage individuals' responsibility for maintaining the quality of the environment; and involve local communities in the appreciation and preservation of their resources.

6.2.3. Environmental Goals

Ecological (environmental) sustainability goals may include natural resources conservation including air, water, energy, land, climate, and the natural characteristics of the site. These sustainability goals intend to conserve environmental integrity of wildlife habitats, promote biological diversity; encourage ecologically sensitive use of natural and cultural resources; minimize resource degradation; and ensure that development is compatible with the maintenance of essential ecological processes of the environment.

6.3. SUSTAINABLE DESIGN INDICATORS

Sustainability indicators, measures, and criteria are guidelines that determine how well a community is meeting the needs and expectations of its present and future generations. In order to make sustainable design a reality, there is a need to quantify some of its measurable components. Indicators can be used to measure progress toward building sustainable developments. An indicator is something that helps us to understand where we are; which way we are going; and how far we are from where we want to be. Indicators alert us to problems before they get too bad, and help us to recognize what needs to be done to fix the problem. Since sustainability measures cover a wide range of areas, 32 indicators related to coastal zones concerns were included in the discussion of this chapter. Sustainability indicators are given values (rates, capacities, etc.) that are used for sustainability evaluation, such as the amount of carbon dioxide as a measure of the air pollution, and job opportunity as a measure of economic health. Criteria are a set of rules, guidelines, and actions that need to be achieved for an indicator such that it meets a specific sustainability goal or objective. Appendix [H] provides examples of sustainability criteria that was developed to guide actions toward sustainable development.

Based on an extensive review of the literature and input from experts in the field, thirty-two sustainability indicators were selected as critical to coastal zone and beach resort development. For this study, the indicators were categorized into three groups. These three groups are: 1) indicators deal with the natural environment and natural resources; 2) indicators deal with cultural environment and human resources; and 3) indicators deal with built environment and the efficient use of resources.

The following section discusses the model's major indicators; an explanation of their importance; goals, required actions; guidelines for implementation; and finally the criteria for the model's sustainability implementation. There is considerable interaction among the three seemingly discrete groups. Although the following information is general, it does serve as a checklist of basic considerations to address once specific site data is obtained. These indicators can provide a guide to the extent to which a tourism development is moving toward or away from a sustainable future. Of course, the categories (topics) below do not completely cover the many indicators that could be tracked. These ongoing measures are meant only to give an overall indication of whether the development is moving in the right direction, and provide a methodological procedure for measuring significant trends. Baselines for these indicators have yet to be researched in detailed micro-level data.

Following are criteria or standards that a sustainable tourism development should strive to meet:

GROUP (I): NATURAL ENVIRONMENT (NATURAL RESOURCES)

6.3.1. ECOLOGICAL/BIOPHYSICAL INDICATORS

Biophysical indicators basically deal with natural resources conservation. The basic elements of natural resources are air, water, soil, and energy. Figure (6-1) illustrates how the natural cycle of those resources that are essential for human life form a complementary chain process. Energy is the primary exchange agent in ecological systems and land is the source for food and fiber. The biophysical objective of sustainability is to provide guidelines to better air quality, enough water source supplies within the standard quality, soil richness for food with better land management, and the efficient use of energy as well as providing alternative sources. Sustainability reveals natural processes that purify water, provide energy, supply food, enrich soil, and make efficient use of these resources within the acceptable limits of changes to the environment.

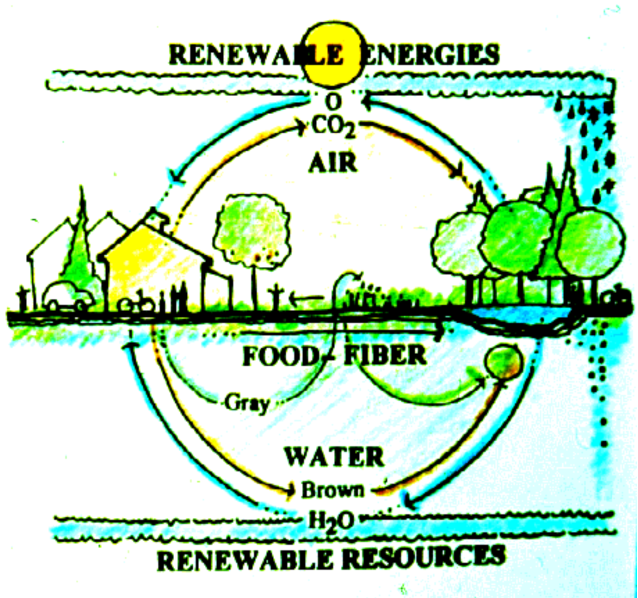

Figure (6- 1): Natural Resources and Energy Cycle

[Sources: Meadows, 1992, p.133; Duncan & Youngquist, 1999]

In the ecological term, stable ecosystems can withstand disturbances more readily thus remaining healthy and productive. This requires conducting a complete survey of wildlife and vegetation prior to construction. Plants and animals are not merely sources of food. Plants also purify the air, moderate the climate, protect and enrich the soil, provide aesthetic value, provide sources for medicine, and are beneficial in many other ways. Animals are involved in nutrient recycling, they provide materials for clothing and medical products, and enrich our lives from an aesthetic standpoint. Humans are within the animal kingdom and providing healthy human habitats could be seen as a part of promoting biodiversity of the ecosystem. Our environment is experiencing extinction of both plant and animal species. Sustaining even a fraction of the diversity known today will be very difficult. Sustainability monitoring requires conducting a complete survey of the native vegetation, wildlife, and the aquatic ecosystems prior to construction as sustainability aims to preserve the biodiversity and enhance the ecological integrity of the environment.

Indicator (1): Air Quality

Development must be evaluated in terms of their atmospheric effects on the environment such as emission of gases that cause alteration of the microclimate, depletion to the ozone layer, and increases in the global warming. Maintaining good air quality (clean air) is to maintain ecological integrity and avoid causes of human illness, plant death, and decay of built structures. Sustainability aims to control indoor and outdoor air pollution resulting from development. This may entail minimization of the use and the accessibility of automobiles; maximization of green covers and walking trails; and evaluation of the wind patterns for detrimental/beneficial effects. Such steps are needed to eliminate the presence of contaminants or pollutant substances in the air that interfere with human health or welfare, or produce other harmful environmental effects to animals, vegetation, and materials. High levels of pollution and long lengths of exposure may cause adverse health and welfare effects.

Air Quality sustainability performance is measured by: amount of $CO2$, $SO2$, SPM, and $O3$ emissions from transportation and other sources; number days/yr air pollutants exceed healthful levels; number of days/yr and days per year that air quality standards are met; emissions of greenhouse gases; and production of acid-forming emissions.

Indicator (2): Water Quality and Supply

One main sustainability goal is to ensure the extent of water resources supply quantitatively and qualitatively. Human, terrestrial, and aquatic animals and plants depend on clean water. Sustainability aims to conserve water sources and usages, thereby ensuring the supply and availability of water resources for future generations. This involves maintaining better water quality by minimizing water pollution and maximizing the creation of pure water; preserving existing natural drainage patterns and underground water; preventing water pollution with chemicals, trash, or other harmful materials; using appropriate plumping design and fixture that provide a rationale flow rates; and more.

This indicator refers to the levels of water quality expected to render a body of water suitable for its designated use. In the US, this indicator is based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes based on EPA-approved standards for water bodies. These standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses. One other goal of sustainability is to minimize water wastes and maximize gray water and surface run-off water recycling and reuse for irrigation or other beneficial purposes (Bristol 2001 Sustainability Report, 2001).

Water Quality sustainability performance is measured by: quality of water entering development / quality after development; percent streams you can drink from; percent beach area fully suitable for swimming; and water clarity index.

Indicator (3): Soil Quality

Soil texture, structure, organic content, nutrient levels, aeration, and moisture are the measures of soil quality. A main sustainability goal is to protect/enhance soil quality and to improve soil richness to maintain soil productivity thereby ensuring the availability of food and other vegetative cover for the health of the environment. This may entail encouraging the formation of new soil lands, conserving forest area, preserving agricultural land for food, and using low-productivity land for structures. Also, soil disturbances should be kept to a minimum to avoid erosion of fragile tropical soils with continuous cover over disturbed soils with erosion control netting.

Soil Quality sustainability performance is measured by: area of land affected by soil erosion and salinity; soil erosion per acre of cropland; soil quality of texture, structure, nutrient levels; and organic matter content.

Indicator (4): Energy

Energy use occurs in 4 cases: transportation (47%), industrial (29%), residential (15%), and commercial (9%). Application of renewable energy sources is limited mainly to hydro (20%) and solar (5%) energy (Meadow, 1999). The main goal of sustainable energy use is to ensure the capability and the extent of energy-producing for future generations and to shift energy usage from nonrenewable to renewable resources. Seeking this sustainable action requires a better understanding of site planning, building clustering, and design quality. Relying on the on-site energy production, energy-efficiency spaces, incorporation of plants, building orientation and massing, natural ventilation, day lighting, and other passive-strategies, can all lower a building's energy demand and increase the quality of the interior environment and comfort of the occupants. The feasibility of implementing energy-saving improvements in facilities requires collecting and reporting data on electricity and fuel usage. Sustainable design encourages a lower level of fuel consumption and the use of those kinds of fuel that are renewable and produce less air pollution such as natural gas. Sustainable design continues searching for innovative approaches to conserving energy resources.

Energy sustainability performance is measured by: cost of energy per tax dollar; energy use /capita; and fossil fuel intensity/energy demands.

Indicator (5): Biodiversity and Ecological Integrity

There is a growing recognition that biological diversity is a global asset of tremendous value to present and future generations. At the same time, the threat to species and ecosystems has never been as great as it is today. Species extinction caused by human activities continues at an alarming rate. In response, the United Nations Environment Program (UNEP) prepared an international legal instrument for the conservation and sustainable preservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising from the use of genetic resources.

Biological diversity maintains the stability of the ecosystem due to a larger gene pool and a higher degree of symbiosis between organisms. Biodiversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. Diversity can be defined as the number of different items and their relative frequencies. For biological diversity, these items are organized at many levels, ranging from complete ecosystems to the biochemical structures that are the molecular basis of heredity. Thus, the term encompasses different ecosystems, species, and genes.

Biodiversity sustainability performance is measured by: wildlife/plant diversity; number wildlife/plants species at risk; and proportion of species approaching target population capacity size.

Indicator (6): Terrestrial Wildlife Preservation

Sensitive habitat areas should always be avoided. However, in tourism development, encouraging wildlife to remain close to human activities centers enhances the visitor experience. This can be achieved by maintaining as much original habitat as possible. Allow opportunities for users to observe indigenous wildlife and avoid creating artificial habitats or feeding wildlife that have disruptive effects on the natural ecosystem. Accessibility to ecologically sensitive areas should be prohibited, limited, and controlled. Limits are set on construction activity and facility operation during construction stages where laws and regulation for protection should be followed. Terrestrial wildlife sustainability performance is measured by: level of migratory bird populations; acres of environmentally sensitive areas; acres of natural and restored wetlands; agricultural or cropland loss that have been converted to developed land; and loss of primary forests / total primary forests remaining.

Indicator (7): Aquatic Wildlife

Tourism development near aquatic areas such as beach resorts must be based on an extensive understanding of the sensitivity of coastal resources and the complexity of its ecosystem. In most cases, development should be set back from the aquatic zone and protective measures should be taken to address indirect environmental impacts. Sensitive habitats should be identified and protected from any disturbance. Harvesting of any aquatic resources should be monitored and regulated based on definitive assessments of sustainable yield.

Indicator (8): Natural Vegetation

It is important to retain as much existing native vegetation as possible to secure the integrity of a site. Natural vegetation is often an essential aspect of the visitor experience and should be preserved. Site selection should maintain large habitat areas and avoid habitat fragmentation and canopy loss. In some areas, such as the tropics, most nutrients are held in the forest canopy, not in the soil - loss of canopy therefore causes nutrient loss as well. Plants occur in natural associations (plant communities) and should remain as established naturally.

Sustainability endeavors to identify and protect sensitive native plant species; discourage the growth of exotic plants to enhance biodiversity; and protect the nutrients held in the biomass of native vegetation. Native planting should be incorporated into new development, and contribute to the visual integrity or natural fit of new development in a natural setting. Moreover, vegetation can clean air, enhance privacy, be used to create "natural rooms," and be a primary source of shade and noise control. In some cases, plants can provide opportunities for food production and other useful products such as medicine use on a sustainable basis.

Indicator (9): Surrounding Nature of the Site

Sustainability aims to integrate the built environment into the natural characteristic of the site, focusing on the preservation of indigenous surrounding natural and cultural resources. Natural elements of a site may include land form/topography; water bodies, streams and drainage ways; and geology and soil. Designing with geologic features such as rock outcrops enhances the sense of place. For example, integrating rocks into the design of a deck or boardwalk brings the visitor in direct contact with the resource and the uniqueness of a place. Also, in recreation environments where steep slopes predominate special sitting structures and costly construction practices may be required. Building on slopes considered too steep can lead to soil erosion, loss of hillside vegetation, and damage to fragile wetland and marine ecosystems. Appropriate site selection should generally locate more intensive development on gentle slopes, dispersed development on moderate slopes, and no development on steep slopes. Design and planning of beach resorts should take advantage of water bodies by orienting buildings to capture pleasant views and water breezes. Facilities should be located such as to minimize erosion, contamination, and impacts on natural hydrological systems, and to minimize fragile soil disturbances.

Indicator (10): Climate Characteristics of the Site

The characteristics of a specific climate should be considered when locating facilities so that human comfort can be maximized while protecting the facility from climatic forces such as violent storms and other extremes. Sustainability design should apply natural conditioning techniques to create appropriate comfort levels for human activities, not to isolate humans from the environment. Natural ventilation through building design avoids over-dependence on the mechanical systems that may negatively alter the climate. Such high dependency on mechanical systems signifies inappropriate design, disassociation from the environment, and no sustainable use of resources. The first step is to analyze whether the climate is comfortable for the anticipated activities, and then the designer can determine which of the primary climatic components of temperature, sun, wind, and moisture make the comfort level better and make full use of natural factors in site planning, facility design, or the operating system. The characteristics of a specific climate should be considered when locating facilities so that human comfort can be maximized while protecting the facility from climatic forces such as violent storms and other extremes. Incorporating the nature and climate factors of the site into the design will provide more comfortable environments for human activities.

Indicator (11): Natural Floods, Streams and Drainage Ways

Natural obstructions are capable of reducing the flood carrying capacity of a stream or accumulating debris, and thereby reducing the flood carrying capacity of a stream. A natural obstruction includes any rock, tree, gravel, or analogous natural matter that has been located within the floodway by a nonhuman cause. When locating a resort development within the area of special flood hazard where small streams exist, but where no base flood data has been provided or where no floodways have been identified, the following provisions may apply: (a) no encroachments, including fill material or structures shall be located within a distance of the stream bank equal to five times the width of the stream at the top of bank or twenty feet on each side from the top of bank, whichever is greater, unless certification by a registered professional engineer is provided demonstrating that such encroachments shall not result in any increase in flood levels during the occurrence of the base flood discharge; and, (b) new construction or substantial improvements of structures shall be elevated or flood-proofed.

Indicator (12): Coastal Sand Dune Conservation and Management

Sand dunes are mounds of sand that lie behind the active part of a beach and are formed over time by wind action. Sand dunes are important because they: a) protect coastal areas from storm surges, hurricanes and erosion; b) provide habitat for coastal plants and animals; and c) provide nesting sites for birds and sea turtles (ANT, 2001). Tourism facility construction or even excessive walking on barrier dunes can destroy the vegetation that anchors the dune, resulting in beach erosion (Lavery & Van Doren, 1990).

The unusual conditions that prevail within dunes (e.g. sandy substrate, low nutrient levels, and variable soil drainage/disturbance regimes) combine to produce a unique ecosystem. Dune systems are our first line of defense against storms because they act as buffers between storm waves and coastal development. They act as a buffer against wave damage during storms, protecting the land behind from saltwater intrusion. This sand barrier allows the development of more complex plant communities in areas protected from saltwater inundation, sea spray, and strong winds. The dunes also act as a reservoir of sand to replenish and maintain the beach at times of erosion.

Dunes in some areas are of importance for wildlife, but these areas may be threatened from intensive recreation and inappropriate uses, such as overgrazing, dumping, and sand extraction. These actions can destroy fragile dune flora and fauna, and potentially can lead to the loss of the system as a natural coastal defense. It is vital for future generations that these areas are managed correctly (EC ICZM, 2000).

GROUP (II): CULTURAL ENVIRONMENT (HUMAN RESOURCES)

6.3.2. SOCIAL/CULTURAL INDICATORS

The first real challenge of sustainability is the high rate of population growth associated with an increase in the demand for tourism and recreational needs. Then, how to increase accommodation density to better utilize tourists' demand growth with scarce land, and how to accept these increases in demand while preserving acceptable quality of services. However, the increasing demand for tourism in specific destinations may threaten cultural resources as well as local communities' social values, traditions, and beliefs associated with the growth of uncontrolled tourism developments. The challenge of sustainable design is to encourage social tolerance, prevent crime, and provide safety and security through design and planning.

In terms of cultural resources several questions of location, and physical conditions should be answered. Do the existing cultural resources have such significance that development cannot be warranted, or can the development be accommodated within acceptable limits? Is the cultural resource in an environmentally sensitive area where increased visitation or the preservation work itself might be detrimental?

Indicator (13): Historic and Archeological Resources

Historical sites and archeological resources are significant parts of the place and should be protected and, if possible, incorporated into designs. Educational tools can reflect the story of the site, and interpret cultural resources to include lessons about the environmental exploitations and successes of the past. Preservation and interpretation of archeological features provide insight into previous cultural responses to the environment. In fact, the reuse and revival of historic buildings whenever possible assists in their preservation and reveals the unique aspects of the development. In the historic sites/building preservation process, treatment and maintenance methods should be both environmentally and culturally sensitive. There are seven alternative decisions for the treatment of a historic resource: preservation, restoration, reconstruction, rehabilitation, revitalization, relocation, and demolition. The resulting treatment plan should protect fragile cultural resources in an environmentally sustainable manner with active community involvement, and should also reflect the best interests of the local population. Preservation must incorporate special techniques for the protection of both natural and cultural resources, and require the use of ecologically sensitive materials and construction techniques.

Indicator (14): Indigenous Cultural

Sustainability seeks balance between existing cultural patterns and new development. Cultural context may include indigenous living cultures, crafts and arts, vernacular architecture, anthropology/ethnic background/sociology; and historic and archeological resources. Existing cultural resources at the site both on land and under water (e.g., submerged cultural resources such as shipwrecks) should be identified and the expected impacts of development on these resources should be informed. Inventories of cultural resources (e.g., cultural site surveys, historical base maps) should be produced and recommendations in determining a range of possible preservation alternatives and factors that are inherent in each cultural resource should be considered. Proposed development sites should be surveyed for the significance, integrity, and qualities of those resources. Sustaining cultural resources provides opportunities that interrelate local natural and cultural worlds within the proposed development.

It is important to identify and quantify evidence of existing cultural resources at the site and to allow informed decisions about the effects of the development on these resources. Development must understand the local culture and their needs to avoid introduction of socially unacceptable or morally offensive practices. Archeological features must be preserved to provide insight to previous cultural responses to the environment, their successes as well as failures. Development can generate sufficient funding to provide for a cultural resource maintenance budget.

Indicator (15): Local Customs and Traditions

Any development should respond to and reflect the cultural heritage of the local environment. If there are cultural resources onsite or nearby, it may be desirable to include elements of the cultural past in the new design. These factors should reflect a contemporary interpretation of the cultural themes and charter defining elements without mimicry. Activities that match the lifestyles of local citizens can be provided. Historical, archeological, or cultural areas that are important to the heritage of the community, region, or nation possibly containing structures or artifacts, or associated with an important historic event should be preserved.

Management must provide opportunities to provide visitors experiences, awareness, and understanding toward local traditions by: a) using the appropriate media; b) encouraging opportunities for visitors and local residents to interact and share their values and to experience local culture and traditions in an intimate sensory fashion; and c) providing local foods, music, local art and crafts, lifestyles, performing arts, dress, and architecture, as well as a means to supplement local incomes.

Indicator (16): Local Social and Healthcare

It is important in tourism destinations, especially in the remote sites, to ensure the availability of emergency and regular healthcare for visitors and for local communities as well. Sustainable health care provides access to high-quality preventative healthcare for all.

Healthcare sustainability performance is measured by: number of hospital beds; child mortality rate; healthcare cost as percent of income; percent of population who smoke; alcohol and drug use reported by youths; life expectancy; new cases of asthma; and number of people attending organized wellness classes.

6.3.3. PSYCHOLOGICAL INDICATORS

Sustainability promotes human diversity (in age, race, gender, culture, income, and profession); promotes local identity; ensures security and safety; controls crowdedness; and reduces crime rates. People's' attitudes and beliefs are related to their local social structure, customs, and traditions and are reflected in their behavior toward the protection of their environment. Connecting people to the site and the landscape promotes personal attachment to the place that leads to an attitude of caring and land stewardship. Development should incorporate the flow of natural resources to reflect appropriate comfort levels for human activities. This can be revealed through design by placement of certain elements that reflect the local identity, choice of colors and textures, degree of enclosure, use of line that help to create a positive psychological feeling or emotional reaction.

Indicator (17): Local Community Identity

Sustainability intends to establish local identity and community spirit, also, to educate the public and foster a sense of locality through participation in the design and maintenance of sites. This can be accomplished by: a) providing informal meeting places; b) sharing sustainable development values with locals; c) giving the development a special sense of place based on the resources of the site; d) consulting with local indigenous population for design input as well as fostering their sense of ownership and acceptance; e) providing opportunities and space for demonstration of local crafts and performing arts; f) participating in activities that focus on significant natural and cultural features of the area; and g) reflecting the cultural heritage of the locality or region in the architectural style, design, and materials. A sense of locality can also be established by: a) providing activities that match the lifestyles of local community; b) encouraging residents to participate in design, development, and maintenance of site; c) incorporating local expressions of art and handiwork into new facility interior design; d) organizing cultural activities and demonstrations that allow locals to share their values and skills with visitors; e) organizing environmental education programs that include members of the local community and schools; f) providing passive, quiet areas where visitors can reflect on the natural scene; and g) assist with interpretive programming to set the stage for private moments in natural settings.

Indicator (18): Safety and Security, Crime, Law Enforcement

One main goal is to maintain a safe and secure resort for all by creating a comfortable environment in terms of places and spaces. The design of a tourism development involves a more integrated relationship of visitors with nature, although, to some extent, this concept is contrary to some conventional provisions for visitor security and safety. Visitor awareness of their natural surroundings is the best safety insurance. Written and personal briefings by staff could help foster awareness of safety risks and encourage visitors to take responsibility for their own safety and security.

To ensure security and safety through design and planning, designers/planners should: a) locate and design walks trials and lodging to discourage visitor contact with dangerous plants or animals; b) consider safety from climate extremes in the design including intense sun, high wind, heavy rainfall, and extreme humidity; c) balance ecological integrity with safety concerns in a development where adventure and challenge are integral to the experience; d) use artificial lighting to retain natural ambient light while providing a basic sense of security; e) enhance security near remote locations with controlled access to the facilities; and f) provide an alternate means of access to essential emergency provisions of water, food, and medicine, and a reliable communication system. Safety and security sustainability performance is measured by: crime rate and level of crime class.

Indicator (19): Local Customs and Beliefs

Sustainability addresses values common to members of the local community and encourages direct and open communication between visitors and local communities. This interaction needs to provide: a) access to people, public services, shopping, healthcare, and religious services places; b) work opportunities in restoration or enhancement of the environment; c) volunteer programs that allow visitors to operate site support systems; d) visitor experiences that are environmentally and culturally compatible; e) public open spaces and common spaces with features that encourage outdoor activities; f) appropriate human activities such as walking and cycling; g) access to educational materials to enhance visitor understanding and appreciation of the local environment and threats to it; and h) work/study programs that emphasize sustainable design values. Local customs and beliefs sustainability performance is measured by: visitors / residents interaction; visitor satisfaction levels; number of complaints; and noise complaints to local authorities.

Indicator (20): Local Architecture, Styles, and Form

Designers should establish an architectural theme or concept around which to develop the design using style that fits the site and the context of the larger community of the region. This architectural theme identifies the culture of the place and expresses the identity and the individuality of the local community. The concepts of past, present, and future encourage architects to renew architecture from the moment when it was abandoned; and bridge the existing gap in its development by analyzing the elements of change, applying modern techniques to modify the valid methods established by our ancestors, and then developing new solutions that satisfy modern needs (Fathy, 1986).

Experience has led people to intimate knowledge of how to live in harmony with the local environment, and to develop economic building methods using locally available materials, climatization using energy derived from the local natural environment, and an arrangement of living and working spaces in consonance with their social requirements. For example in Egypt, local architecture used the interior courtyard where the cool, clean air, the serenity and reverence of the courtyard were shed, while the modern building facing streets embraced with its heat, dust, and noise.

Indicator (21): Efficient Use of Resources

Increased efficiency in using natural resources leads to decreased waste. As human populations increase and industrial activity expands, pressures on the environment are intensifying. There is real doubt as to whether the earth has the capacity to support continuously escalating levels of resource extraction and disposal. Resource consumption continues to rise and pollution and ecosystem degradation continue to increase. Resource consumption and waste generation are rising broadly in line with economic growth. In thinking about more rational ways of meeting demands for key natural resources in the future, it is necessary to think about the entire use cycle, from production to final consumption and disposal. Material flow analyses track the physical flows of natural resources through extraction, production, fabrication, use and recycling, and final disposal, accounting for losses along the way. The sustainability goal of resource flow and consumption is to develop new thinking, new metrics, and new management tools, which will help bring about a transition to more efficient and less environmentally-harmful patterns of material use (World Resources Institute, 2000).

GROUP (III): BUILT ENVIRONMENT

6.3.4. PHYSICAL INDICATORS

Sustainability must be evident in all aspects of the operation including utilities, waste management, maintenance, retail operations, and visitor services. Sustainable design measures activities causing pollution such as vehicle travel and the use and generation of toxic materials (both in production and by users). Sustainable design uses resources at a sustainable rate in terms of the total energy used from all sources and the ratio of renewable energy used at renewable rate compared to nonrenewable energy. Facilities should complement both the natural and cultural environment. Shops, grocery, convenience store, restaurants, coffee shops, snack bars, drugstore, gift shops, food service, merchandising, and other services should directly contribute to an increased understanding of and appreciation for environmental and cultural awareness, as well as sustainable design.

Indicator (22): Waste Management

Sustainability encourages minimization of wastes[1]; recycling wastes for reuse; and utilizing on-site biological waste treatment when possible. This strategy reduces human and ecological exposure to toxic materials released during waste management, and assesses and remediate contamination that has occurred due to improper waste management (EPA, 2001).

Americans generates between 3 and 4 pounds of solid waste per day (Miller, 1996). This means a total amount of almost one billion pound of solid wastes needs to be managed daily.

A sustainable approach focuses on conservative and cyclical use of materials and measures the percent of products produced which are durable, repairable, or readily recyclable. An evaluation of the full life cycle of products and processes is needed to approach the state of natural systems in which there is no waste. Waste management systems must be developed within the capabilities of operators and at acceptable environmental costs. The only way to avoid environmental harm from waste is to prevent its generation.

The Agenda 21 emphasizes four types of waste management: 1) limiting waste and inefficiency during construction by recycling demolition and construction waste, reusing on-site materials and monitoring of material use and packaging; 2) accommodating recycling into building design reduces waste while generating revenues form the sale of reused and recycled materials; 3) effective building commissioning is essential to ensure proper and efficient functioning of systems; and 4) facilities operations benefit from the monitoring of indoor air quality and energy and water saving practices, waste reduction and environmentally sensitive maintenance and procurement policies.

Waste management sustainability performance is measured by: lbs of garbage per capita/day; solid waste weight / volume; and tons of wasteland filled annually.

Indicator (23): Reuse and Recycling Building Materials

Waste and inefficiency can be limited during construction by recycling demolition and construction waste, reuse of on-site materials and monitoring of material use and packaging.

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1 solid waste, sewage effluent, exhaust emissions

Accommodating recycling into building design reduces waste while generating revenues. Waste is minimized by recovering and reprocessing usable products that might otherwise become waste (i.e. recycling of aluminum cans, paper, and bottles, etc.). The conversion of solid waste into useful products; e.g., composting organic wastes to make soil conditioners or separating aluminum and other metals for recycling, can make a significant positive impact on the environment.

Reuse and recycling practices that are sustainable include: a) Collecting gray water for secondary purposes; b) Purifying wastewater or rainwater for irrigation or drinking; c) Capturing rainfall for a variety of uses (e.g., drinking, bathing); d) Recycling waste energy; d) Harvesting resources only at the rate of regeneration; e) Recycling demolition and construction waste; f) Separating composting materials from other trash for soil enhancement; g) Composting anaerobic ally digests biodegradable wastes; h) Reusing materials onsite or collect suitable materials for offsite recycling; and i) Recycling solid waste versus dumping solid waste. It is important that visitors are aware of recycling opportunities and environmental benefits.

Reuse and recycling sustainability performance is measured by: ratio of renewable to non-renewable energy consumption; quantity of food and agricultural residuals recycled; recycling rate as a percentage of material generated; and percentage of residents, businesses, institutions that participate in recycling programs.

Indicator (24): Traffic and Transportation

Sustainable design maintains the continuity and the quality of traffic and transportation systems, as well as minimizes their impacts on the environment. This may mean discouraging automobile use and maximizing walking and cycling by providing bike trails and pedestrian paths. This reduces energy use, avoids air pollution, and minimizes the overall impact to the environment. Planning also should provide easy access to public mass transportation (train, bus, shuttles) and provide recreational facilities, shopping, and services within human walking distance with footpaths and bike trails for convenient access to accommodation units and natural areas of a tourism destination.

Sustainability can be achieved by: a) Minimizing the parking lots and restricting the number of cars per unit or per person; b) designating energy-efficient transportation systems that restrict transportation to the zero emission level; c) Practicing good vehicle maintenance; d) Favoring the use of low-energy and non-polluting transportation; e) Encouraging the use of transportation that runs on clean and renewable energy sources such as solar power, wind, or geothermal sources. Mobility, accessibility, and sustainability are the three concepts that optimize transportation use. In some cases, traffic and transportation issues affect development decisions from the start as potential investors use traffic as a guide for their investment decisions. For example, if car parks/public transportation is perceived as too expensive, then visitors, the main client of the tourism industry, may stay away in preference to cheaper or more accessible tourism centers. Traffic and transportation sustainability performance is measured by: auto registration; and parking-spot inventory.

Indicator (25): Pollution Control

Pollution refers to the presence of a substance in the environment that because of its chemical composition or quantity prevents the functioning of natural processes and produces undesirable environmental and health effects. Sustainability aims to prevent/minimize air, water, and noise pollution in important wildlife habitats vital to maintaining environmental quality and ecological integrity. A sustainable approach focuses on measuring activities causing pollution both in production and by users (Hart, 1998). It is critical to identify areas, processes, and activities that create excessive waste products or pollutants in order to reduce or prevent them through, alteration, or eliminating a process.

Pollution prevention means changing the way activities are conducted and eliminating the source of the problem. It does not mean doing without, but doing differently**. Water pollution** control involves the protection of water sources from contamination and minimizing direct pollution to watersheds. Air pollution control requires the minimization of off-site and on-site air pollution; knowing long-term implications of using any treated materials or chemical treatments; avoiding use of materials containing harmful chemicals; minimizing toxic waste, and clean-up toxic waste sites. Waste pollution control requires a) minimizing industrial disposals and wastes; b) minimizing the effects/causes of car, coal, nuclear power, exploitation of forestry, destruction of habitat, global warming; c) avoiding the use of material that causes thermal pollution; d) taking waste motor oil to a recycle center; and e) controlling mold and mildew on carpets, drapes. Noise pollution control requires designers to create silence and limit noise levels through design by locating accommodation units away from major arterial and noisy activities off site and from commercial activities on site.

Pest pollution control requires designers to: a) minimize intrusion by noxious insects, reptiles, and rodents; b) develop a non-chemical means of pest control management; c) prohibit exotic bird species that are introduced by man and cause extensive damage, diseases, and destruction of native birds; d) prohibit exotic mammals' impacts where they have become destructive to native wildlife; e) store food properly and keep all areas of a facility clean; f) protect humans from disease organisms and protect humans from exotic insects; and g) protect humans from interaction with pests. Control can be accomplished by: proper sanitation; providing separate active recreational areas and residential units; using well-fitting and insulated windows and doors; and using window screens and nets to keep out mosquitoes.

Dust pollution control requires design that avoids the use of untreated dirt roads, and regulations limiting dust from businesses on site and using vegetation to absorb dust. Foul odors pollution control requires designers to: locate farm areas away from accommodation units to prevent foul odors; avoid placing residences' units downwind of foul odors from off site; locate agricultural areas away from residences' units to minimize odors that may be generated from natural fertilizers and compost; encourage regulations limiting odors from businesses on site; ensure that water bodies are designed properly so they do not generate foul odors; and use vegetation to absorb odors.

Indicator (26): Toxic Products and Toxic Wastes

It is critical that no hazardous or destructive wastes be released into the environment. Sustainability practices try to: substitute nontoxic materials for toxic materials; avoid use of toxic materials; use minimum amounts of nontoxic materials to accomplish a task; provide onsite controls and disposal systems; and segregate toxic waste and ship wastes to offsite facilities for disposal (landfill or incinerator). Toxic Wastes sustainability performance is measured by: equitable distribution of the hazardous material/waste exposure throughout the city; number of contaminated sites within city borders; and public awareness of hazardous materials/waste issues.

6.3.5. ECONOMIC INDICATORS

Any development in a sensitive area has a significant effect on the local community and will probably affect the economy. Sustainability attempts to positively affect the cost and benefits to ensure the economic viability and profitability of the development in the long-term. The main measures of the economic strength of a local community are their income, opportunity for employment, and their ability to spend. Sustainable measures of the income are determined by the number of hours of paid employment at the average wage required to support basic needs. These basic needs are defined in terms of sustainable consumption. Sustainable employment may involve the resilience of the job market, and the ability to be flexible in times of economic change. This requires: a) diversity and vitality of the local job base; b) number and variability in the size of companies; c) number and variability of industry types; and d) variability of skill levels required for jobs. Spending measures the health of the local economy, as does wages paid in the local economy that are spent in the local economy to pay for local labor and local natural and renewable resources.

Indicator (27): Self-Reliance on Local Resources

Sustainability encourages the use of technologies that function in self-sustaining ways. It is essential to meet human needs locally and maximize land productivity. Self-sufficiency can be achieved by using sustainable practices such as: a) providing ponds in which to raise fish within the development; b) raising fish in wastewater-treatment areas; c) providing local areas for farming and food production; d) regenerating degraded farm areas where possible; e) provide appropriate natural habitats; f) provide access to food, water, shelter, and fuel at reasonable costs; g) choosing crops based on regional market, climate, and characteristics of the site; h) planting fruit and nut trees and fruit-bearing shrubs; and i) providing areas for tree-farming or timber production. Self-Reliance sustainability performance is measured by: number of public agricultural gardens; and vocational and community education and training programs about sustainable agriculture and nutrition.

Indicator (28): Consumption Lifestyle

The UN summit of 1992 emphasized two main goals; the efficient use of resources and minimizing wastes. This requires the minimization of economic activities that feed the belief of endless growth and endless resources, as well as a change in over-consumptive lifestyles. To make such a change, people should be provided with basic knowledge, information, and awareness on the current environmental concerns and sustainability principles needs. This could be achieved through encouraging people to: a) minimize consumption of manufactured goods; b) minimize economic activities that promote the belief of endless growth and endless resources; c) learn about the resource and appropriate built responses to that environment; d) encourage organizations to adopt sustainable development goals; e) interpret how development works within natural systems to effect resource protection and human comfort and foster less consumptive lifestyles; and require some profit be put aside for investment in a renewable substitute resource. Consumption Lifestyle sustainability performance is measured by: per capita water consumption.

Indicator (29): Development Integration (agriculture, housing stock)

Agriculture: Sustainability encourages developing a local agriculture and food supply with appropriate harvesting and food storage techniques. Locals may need to adopt acceptable levels of technology and tools that encourage the use of mixed cropping, companion planting, pest-resistant crop varieties, natural pesticides, and organic, labor-intensive methods.

Retail and Housing Stock: Retail data can provide an idea of local economic activity and encourage local potential investors by showing which part of a destination is failing, prospering, or needing help to maintain sustainability. It shows how healthy a destination’s economy is by showing trends and identifying which areas are thriving or in decline and how a diverse range of shops and facilities will attract more customers/investors. The number of leisure attractions such as theatres, cinemas, and museums could be of interest to leisure investors and retailers who rely on tourists for trade. Potential investors and retailers may find it useful to know the number of hotels/guest houses in an area when planning new leisure facilities. The number of pubs, bars, and restaurants can help show the strength of the evening economy. This also could be of interest to public transport managers, potential investors, and customers (CASA).

Indicator (30): Workforce and Employment, Combating Poverty

The economic goals of sustainability practices related to employment are to: increase the local community income; create job opportunities; use local skilled artisans to reflect and enhance local cultural values; ensure a dependable skilled work force and staff; and keep a consistent local labor pool. Using local workers helps ensure benefits to the local economy and creates goodwill. It is also important to designate jobs for unskilled labors (e.g., grounds maintenance, agricultural labor). Workforce sustainability performance is measured by: number of residents in job training programs; personal wages and salaries (income per capita); job opportunities available; national revenue from tourism; expenses/income ratio; cost of living index; unemployment rates; distribution of income and wealth; and number of business establishments.

6.3.6. GROUP 6: MANAGERIAL INDICATORS

Effective building management is essential to ensure proper and efficient functioning of systems. Facilities operations benefit from the monitoring of indoor air quality and energy and water saving practices, waste reduction and environmentally sensitive maintenance and procurement policies. Plans, guides, and supports to visitor services can enhance the efforts to become sustainable. Employee training can emphasize maintaining quality visitor experiences without the depletion of resources while promoting environmental and cultural resource awareness and education.

Indicator (31): Public Participation

Hart (1998) and McHarry (1994) emphasized the importance of the publics' ability to participate in decision-making. One sustainability challenge is to improve public knowledge, awareness, and understanding of the significance of their local resources, values, and identity, as well as the meaning of sustainability (why we need to live sustainably and how to do so). Sharing knowledge links long-term sustainable considerations and the integral relationship between natural processes and human activity. Learning opportunities include an interpretation of the systems that sustain the development as well as programs about natural and cultural resource values through participating in up-dated environmental education programs. Involving the local population in the appreciation and preservation of their resources encourages volunteers to work for the community.

Public Participation sustainability performance is measured by: frequency of sustainable development in educational curricula; sustainable development literacy of the public; number of environmental education programs for community; visibility of local issues; campaign contributions from small contributors; and community representation on health boards.

Indicator (32): Beach Services Quality and Organization

It is important to maintain a quality beach area as this is the base for tourism. Basic services and facilities that are needed to operate a beach include: beach driving maps; beach driving and parking; beach environment quality; beach information for the disabled; beach rules; beach water quality; daily beach report; lifeguard corps; personal watercraft zones; skin care tips; and sponsorship opportunities. Also, it is essential to provide safety and security programs that are problem-oriented and policing that deals with issues such as bike or auto theft prevention; crime prevention; citizens' observer patrol; protecting kids; prostitution prevention; graffiti problems; criminal suspects; sex offenders; citizens criminal justice; and more. Beach Quality sustainability performance is measured by: beach area size and quality; and shoreline length.
Indicator (33): Maintenance

Sustainable property must be in a maintainable condition that is useful to occupants. Maintenance includes buildings, beaches, facilities and services such as vehicles, as well as cultural resources within the site. A good preventive maintenance plan will ensure that cultural resources are protected for generations to come. A preventive maintenance program requires a maintenance staff with the proper skills, knowledge, equipment, and materials.

Sustainability provides guidelines that define acceptable maintenance and operational practices. Sustainable maintenance practices include; a) Using a cyclic maintenance plan that includes foreseeable replacement of resources due to service life and to ensure resource longevity; b) minimizing environmental impacts on the site by supporting a non-disruptive functional operation of the development; c) integrating maintenance and operational staff into the life of the resort as a necessary element to sustain its operation; and d) ensuring scheduled maintenance with proper and timely treatment and documentation of all work done. For the original design to retain its high quality, facility maintenance must have the highest quality standards. The true test of a successful maintenance program is through the perceptions and reactions of the users.

Indicator (34) Facilities, Services, and Activities

Services, facilities, and activities provided at a tourism destination should be based on visitors' desires and needs and on the availability of local resources. Management should provide examples that show their concern for the quality of the environment such as: establishing no-smoking sections; planting some attractive local species of plants and trees on property to maintain local biodiversity; using vehicles maintenance guidelines; using gas rather than electric clothes dryer; encouraging the use of clean transit such as bikes rather than cars within the site; establishing a scheduled system of quality inspections and service[14]. Sustainability values should be apparent to visitors in all their daily activities. Resort management should communicate sustainable development values by encouraging visitor experiences based on intimate and sensory involvement with actual natural and cultural resources. Also, this should be clear in energy use; food handling; waste handling; maintenance activities, retail operations, and visitor services (CASA). Facilities & Services sustainability performance is measured by: level of guest activity participation; common guest activities; acreage of land used for parks and playgrounds; services area % (services and facilities/total site area); and traffic road infrastructure.

This study aims to provide a better understanding of the role of carrying capacity control as a tool for measuring sustainability implementation and environmentally sound beach resorts design and planning. Coastal zones in Egypt and worldwide have reached a crucial stage of intensive traditional tourism development that demonstrates the need to escape from the model of massive, ill-planned tourism development. This requires a careful formulation of a design and planning framework with more detailed polices and regulations oriented toward sustainable coastal resort development patterns and implementation measures. The proposed study suggests

[14] The "Eco-Environment Star" system proposed by the researcher that measures not only how facilities and services the resort has rather how the quality of these facility and services is responding to the environmental requirements and sustainability trends.

certain implications and measures for sustainable design and planning. Urgent application of such measures is required, based on carrying capacity thresholds and sustainability indicators monitoring. There is a need for a more holistic and systematic approach to identify the critical factors and to assess the potential impacts. Sustainable carrying capacity must be considered within the context of social, economic, physical, ecological, and managerial aspects of the environment. This promises valuable guidelines or a framework that can be used to measure how future development in coastal zones can be formed and controlled to meet sustainability requirements. The study's framework is divided into two main components: carrying capacity modeling and sustainable indicators monitoring. It also examines what indicators are to be included; why sustainability is important; how to implement sustainable practices; when sustainability is a consideration (i.e., at which development phase); and where its impacts will be noticed. This research will provide a benchmark for a new approach to beach resort design and planning principles.

6.4. SUSTAINABLE DESIGN MODELING

It is clear from the literature that sustainable design is a multi-dimensional concept. In order to develop a model or framework it must include components that present these different dimensions. Thus, the proposed SDM begins with the initiation of six steps, envisioned as a six-dimensional matrix, to answer the critical questions presented below:

1- Why is sustainability important (goals and objectives)?

2- What indicators should be considered (relevant to specific site)?

3- How can it be achieved (criteria and measures for implementation)?

4- Who may be responsible (stakeholders)?

5- When should this be considered (development phases)?

6- Where will its influences extend (distance of impact) as related to sustainability?

Each of these steps is described below with examples for implementation [see Figure

(6-2)].

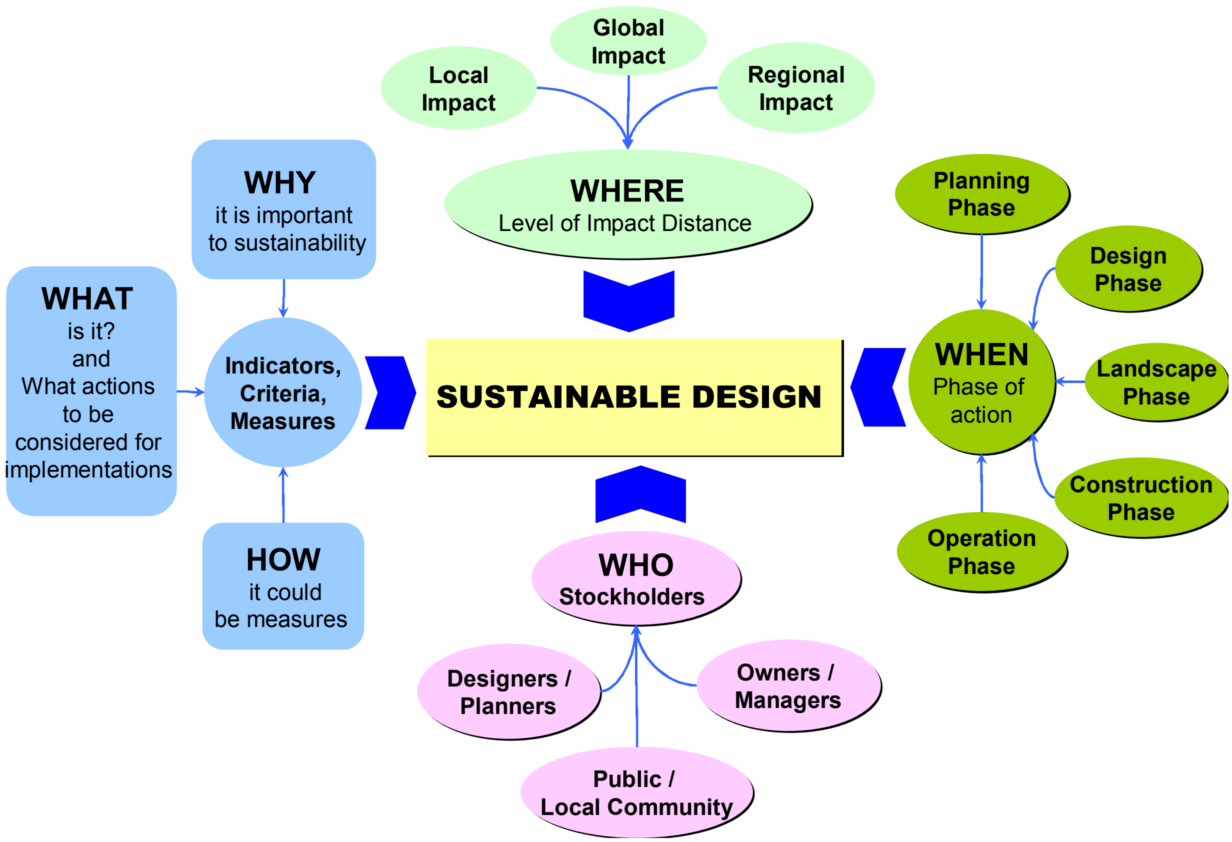


Figure (6- 2): Sustainable Design Model: Questioning

STEP (1): The WHAT answers the question of what it means to be sustainable. This step describes the main sustainability goal(s) and objective(s), and determines the problematic issues of sustainability that pertain to a specific setting. Identifying the causes and the anticipated effects/impacts resulting from an action should be done to minimize the negative and emphasize the positive contributions to sustainability implementation in the economical, societal, and environmental areas. For example, maintaining air quality (clean air) is essential to avoid human illness, plant death, and decay of built structures.

STEP (2): The WHY discusses the problematic issues of sustainability that pertain to specific settings, determining relevant indicators that need to be achieved for sustainability implementation to occur. In this study, relevant indicators are grouped into 34 themes under six categories: physical, ecological, social, psychological, economical, and managerial, associated with guidelines which define the actions to be taken for implementation of each category [see Table 6-2]. In determining specific indicators that are relevant to specific coastal zone/destination, there is a need to: a) conduct a definable local sustainability assessment; and b) gather baseline information on such subjects as key environmental, economic, and social issues in the coastal environment pertaining to the zone under evaluation. This information provides a baseline for measuring progress later, and can help to identify the key goals and priorities of sustainability.

STEP (3): The HOW provides "sustainability implementation guidelines," the ways in which sustainability can be achieved, and how it can be measured. This step identifies action(s) needed to achieve the sustainability goal.

STEP (4): The WHO determines the individuals and/or groups (stakeholders) responsible for sustainability action, or who should be involved in achieving these objectives, actions, or behaviors for correction toward sustainability. By articulating specific measures, different partners will be able to identify areas where sustainability criteria are necessary to turn the broad concept of sustainable development into an action agenda for specific individuals: designers/planners, managers/owners, visitors/public, and others. The tourism development process for beach resorts involves many groups with different objectives and experiences. For example, designers and planners play an important role in having sustainable and successful beach resort projects by carefully controlling the assignment of acceptable development carrying capacity thresholds.

STEP (5): The WHEN determines the time frame for achieving sustainability. It identifies when actions should be considered (what stage or phase of development). This step deals mainly with the development phase, when these actions should take place, and determining the development stage or phase in which these sustainability steps or actions should be considered or implemented. The development of a beach resort passes through five main stages including the "Planning Stage" (PS), "Design Stage" (DS), "Construction Stage" (CS), "Landscape Stage" (LS), and "Operational Stage" (OS). These divisions help to determine sustainability steps that should be implemented in each stage.

Different groups are involved in the development process in different stages. Host communities may be involved in all of the development phases, evolution to maturity, in different ways and with different levels of involvement. Visitors may be involved in the operation stage only. Developers may be involved in decision-making at the early stages as well as the operation stages, but managers may be involved in the operation process only. Designers and planners are involved in the decision-making process at most of the development phases. In fact, planners and designers' decisions have a vital input on the final image of the project and its overall quality.

STEP (6): The WHERE determines the extent of the impact (impact distance) which focuses mainly on determining the level of impact that results from design, planning, construction, and operation decisions. There are three levels of impact: a) the Global Level (GL) - the action has a broad distance effect that extends to a global consequences; b) the Regional Level (RL) - the criteria of impacts go beyond the limit of the site to affect the surrounding region; and c) the Local Level (LL) - the impact is limited to the project and the local area or the site. Table (6-1) presents the answer to each question that corresponds to each sustainability indicator.

Table (6- 1): Sustainable Design Modeling

WHAT & WHY	HOW	WHO	WHEN	WHERE
Indicator, Criteria, and Objectives	**Measures**	**D/M/V**	**P/D/L/C/M**	**L/R/G**
Air Quality		D	P	G
Water Quality and Supply		D/M		L/R
Soil Quality & Land Management		D		L
Energy Conservation		D/M		L/R
Biodiversity				L/R/G
Terrestrial Wildlife				
Aquatic Wildlife				
Natural Vegetation				
Natural Characteristics of the Site				
Atmospheric and Climate Characteristics				
Streams / Drainage ways				

Sand Dunes				
Historic Sites Preservation				
Cultural Resources Preservation				
Local Customs and Traditions				
Local Social, healthcare, education, crime				
Local Environment Identity				
Safety and Security				
Local Custom and Beliefs				
Local Architecture, Styles, and Forms				
Efficient Use of Resources				
Waste Management (e.g., sewage, garbage)				
Reuse and Recycling Practices				
Traffic and Transportation				
Pollution Control (noise, dust, foul odors)				
Use of Non-Toxic Materials/ Product				
Self-reliance on Site Resources				
Productivity and Over-consumption Lifestyle				
Development Integration				
Local Economy and Employment				
Public Participation and Decision Making				
Beach Quality and Organization				
Maintenance Quality Programs				
Services, Facilities, and Activities				

* Stakeholders (responsible parties): D=Designers, M=Managers, V=Visitors.

Phases of action: P=Planning, D=Design, L=Landscaping, C=Construction, M= Management

Areas of impact: L=Local, R=Regional, G=Global [this determining table is to be filled based on individual site or project]

During each development stage, decisions are made reflecting, first, the developer's objectives (short-term or long-term) and second, the degree of cooperation between different groups involved in the development process. This research focuses mainly on the role of designers and planners' decisions for achieving sustainability. Although design and planning decisions of capacity are made during the early stages of the development process, their effects extend beyond the completion of project construction and operation for some time and greatly affect the project of the outcomes. The proposed research study argues that design and planning decisions about the resort size and capacity are critical in determining the degree of sustainability of these developments. In addition to the quantitative values of capacities, there are other design and planning issues that form the qualitative values of the product design and planning measures toward sustainability.

Figure (6-3) provides a visual representation of these indicators that are classified into natural, cultural, and built environments. These indicators are placed in six corresponding groups to better determine the biophysical/ecological, societal/cultural, psychological, physical, economic, and managerial/operational criteria for sustainable development [see Table 6-2].

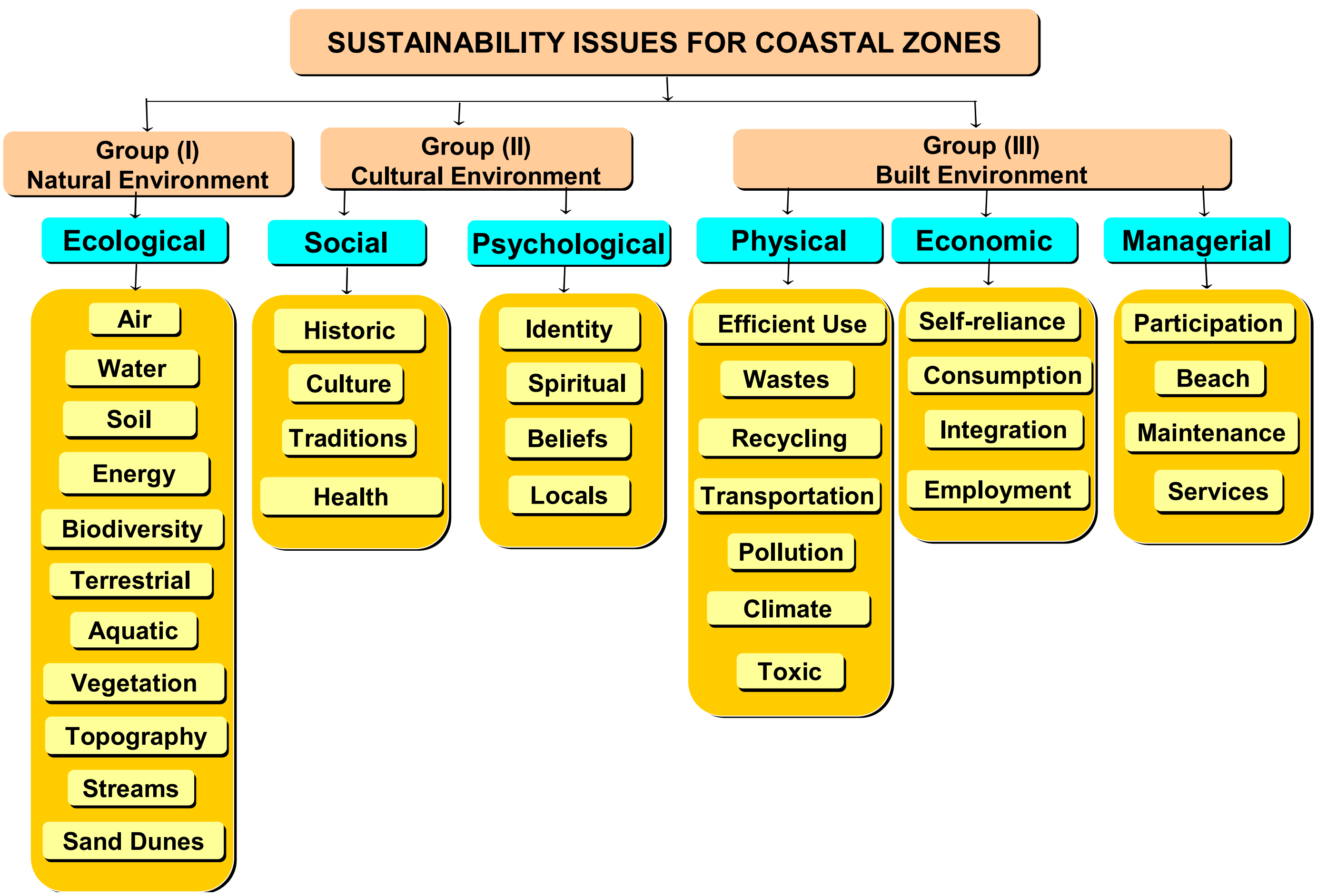


Figure (6- 3): Indicator Categorization

Table (6-2): Sustainability Indicator Categories

GROUP (I): NATURAL RESOURCES (NATURAL ENVIRONMENT):		
	1. ECOLOGICAL/BIOPHYSICAL INDICATORS	
	Indicator (1)	Air Quality
	Indicator (2)	Water Quality and Supply
	Indicator (3)	Soil Quality & Land Management
	Indicator (4)	Energy Conservation (use of passive energy technology)
	Indicator (5)	Biodiversity and Ecological Integrity
	Indicator (6)	Terrestrial Wildlife
	Indicator (7)	Aquatic Wildlife
	Indicator (8)	Natural Vegetation
	Indicator (9)	Natural Characteristics of the Site (Topography/Land Form)
	Indicator (10)	Atmospheric and Climate Characteristics of the Site
	Indicator (11)	Streams / Drainage ways
	Indicator (12)	Sand Dunes
GROUP (II): HUMAN RESOURCES (SOCIETAL ENVIRONMENT)		
	2. SOCIAL / CULTURAL INDICATORS	
	Indicator (13)	Historic Sites Preservation
	Indicator (14)	Cultural Resources Preservation
	Indicator (15)	Local Customs and Traditions
	Indicator (16)	Local Social (healthcare, education, crime, persecution, laws)
	3. PSYCHOLOGICAL INDICATORS	
	Indicator (17)	Local Environment Identity (indigenous products, materials, and crafts)
	Indicator (18)	Safety and Security (crowdedness, spiritual harmony)
	Indicator (19)	Local Custom and Beliefs
	Indicator (20)	Local Architecture, Styles, and Forms
Group (III): BUILT ENVIRONMENT		
	4. PHYSICAL ENVIRONMENT INDICATORS	
	Indicator (21)	Efficient Use of Resources
	Indicator (22)	Waste Management (e.g., sewage, garbage)
	Indicator (23)	Reuse and Recycling Practices
	Indicator (24)	Traffic and Transportation
	Indicator (25)	Pollution Control (noise, dust, foul odors, and pests)
	Indicator (26)	Use of Non-Toxic Materials/ Product and Disposal of Toxic Wastes
	5. ECONOMIC INDICATORS	
	Indicator (27)	Self-reliance on Site Resources (meeting needs locally)
	Indicator (28)	Productivity and Over-consumption Lifestyle
	Indicator (29)	Development Integration (agriculture, industry, housing stock)
	Indicator (30)	Local Economy, Employment, and Workforce, and Combating Poverty
	6. MANAGERIAL AND OPERATIONAL INDICATORS	
	Indicator (31)	Public Participation and Decision Making Involvement
	Indicator (32)	Beach Quality and Organization
	Indicator (33)	Maintenance Quality Programs
	Indicator (34)	Services, Facilities, and Activities

SUSTAINABLE DESIGN MODEL: IMPLEMENTATION PHASES

This section discusses development phases of the built environment starting from initiating the idea, planning, design, construction, landscape, and ending with operation and management of the project. Phasing development refers to partial development of a project in which the site is divided into sections and based on priorities. For example, construction, finishing, and operating may be initiated in one section followed by others at later stages. Phasing the development provides the opportunity to allow for monitoring of resource impacts and adjustments in subsequent phases.

PHYSICAL DEVELOPMENT

Built environment must include a professional understanding of the natural and cultural resources involved in development and clearly express the harmony with nature. Site plan, design, and construction must consider the key elements of the natural and cultural environments that provide a special sense of place and feature architectural materials that are native to the site or region and that are renewable and environmentally sensitive. Opportunities for sensing, experiencing, and understanding resources are provided. Education about the natural and cultural environments and the support systems that sustain the development while bringing visitors and resources together whenever possible is critical at this stage.

6.4.1. Planning Phase

Sustainable planning should meet the human needs of housing, water, sanitation, and safety. Environmentally sensitive planning looks beyond the boundaries of combining and comparing site inventories to the idea of sustainable development as a process for the future that evaluates linkages to transportation and infrastructure, ecosystems and wildlife habitat, and community identification. Site planning evaluates solar and wind orientation, local micro-climate, drainage patterns, utilities and existing site features to develop optimal building location and appropriate low maintenance landscaping. No site can be understood and evaluated without looking outward to the site context.

Recognition of site context is the first step before planning and designing a project. Fundamental questions must be asked in light of its impact on the larger community. Such exemplary questions are: Can development impacts on a site be minimized? What inputs of energy, material, labor, and products are necessary to support a development? Are required inputs available? Can waste outputs of solid waste, sewage, and exhaust emissions be dealt with at acceptable environmental costs?

Planning Strategy

The initial step of site planning is appropriate site selection based on proximity to supplies, resources, and attractions and distance from areas of natural hazards. Inventory of a project site may recognize the existence of significance facilities or buildings within the site that could be utilized in the proposed development. This decision requires an analysis to determine whether to renovate or build new, sell existing facilities or lease, consolidate, or decentralize. This decision is critical to ensuring long-term viability, resource conservation, and life-cycle cost benefits.

Sustainability provides specific actions for minimizing loss and damage to nonrenewable cultural and natural resources in the event of a disaster. Most disasters can be attributed to wind, natural forces. (e.g. hurricane, earthquake, flood), damage from domestic water and sewer systems, fires, war, vandalism, and theft. Some actions that are sustainable and minimize the cost of disasters are: a) designing facilities in such way to withstand natural forces (sufficient mass and detail) or to yield to them (light and of renewable materials); b) preparing plans of fire and security systems to protect structures from fire, domestic water damage, and theft; c) safe display and storage of artifacts; d) reinforcing structure enough to withstand winds, earthquakes, and floods; and e) making necessary equipment, supplies, and human resources (rescuers or repair crews) being available through an incident command system.

6.4.2. Building Design Phase

This phase involves setting priorities and a new design philosophy for proposed built-environment developments. The basic idea of sustainable design is the optimization rather than the maximization of resources to meet physical as well as psychological human needs.

Optimization does not mean getting more with less rather optimizing building design in such a way as to meet goals within the stated budget for materials, labor, and energy. Optimization also means to provide flexible spaces enough to accommodate many human purposes and serving different needs within the project. For example, placing functional windows in all rooms to catch breezes in the summer and warmth in the winter, or using technologies that function primarily in self-sustaining ways. It is essential to construct space-efficient buildings designed for energy saving indigenous responsiveness to, and in harmony with, local environmental factors. Sustainable design strives for minimal environmental disruption, resource consumption, and material waste; and identifying opportunities for reuse/recycling of construction debris.

6.4.3. Construction Phase

Construction work may cause ground disturbance. This could affect the natural environment and any possible cultural resources. Sustainable planning and design that precedes the construction phase should ensure the protection of any cultural resources and should avoid damage to natural and culture resources at the site. During construction unknown cultural resources may be discovered, such resources tend to be archaeological and are uncovered during construction. Both natural and cultural resources must be protected from damage during construction. This may involve fences or barricades, covers, or other special measures. It may require the use of less efficient construction methods, such as hand tools or light equipment. Even minor impacts can be permanent. In general, sustainability manage to include local construction techniques and materials that are environmentally sound.

In 2000, experts on eco-tourism held a conference in Cairo to promote the construction of environmentally-friendly hotels in Egypt. This conference took place at a time of growing concern about the impact of Egypt's tourism industry on the environment. Massive development had occurred the previous ten years along the Red Sea coast, with damage to coral reefs caused by hotel construction as well as divers. Egypt's ambitious tourism plans that intend to quadruple visitor numbers to sixteen million annually in the next two decades must be implemented carefully (BBC News Online, 2000).

Construction Techniques

Applying construction techniques that protect natural and culture resources from disturbance or damage during construction may require the use of less efficient construction methods, such as hand tools or light equipment, and the use of fences or barricades, covers, or other special protections. Use of suitable and ecologically sensitive construction techniques avoid damage to resources. It is important to include local construction techniques, materials, and craftsmen in the original construction.

Sustainability encourages the use of local workers to benefit the local economy and create goodwill among locals toward development. In making environmental or culturally-sensitive repairs the most skilled labor should be used. The use of local workers in the preservation of cultural resources enhances the local population's appreciation of the value of their resources, contributes to the conservation of local folkways, and trains future artists in traditional craft methods. It will also contributes to a pride of heritage and visitor education. New construction should be seen as an extension of the present built fabric. Building materials need to be considered for their broadest effects within local and global context. Establish acceptable limits of change during and after construction. Allow time between construction projects to monitor environmental impacts and adjust the baseline model.

Building Materials

Sustainability encourages the use of ecologically-sensitive natural materials that are less energy-intensive and polluting with their transportation, and can help sustain the local economy. Use indigenous and local suppliers of materials (e.g., stones, gravel, sand, or cinders, or rocks from local quarries; wood from local forests; and adobe bricks or rammed earth from local soils). Environmentally preferable building materials are durable, renewable, with low maintenance cost, and have potential reuse or recycling opportunities. Within the parameters of performance, cost, aesthetics and availability, careful selection and specification can limit impacts on the environment and occupant health. Materials should be considered in light of their sustainability; their process of extraction, manufacture, transformation, degradation, their embodied energy. In selecting building materials, it is helpful to prioritize them by local availability, origin, avoiding materials from nonrenewable sources, and use quality building materials compatible with the site, environmentally sensitive, and easily maintained with low costs. Consider insulation and fireproof materials that provide a greater safety value. Avoid construction materials that involve toxins or contain harmful or hazardous chemicals. This requires that designers keep alert for new environmentally sound materials from recycled goods currently on the market

Construction materials should also be evaluated according to the following key issues; life expectancy, degree of required labor training, specialized equipment needed, level of health hazard, renewable or nonrenewable resources, maintenance costs, disposal problems, and more. Environmentally sound and preferable building materials should be durable, aesthetic, available require low maintenance, within reasonable cost, and perform within acceptable parameters.

6.4.4. Landscape Phase

Views also are critical and reinforce visitors' experiences. Site location should maximize views of natural features and minimize views of visitor and support facilities. Examples of the aesthetic features that are connected to human senses are: 1) sound: design so that natural, not human, sounds dominate; 2) touch: allow visitors to be in touch with the natural and cultural resources of the site; 3) smell: direct breezy air to area where people stay and exhausted from utility areas away from public areas; 4) taste: provide opportunities to sample local produce and cuisine. A variety of regional-scale planning issues must be considered when designing at the site scale. For instance, connecting circulation routes, infrastructure, and open spaces to surrounding areas; coordinating with the existing and proposed commercial and service enterprises in the region to provide all necessary human services.

The setting of facilities should carefully weigh the relative merits of concentration versus dispersal. Natural landscape values may be easier to maintain if facilities are carefully dispersed. Conversely, concentration of structure leaves more undisturbed natural areas. Creating onsite visual intrusions (road cuts, utilities) should be avoided, and views of offsite intrusions carefully controlled. A natural look can be maintained by using native building material, hiding structures within the vegetation, and working with the topography. It is easier to minimize the building footprint initially than it is to heal a visual scar at the end of construction.

6.4.5. Managerial and Operation Phase

Resort management and operators should show the values of sustainable development by providing: a) tours that present the sustainability goals of a development as shown in the operation and maintenance functions such as utility and support systems; b) visitors the opportunity to understand the relationships of local water, wastewater, solid waste, and electrical systems to local, regional and global environments; and c) means to share with those who live in the surrounding areas the local culture that should have a significant role in the operation of the facility. This may require organizing of cultural activities and demonstrations that allow local residents to share their values and skills with visitors; and organizing environmental education programs that include members of the local community and schools.

Sustainability principles must be visible in all daily aspects of operation, including energy use, food handling, waste handling, maintenance activities, retail operations, and visitor services. The values of sustainable development are shown by: a) providing a central staffed location for resource and activity information; b) serving meals that feature local foods and products and by cultivating local foods within the development; c) recycling all possible waste; and selling appropriate informational materials and quality items crafted by local people.

IMPLEMENTATION EXAMPLES OF SUSTAINABLE DESIGN AND PLANNING

David Wann observes in his book, Biologic (1994), that “poor design is responsible for many, if not most, of our environmental problems.” Design is the act of giving physical form to functional spaces and places and should be based on the expected users and their building needs (i.e., heating, water, etc.). Today's increasing demand for ecologically oriented tourism provides a prime opportunity for applying the attributes of sustainability. As eco-tourists seek close involvement with authentic natural and cultural experiences. Eco-based building design could establish a "right of passage" to place human activities in harmony with local, regional, and global resources.

This study provides benchmark principles to promote sustainable design actions. Thus, the study will further link specific sustainable design and planning principles that contribute to improving the quality of the built environment and its ability to meet sustainability requirements and constraints. The required modifications or enhancements for the existing projects could be made to fill the gap between the existing situation, in which designers and planners create their designs based on the traditional building regulations and rules using a single static value of carrying capacity, to the sustainable design model, a multi-capacity measure of the environment‘s economic, social, psychological, ecological, and managerial thresholds that are linked to sustainability indicators. A system with these attributes may be able to provide assistance to designers, planners, managers, and decision-makers to improve actions toward sustainability for existing projects as well as for future strategies planning. It presents beach resorts development and the associated carrying capacity as a dynamic process which evolving and changing over time and addresses the role of designers and planners in the implementation of sustainability principles.

The greatest challenge in achieving sustainable site design is to realize that much can be learned from nature. When nature is incorporated into designs, spaces can be more comfortable, interesting, and efficient. Like nature, design should not be static but always evolving and adapting to interact more intimately with its surroundings. By definition, sustainable design seeks harmony with its environment requires detailed analysis of the specific site. How facilities relate to their context should be obvious so as to provide environmental education for its users. Sustainable design should analyze the incorporation of the primary climatic components of temperature, sun, wind, and moisture into the built environment to make the comfort level better (asset) and to make a full use of natural factors in site planning, facility design, or the operating system so that human comfort can be maximized.

Temperature is a liability in climates where it is consistently too hot or too cold. For example, areas that is very dry or at high elevation typically has the asset of large temperature swings from daytime heating to nighttime cooling, which can be flattened through heavy/massive construction to yield relatively constant indoor temperatures. When climate is predominantly too hot for comfort designers should minimize solid enclosures, maximize roof ventilation, use elongated or fractured floor plans to minimize internal heat gain, maximize exposure for ventilation, maximize wall shading, isolate heat-generating functions such as kitchens and laundries from living areas, and provide shaded outdoor areas such as porches and decks. In cases where climate is predominantly too cool for comfort designers should consolidate functions into the most compact configuration, insulate thoroughly to minimize heat loss, minimize air infiltration with barrier sheeting, weather-stripping, sealants, and airlock entries, and minimize openings not oriented toward sun exposure.

Sun can be a significant liability in hot climates where sun is abundant and an asset in cool climates to provide passive heating. Design must reflect seasonal variations in solar intensity, incidence angle, cloud cover, and storm influences. The most economical and practical way is to use natural vegetation, slope aspects, or introduced shade structures. It is imperative to provide shade for human comfort and safety in activity areas (e.g., pathways, patios, etc.). Natural lighting for indoor spaces and the use of solar energy could be important considerations to save energy and showcase environmentally responsive solutions. In the case where conditions are too hot for comfort, the designer should use overhangs and vegetation to shade walls and openings as well as use louvers, covered porches, and trellises with natural vines to block sun without blocking out breezes and natural light. Also, designers should orient broad building surfaces away from the hot late-day western sun, use lighter-colored wall and roofing material to reflect solar radiation, and use shutters and screens, avoiding glass and exposures to direct solar gain. While in cases of conditions that are too cool for comfort, designer should maximize building exposure and openings facing south (facing north in the southern hemisphere), increase thermal mass and envelope insulation, and use darker-colored building exteriors to absorb solar radiation and promote heat gain

Wind possesses a major advantage in its cooling aspect to the built environment. Wind can be an asset in hot, humid climates to provide natural ventilation. For example, trade winds in the tropical environments often come from the NE to the SE quadrant, thus, orientation of structures and outdoor gathering places to take advantage of this cooling wind movement, or "natural" air conditioning. Native cultures understand this technique quite well, and local structures reflect these principles. Back in history, the pharos used the clear story roofs for natural ventilation in most of their building. Also, designer should configure the size and position of walls and roof openings with a relationship to grade and surrounding vegetation. On the other hand, designers should consider the detrimental wind effects on walls and roofs by the use of appropriate wind bracing and tie-downs.

Moisture can be a liability if it comes in the form of humidity; causing such stickiness that one cannot cool by perspiring in summer. Strategies to reduce the discomfort of high humidity may include: maximizing ventilation and inducing air flow around facilities; and by venting or moving moisture-producing functions such as kitchens and shower rooms to outside areas. On the other hand, moisture can be an asset by evaporating in hot, dry climates to cool and humidify the air (a natural air-conditioning). Techniques for evaporative cooling may include locating facilities where breezes will pass over water features before reaching the facility or by providing fountains, pools, and plants within the development environment.

Rainfall is a significant natural factor; even in tropical rain forests where water is seemingly abundant, clean potable water is often in short supply. Many settings such as many beach tourist resorts in Egypt that are located in remote sites away from the quality water supply of the Nile Valley, import water that is relatively expensive (one cubic meter may cost up to $3) compared to other urban areas that cost not more than a few cents. This cost is due the substantially increased energy use and operating costs. This makes conservation of water in these resorts extremely important. In response to this, rainfall should be captured for a variety of uses (e.g., drinking, bathing) and this water reused for secondary purposes (e.g., flushing toilets, washing clothes). Wastewater or excess runoff from developed areas should be channeled and discharged in ways that allow for groundwater recharge instead of soil erosion.

Privacy and Reflection

Providing privacy and places for reflection may require that planning: a) provide private yard space for all accommodation units; b) orient buildings to maximize space between private yards; c) place windows to prevent views into private yards from other building units; d) avoid placing high-activity areas near private yards: e) use cul-de-sacs to eliminate through traffic; f) provide a sense of enclosure; g) use a change in vegetation, fencing that can be seen through, or hedges; h) use hills, trees, rivers, and buildings to create outdoor rooms of various sizes; i) provide public garden and open spaces; j) designate accessible areas for gardens or open spaces near small groups of units; k) create natural outdoor spaces which are quiet, private, and away from high activity areas, where people can relax and unwind; l) provide gardening areas; and m) locate such places within easy reach (5 minute walk) of all users. A change in surface cover (e.g., groundcover, or brick vs. wood chip paths) can delineate boundaries.

Plantation

Designers should use plants that: a) give off pleasant fragrances; b)coordinate with the color and texture of building materials; c) attract birds and flower; d) whose leaves rustle in the breeze; e) cover the ground with materials that are soft to walk on; f) different flowing seasons; and g) have attractive color in Fall.

Architecture Style

Local Architecture can feature architectural design and materials that are native to the site, renewable, and environmentally sensitive. Buildings can be named for important people, their owners, or their function. Choose a naming scheme for streets, based on geographic or natural features along them, historical events that occurred on the site, or important people from the area is one way to recognize local contributions.

Since antiquity, man developed techniques in reaction to his environment in order to establish an internal psychological balance with nature. Man's creations were natural when built of the materials offered by the landscape. Learning to manipulate local material; clay, stone, marble, and wood, man penetrated their properties, and his techniques gave expression to his aspirations toward the divine. In architecture, this can be seen in the temples of Karnak, the great mosques of Islam, and the cathedral of Chartres in France. With the advent of the industrial revolution, the inherited techniques using handmade tools were lost. Industrialization and mechanization of the building trade and importation of the sophisticated urban approach caused vast changes in building methods, weakened the craft-developed cultures, and created societal and ecological imbalance.

Also, the "*qa'a"* [a central, high-ceilinged upper-story room for receiving guests, constructed so as to provide natural light and ensure ventilation], and all such delights as the fountain, the "*salsabil"* [a fountain or a basin of still water designed to increase air humidity], and the "*malqaf"* [wind catch] were discarded in the name of progress and modernity. Thus when the modern architect replaced these decorative elements with air-conditioning equipment, he created a large vacuum in his culture. Every advance in technology has been directed toward man's mastery of his environment. Unhappily, the modern architect of the Third World such as those beach resorts developed along the coastline in Egypt, accepts every facility offered by modern technology, with no thought of its effect on the complex web of local culture. Unaware that civilization is measured by what one contributes to culture, not by what one takes from others.

6.5. TOURISM CARRYING CAPACITY (CC)

Discussion of the impact of tourism often leads to the question of capacity. The idea of capacity derives from the notion of quality, since it is implied that when capacity is exceeded, quality is reduced. Carrying capacity determines the upper limits of development. All systems have definable limits of tolerance to the pace and extent of change before key thresholds are crossed and negative feedback takes over. Once this level is exceeded, some form of deterioration can be expected in the environment and/or the activities taking place (Murphy, 1985).

In the tourism field, carrying capacity, usually called recreational carrying capacity, is defined as the maximal level of recreation use at any given period of time. Recreational carrying capacity does not (Mieczkowski, 1995, p. 310-311):

- Lower the quality of the natural environment,
- Decrease the perceived quality of the recreational experience and the satisfaction of the visitors, or
- Harm the well being of the residents (i.e. exceed local tolerance levels).

Figure (6-4) below provides a visual depiction of the CC categories that make up the overall concept of tourism CC, and when applied, lead to the proposed concept "Sustainable Carrying Capacity".

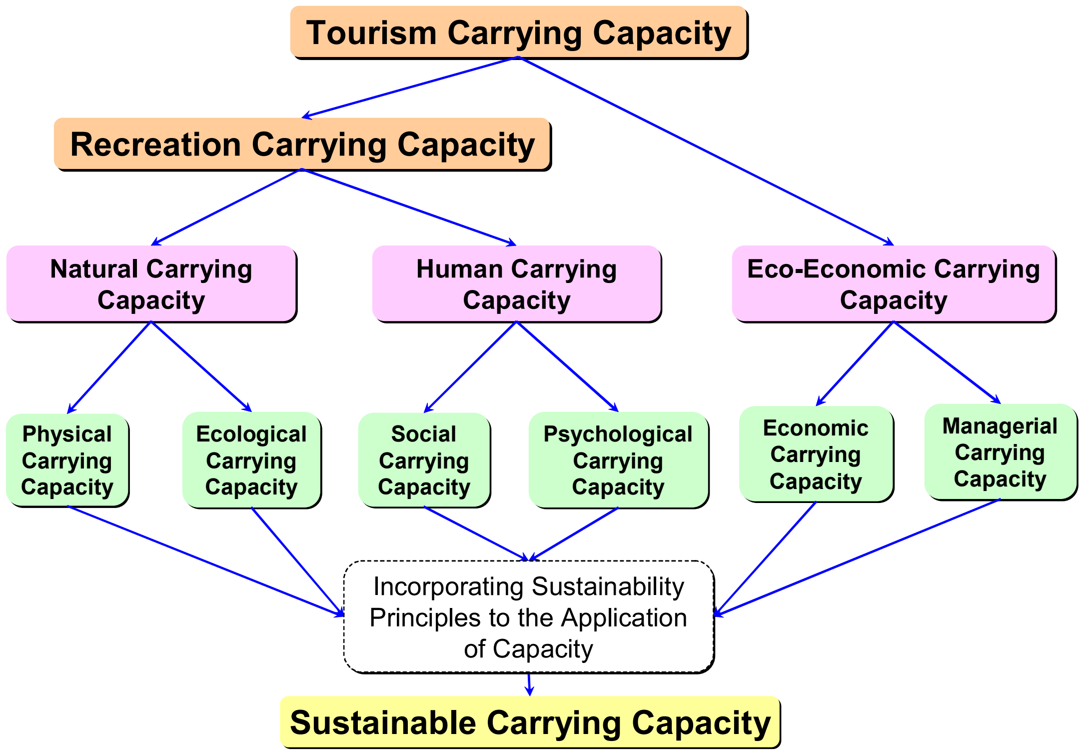


Figure (6- 4): The Concept of Sustainable Carrying Capacity

[Source: after Mieczkowski, 1995: pp.311]

Carrying capacity, used as a planning tool, is mainly targeted to facilitate the development of structures. In general, it means the maximum capacity that a facility, infrastructure, or building can sustain in terms of the number of users. Sustainable carrying capacity, as it pertains to coastal resort development, is much more complex. As seen in the figure above, sustainable CC includes three parts. The first part, natural thresholds, is associated with the natural resource base, a component of tourism supply. The second part, the human thresholds, deals with the perceptions of the local population and visitors. The third part, the eco-economic thresholds, pertains to the management and demand side of the equation. To summarize, the natural CC deals with resources; the human CC deals with socio-cultural factors; and the eco-economic CC deals with the decision making process focused on economic and managerial factors. According to Yapp and Barrow (1979), the physical CC relates to the scope of built facilities, including general and tourist infrastructure, and is relatively easy to determine with a high level of accuracy. Watson and Kopachevsky (1996) clearly identified 5 categories of

Tourism Development Carrying Capacity: physical, ecological, social, psychological, and economic. In the field of tourism, it is essential to add a new capacity that deals with the tourism management aspect. Quality tourism management must provide input into a successful environmentally sound beach resort and sustainability implementation. Below is the discussion of the six categories of carrying capacities.

(1) Physical-facility capacity - The level of tourist development or recreational activity beyond which facilities are "saturated;" or physical deterioration of the environment occurs through overuse by tourists or inadequate infrastructure network.

Physical capacity is concerned with the amount of space in undeveloped natural areas (Shelby and Heberlein, 1984), or alternatively, as the maximum number of "use units" (people, vehicles, boats) which can be physically accommodated in an area (Pigram, 1983). In many ways, it can be considered as a design concept, and impacts can be thought of as "space parameters." Calculation of physical carrying capacity is often complicated, as assessment of space requirements for different types of activities often have to be made. As the amount of space in natural areas is fixed, the only opportunity to increase physical capacity will lie in the development of management parameters aimed at more complete or efficient utilization (Shelby & Heberlein, 1984). Thus, calculation of physical carrying capacity should serve as a starting point from which the assessment of overall recreational carrying capacity can proceed.

Shelby and Heberlein (1984) describe facility capacity as those man-made improvements intended to handle visitor needs, including such things as parking lots, boat ramps, developed campgrounds and rest rooms. Administrative personnel are also included in this category because they also "facilitate" use. Facility capacity can almost always be increased by spending money. It is possible for example, to expand campgrounds, build additional launch facilities, or add more personnel. Impacts associated with facility capacity can be referred to as "built environment parameters."

Planners used to determine the carrying capacity of a destination by: number of visitors, amount of "use" by the average visitor, or number of area residents and their quality-of-life needs. One of the applications on measuring the physical carrying capacity in coastal zones has been made by An Foras (1973) as he tried to measure tourist carrying capacity of the Brittas Bay, California using air photos and visitor questionnaires. He found the best capacity rates to be 420 capita/acres or 10m2/capita.

(2) Ecological-environmental capacity - the level of tourist development or recreational activity beyond which the environment has previously experienced is degraded or compromised.

Ecological capacity is concerned with impacts on the ecosystem. That is, how does use level affect plants, animals, soil, water and air quality and so on? It can be formally defined as the maximum level of recreational use, in terms of numbers and activities that can be accommodated by an area or an ecosystem before an unacceptable, or irreversible decline in ecological values occurs (Pigram, 1983). “Ecological values” or ecosystem "parameters" (Shelby & Heberlein, 1989) that might be examined include percent of viable ground cover, ratios of various plant species, number of animals observed, or coliform counts.

The ecological CC, the quantitative measure of the environmental impact of recreational use on ecosystems, is difficult to measure for four reasons (Mieczkowski, 1995):

- It is difficult to establish a base level for measurement because the environment before human intervention is not adequately known.
- Any use causes changes and it is difficult to isolate human impacts from natural processes.
- Spatial and temporal gaps can occur between cause and effect. It may take a long time before the full impact on the environment becomes evident.
- The complexity of the interactions between components in the environment make the total impact difficult to measure.

However, Kocasoy (1995) developed and verified an equation by which the effects of the increase in tourist population on coastal water quality can be determined. The microbial pollution, which is indicated by coliform concentration, is a function of human population, intensity of light, turbidity, temperature of seawater, human population density, and the coastal characteristics coefficients. Kocasoy’s study indicates that the proposed method can be used to determine the bearing capacity of the environment as well as sustainability measures. This simplified the prediction and the prevention of possible negative effects that can be caused by developing coastal area for tourism.

(3) Social-perceptual capacity - the level reached when local residents of an area no longer want tourists because they are destroying the environment, damaging the local culture, and crowding them out of local activities.

Miossec's (1977) developed a model that pointed out to the tourism quality through changes in tourist behavior and the local population as related to the growth of development. Gormsen (1981) looked at changes in the social structure of tourist demand associated with changes in accommodation type demand that could be seen as an indication for the change in tourist personality and characteristics. Pigram (1983) defines social carrying capacity as the maximum level of recreational use, in terms of numbers and activities, above which there is a decline in the quality of the recreation experience from the point of view of the recreation participant. Shelby and Heberlein (1984) relate it to "experience parameters" and define social capacity as that level of use beyond which experience parameters exceed acceptable levels specified by evaluative standards. Experience parameters focus on the numbers, types, and locations of encounters with other human groups and on the way these encounters affect the recreation experience. This is the least tangible of the capacity concepts, since the level of crowding tolerated would not only vary between individuals, but could also vary for the same person in different situations.

(4) Psychological capacity - this is exceeded when tourists are no longer comfortable in the destination area, for reasons that can include perceived negative attitudes of the locals, crowding of the area (traffic jams), or the deterioration of the physical environment.

Psychological Capacity, also referred to as perceptual or behavioral capacity, is concerned with the visitor's perception of the presence (or absence) of others simultaneously utilizing the resources of an area. This concept is concerned with the effect of crowding on the enjoyment and appreciation of the recreation site or experience.

(5) Economic carrying capacity - the ability to absorb tourist functions without squeezing out desirable activities. This assumes that any limit to capacity can be overcome, even if at an ecological, social, cultural or even political cost.

Pigram (1983) defines economic capacity as relating to situations where a resource is simultaneously utilized for outdoor recreation and economic activity, such as a domestic water-supply reservoir. Here, the concern is to establish acceptable recreation-use levels that do not unduly interfere with the non-recreational activity so as to reduce the economic viability of the resource. In such situations, it is often necessary to undertake an ecological study in order to determine the economic tolerance level of the system to different levels of recreational use.

Another aspect of sustainable economic capacity of beach resorts is explained by its ability to be operated most of the year. More successful resorts enjoy substantial year-long operation and often have real estate sales or rent programs associated with their development that ensure the economic feasibility as well as its maintenance quality (ULI, 1981). For example, in Egypt, the tourism season extends for 6-9 months with an average of 10 hrs/day of sunshine (MT, 1976, p. 7). The ability of the North Coast of Egypt to bear a high season of tourism could extend for 9 months from March to November (MR, 1976, p. 227).

(6) Managerial carrying capacity - the ability of tourism operators and management to respond to sustainability principles and build in successful environmentally sound management actions. This may be applied in tourism development as part of the decision-making process involving investors, owners, or tourism managers who make decisions in the operational stage of development that greatly influence the quality of development and its impact on the surrounding environment, economic order, and social structure of a tourism destination.

Long (1984) indicated that with increased volume and intensity of tourist inflow different levels of authorities often take up the leading role in the decision-making process. These decisions may relate to product selection, maintenance, waste management, recycling, or efficient use of resources. Managerial carrying capacity could be the governing factor for sustainability implementation to a beach resort through its life course.

The summary of all the above aspects of carrying capacities is referred to in this research as the "Sustainable Carrying Capacity" (SCC). SCC requires attention be paid to all six capacities. The definition of SCC can be further broken down according to whether these capacities are static or dynamic; deterministic or stochastic; and based on a single limiting factor or several possible limiting factors. Since the real world is characterized by both changes with time and variability, dynamic stochastic estimates should lead to the most realistic estimates of SCC.

6.6. SUSTAINABLE DESIGN MODEL

There is little research that investigates the applicability of sustainability concept in the planning and design of coastal resorts. Further, the issues related to a sustainable coastal development such as carrying capacity have not been addressed in a systematic manner. A gap exists between the theoretical concepts of sustainability and real world developments. There is a clear need for an implementation tool to examine sustainability application and the role that carrying capacity approach within the context of sustainability could contribute in coastal resort developments.

Sustainable development requires the recognition that a capacity limit exists, and if the numbers exceed this level, then the situation is not sustainable. According to Martin and Uysal (1990) the actual cause of the decline of a tourist destination is that the CC of the area has been exceeded, over-reaching environmental capacity parameters. The issue of limiting numbers is the most basic and fundamental aspect of achieving sustainability. The conceptual sustainable design model proposed in this study [Figure 6-5] is based on linking sustainability indicators discussed earlier in this chapter with the above categories of carrying capacities. The sustainability evaluation method proposed in this research is the application of development capacity thresholds to convert different variables and criteria to common scale, so that comparisons may be made. These capacity thresholds reflect real interrelationships within the concept of sustainability, as relationships between different sustainable capacity threshold components are rarely linear [see Figure (6-5)]. Despite this fact that the direct relationship between the number of visitors to a destination (capacity thresholds), and its degree of sustainability is often assumed by researchers.

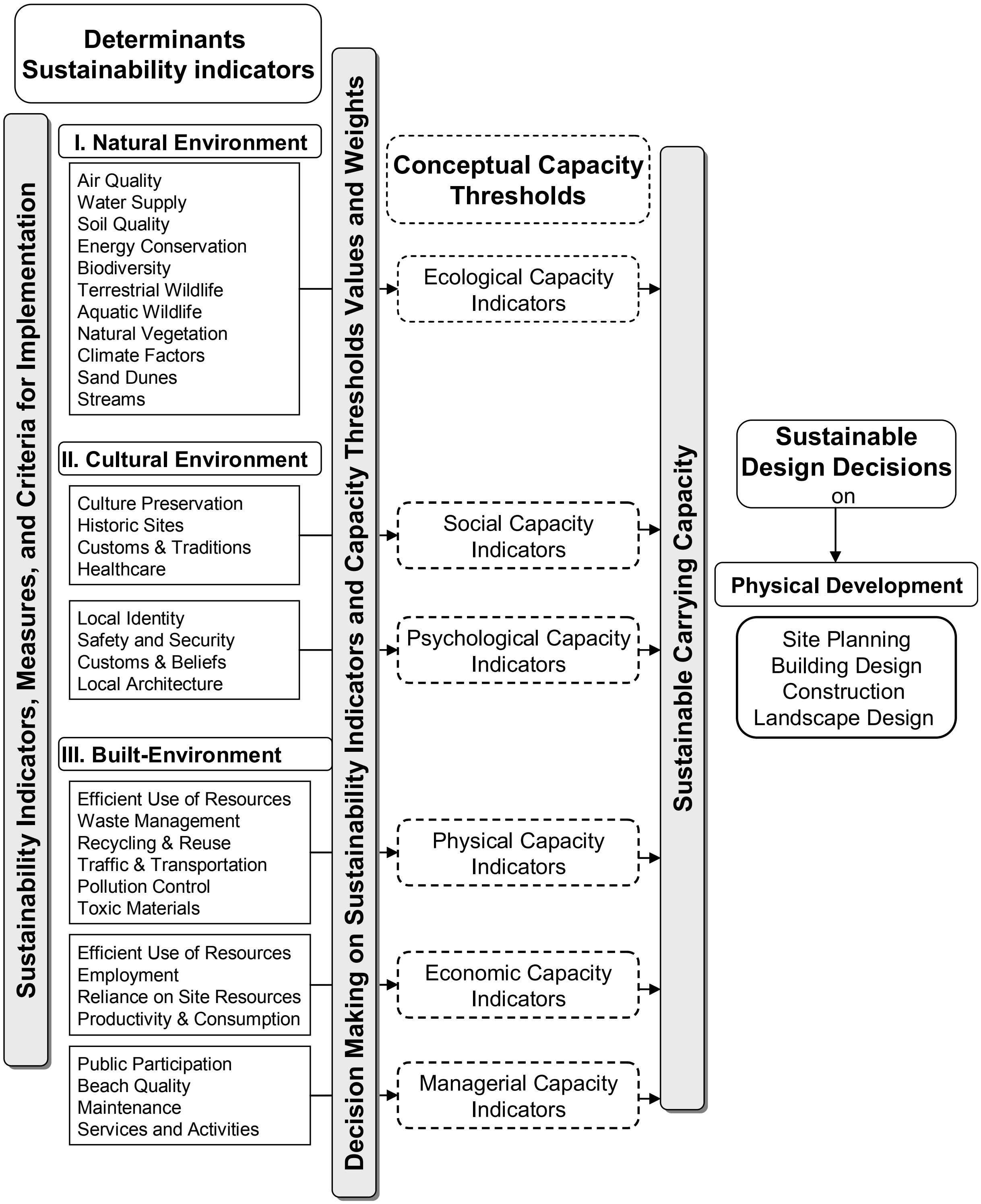


Figure (6- 5): The Framework for the Sustainable Design Model

The task of prescribing carry capacities is ultimately a judgmental matter and decision-makers must account for various environmental, cultural, as well as the economic considerations in making such judgments. It is likely that one reason the general model of CC was adopted as a framework for managing use impacts is that it was seen as a "scientific and objective" approach that would lead to hard, unequivocal answers to the question of "how much use is too much." The issue of CC is often linked to the question of access to an opportunity and the issue of allocation. Prescribing carrying capacities for decision-makers remains a complex and difficult task. The emphasis on the social and recreational aspects of the CC issue must be integrated with concerns about ecological conditions as well. Judgments must be made and decision-makers need frameworks that help avoid unintended consequences (Shelby & Heberlein, 1986).

Based upon the above discussion one would expect that SCC could be used as a tool for sustaining tourism development, and that it could indeed make an important contribution to the welfare of both the visitors and the visited environment. SCC is widely used to underline the importance of maintaining a level of development that is environmentally and culturally sustainable. The economic benefits and costs of tourism, and the degree of tourism activities determined by the number of tourists and the amount of land used or exposure to tourism activity, can have a bearing on the social and psychological environment of the resident population, and the ecological capacity of the destination. There is a need to establish and explore a framework to examine the overall tourism capacity of destinations.

As a part of this model, designers and planners should take particular care to maintain and improve resources for continuous future use, and reflect the needs and the goals of the involved groups in their architectural designs and use of space, form, and materials. Figure (6-6) illustrates one example of building design that responds to environmental considerations.

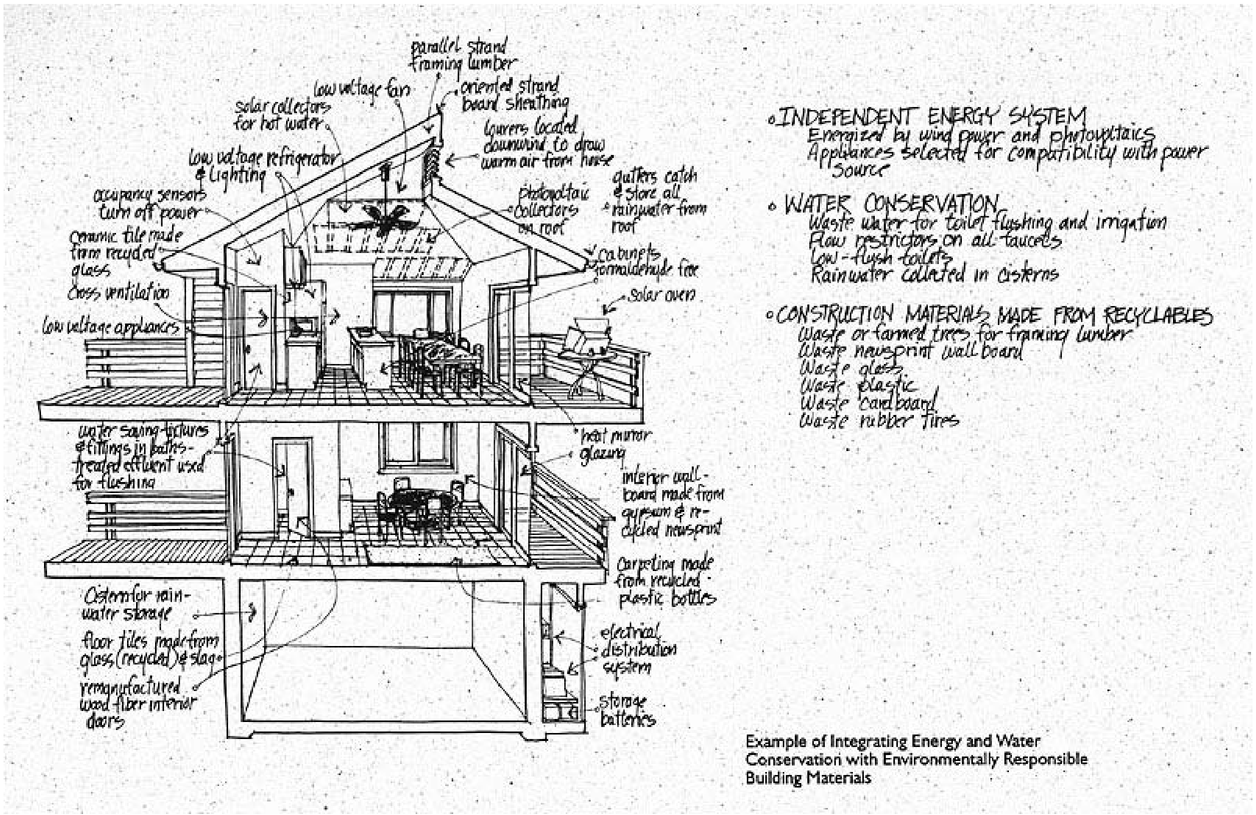


Figure (6- 6): Building Design Responding to Environmental Considerations

Decisions made by designers involved in what is to be built, where it is located, how to build it, and what affect the quality and the image of the final project and its relationship will have on the environment, determine the quality of the project. Natural attractions are not infinite and timeless, and should be viewed as finite, and be protected and carefully developed. The focus of planning and management strategies should be aimed at minimizing the negative impacts of tourism and recreation on the environment, and on methods to make it environmentally sustainable.

Sustainable design model recognizes the integral part nature plays in the human community, and stresses the principles of conservation. It recognizes the impact of design choice on the natural and cultural resources of the local, regional, and provides a sound environmental development. Sustainable design holds that the capability of natural and cultural systems to continue over time is based on their ability to maintain biodiversity, environmental integrity, and incorporate facilities planning, design, construction, and operation that reduce the impacts of human use.

The indicators presented in this chapter were selected as vital to the sustainability of coastal zone development by experts in the field, and through an extensive literature review. These sustainability indicators were therefore used in the development of the sustainable design model concerning the perceived importance of these independent variables in sustainable resort development. These indicators are linked to the conceptual level of capacity: ecological, social, psychological, physical, economic, and managerial.

The concrete value of all the above capacities is the number of visitors and the associated quality of the activities, facilities, and the overall development. The capacity in this model is not based on the static numeric value of capacity, rather it is based in its quality as well as its quantity. Thus, any of the six conceptual capacities will be measured based by their corresponding indicators that have improved or declined based on the change of the number of visitors and the associated impacts to the indicators. In all cases the number of visitors to beach resorts must be kept under control based on the characteristic of the site. This capacity may be shifted from one category to another based on local priorities and needs. For example, in the environmentally sensitive areas the ecological capacity will be a priority concern of decision makers, while this concern may be shifted to the social capacity in a site with valuable cultural resources. The need for a monitoring technique is a complementary component of this model and ensures that the capacity has not exceeded its acceptable limits.

6.7. ANALYSIS OF THE SUSTAINABLE DESIGN MODEL

This section includes the implementation of the proposed conceptual sustainable design model. The section is divided into four parts: 1) test the reliability of instrument scale; 2) test of the multicollinearity for the dependent and the independent variables; 3) the loading factor analysis for the independent variables; and 4) the regression analysis of the model and the associated values of “B” and “R^2”.

6.7.1. Reliability Analysis of the Instrument

A reliability analysis was used to test the validity of the collected data by using Cronbach's alpha coefficient as the measured scale. This test was performed to determine the internal consistency of the survey instrument. Since the study included two groups of respondents rather than an individual subject, a minimum of 0.65 alpha coefficient was determined acceptable (Malhotra, 1996). The test of Cronbach's coefficient was analyzed for each scale variable (question) in the study. The resulting values of the test indicate a high level of reliability for the survey instrument [see Table 6-3 below]. Based on these results, both individual questions as well as the overall scales in the instrument had significantly high reliability alpha coefficient values that meet Malhotra's standard of 0.65. There was only one variable (perceived economic sustainability indicators) that showed an Alpha value less than 0.65 with a 0.6424 on the perceived economic sustainability indicators variable scale. While it is not as high as the other variables, it is still reliable since it is not significantly different from the value of 0.65. The test also provides the opportunity to observe the strength of each variable in relation to other variables (scales).

Table (6-3): Cronbach's Alpha Coefficient of Reliability Test

Variable (Scale)	Number of Scales	Alpha Value
Perceived ecological sustainability indicators	12	0.91
Perceived social sustainability indicators	4	0.80
Perceived psychological sustainability indicators	4	0.82
Perceived physical sustainability indicators	6	0.84
Perceived economic sustainability indicators	4	0.64
Perceived managerial sustainability indicators	4	0.71
Perceived carrying capacity thresholds	6	0.68
Factors that influence visitors choosing a resort to visit	15	0.66
Designers/managers' concern about environmental issues	8	0.82
Designers/managers' concern about sustainable development	8	0.82
Values of carrying capacity, product life cycle, and ecotourism to sustainability	3	0.78
Familiarity with carrying capacity, product life cycle, and ecotourism	3	0.72
Effectiveness of laws and regulations in protecting the environment	2	0.80

6.7.3. Factor Analysis

Questioning the sustainability indicators degree of significance is important in setting priorities of action. The survey instrument included questions that identified the perceptions of three groups; visitors, designers/planners, and managers/owners on the importance of certain factors (independent variables). These independent variables were used to develop the sustainable design model that is presented in this study to help these stakeholders and other decision-makers with determining priorities in design and planning as well as with overall development. Variables considered for the analysis were tested through the Delphi technique and re-tested through the reliability test using Cronbach's alpha coefficient. Moreover, the factor analysis presented in this section was used to classify these variables in a way that determines the most important factors that represent the major areas of concern. This will help the decision-makers set priorities for actions based on the level of importance that was specified through this analysis. Thirty-four independent variables were included (9 variable relevant to the natural environment, 6 variables on the cultural environment, and 19 variables on sustainability ideas).

Factor analysis was used to determine how respondents evaluate each variable in multiple variable questions, and to determine how these factors construct the answers to the main question. Factor analysis is mainly applied for data reduction and was used in this section as an initial solution with a coefficients correlation matrix to see whether to include a limited group of variable that posses the most loading factor.

To determine the adequacy of the number of reduced factors to identify the real data, it is measured by the Kaiser-Meyer-Olkin (KMO) method. The applied statistical methods are “Bartlett’s Test of Sphericity” and extraction statistics, and the “Principal Component Analysis” (PCA) using the “Varimax” rotation. A KMO value of 0.70 is considered a good level of adequacy to represent the classified variables. The finding of this test will be useful in determining whether to verify the variables used in applying the sustainable design model in each country or to include all variable in the initial regression analysis.

The U.S. Application

The results of the rotated loading values of all variables are shown in Table (6-4) below. The number of reduced factors selected for variable grouping was six, and the resulting measure of KMO was 0.809, which indicates a good factor model.

Table (6-4): Factor Analysis for Independent Variables, U.S. Model

Rotated Component Matrix [a]

	Component					
	1	2	3	4	5	6
Terrestrial wildlife	.791	.242	5.796E-02	.161	-2.387E-02	.151
Aquatic wildlife	.769	.271	.191	.163	-2.283E-02	.181
Soils	.762	.209	.237	8.311E-02	.210	.216
Maintenance	.743	7.875E-02	-6.498E-03	.128	.344	9.232E-02
Ground water / wetlands	.712	.151	.287	.224	-1.118E-02	.250
Ecological integrity	.708	.184	.337	.141	5.680E-02	.111
Pollution control	.675	.166	.160	-2.270E-02	.489	.133
Efficient use of resources	.671	.278	8.289E-02	9.469E-02	.515	.174
Air quality	.670	.248	4.136E-02	4.551E-02	.612	.150
Satisfying basic human needs in the area	.652	6.479E-02	.462	7.066E-02	7.813E-02	.155
Public participation	.613	.262	.267	-.110	.514	9.378E-02
Recycling waste products	.573	3.064E-02	.278	.382	.334	.169
Utilizing site nature and climate characteristic	.478	.199	-.135	.341	.336	.250
Use of passive energy technology	.460	.364	.302	.168	.208	8.740E-02
Sand dunes	.243	.885	9.453E-02	.165	-2.742E-02	2.800E-02
Natural vegetation	.318	.867	6.964E-02	.192	9.395E-02	7.128E-02
Streams / drainage ways	.193	.821	.145	.171	.202	9.052E-02
Landform / topography	.220	.677	.420	.230	.260	-1.555E-04
Historic features	.230	.622	.487	5.244E-02	9.561E-03	.295
Preserving local customs and traditions	.210	.283	.840	.204	.110	9.720E-02
Preserving cultural resources	.239	.294	.777	.142	.199	.116
Providing for spiritual harmony	.373	1.481E-02	.733	.254	6.844E-02	4.285E-02
Use of non-toxic materials	7.450E-02	.148	.541	.513	.105	.105
Encourage less consumptive lifestyle	7.523E-02	.256	.149	.845	-3.056E-03	-.140
Recycling water	.197	9.481E-02	.159	.760	.308	.175
Using indigenous building materials	.215	.243	.302	.689	.216	.200
Local architecture	.285	.318	.209	.513	.215	.443
Quality of facilities services, and activities	.106	6.024E-02	.154	.201	.745	.133
Traffic and transportation	.225	9.560E-02	.138	.360	.723	.105
The local housing stock	.399	-1.016E-02	-6.989E-02	.114	7.557E-02	.757
Local social and health service	.188	.111	.105	-3.856E-02	6.124E-02	.751
Local economy / employment	.142	-9.838E-02	.321	.391	.258	.692
Beach	.457	.381	4.864E-02	7.068E-03	.110	.522
Local customs and beliefs	7.488E-03	.440	.410	6.325E-02	.204	.521

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 9 iterations.

The proportion of variance explained by the first factor (45.47% and 22.016% after rotation) is almost twice that of the second factor. It is concluded that with the questions that address the factors (terrestrial wildlife; aquatic wildlife; soils; maintenance; ground water / wetlands; ecological integrity; pollution control; efficient use of resources; air quality; satisfying basic human needs in the area; public participation; recycling waste products; utilizing site nature and climate; and use of passive energy technology) that loading on the first factor is most important to determine the perception of the American respondents concerning the importance of sustainability factors related to the natural and cultural environment in the U.S.

Egyptian Application

The KMO value of the selected six factors in the Egyptian model is 0.696; very close to the acceptable value of 0.70. The rotated matrix of the six factors is shown in Table (6-5) which shows that the rotated loadings of the most effective variables for measures are: ecological integrity; using indigenous building materials; use of passive energy technology; local architecture; recycling waste products; providing for spiritual harmony; local customs and beliefs; use of non-toxic materials; and preserving cultural resources. This shows that the variance explained by the first group of variables presented in the first factor is 37.37%, and after rotation 17.76%, which is acceptable for Egypt at this initial stage of development.

Table (6-5): Factor Analysis for the Independent Variables, Egypt Model

Rotated Component Matrix [a]

	Component					
	1	2	3	4	5	6
Ecological integrity	.882	.227	.246	7.063E-02	.122	5.445E-02
Using indigenous building materials	.804	.136	.288	6.875E-02	.281	-1.185E-02
Local architecture	.797	.150	-4.241E-02	.455	9.570E-02	-6.934E-02
Use of passive energy technology	.787	.230	.159	8.688E-02	.135	1.996E-02
Local customs and beliefs	.741	9.500E-02	2.399E-02	-.103	-.126	.289
Recycling waste products	.730	.302	-.137	3.553E-02	.416	.246
Providing for spiritual harmony	.702	.159	8.519E-02	1.670E-02	.489	.371
Preserving cultural resources	.464	.257	.414	-1.827E-02	.455	.311
Air quality	.190	.883	.143	.110	.217	.145
Efficient use of resources	.192	.822	.298	8.167E-02	.164	.171
Pollution control	.182	.811	.278	9.759E-02	.255	.153
Public participation	.278	.736	.163	-4.648E-02	-7.026E-03	.162
Maintenance	.204	.683	.212	1.437E-02	-1.557E-02	.227
Utilizing site nature and climate characteristic	.215	.610	.184	3.824E-02	-.136	-.148
Traffic and transportation	-9.229E-02	.516	-5.864E-02	.293	.231	-.383
Quality of facilities services, and activities	-1.880E-02	.481	-4.066E-02	.308	.445	-2.078E-02
Preserving local customs and traditions	.269	.128	.792	.127	-.158	.115
Local social and health service	8.664E-02	.196	.773	5.398E-02	-1.585E-02	.208
Beach	1.047E-02	.288	.711	.130	.233	.169
Soils	9.415E-02	.107	.661	.401	5.550E-03	.158
Recycling water	5.933E-02	.312	.660	.125	.387	-1.463E-03
Aquatic wildlife	-1.677E-02	.205	.648	.224	.145	.534
Local economy / employment	.345	.190	.502	.117	.384	.466
Streams / drainage ways	.146	-3.401E-02	-2.867E-02	.896	9.431E-02	.207
Terrestrial wildlife	-.156	2.736E-03	.154	.892	9.860E-02	.177
Ground water / wetlands	9.618E-03	.234	.226	.830	7.584E-02	-6.884E-03
Satisfying basic human needs in the area	.304	9.580E-02	.471	.752	-.104	-.188
Landform / topography	.409	.179	.386	.651	.200	.159
Historic features	.304	2.212E-03	1.044E-02	.312	.733	9.714E-02
Use of non-toxic materials	.444	.259	.171	-7.988E-02	.711	.192
Encourage less consumptive lifestyle	.327	.226	.373	-6.523E-03	.413	-.170
Natural vegetation	.136	.185	.159	.122	5.376E-02	.796
The local housing stock	.128	.134	.136	7.871E-02	1.112E-02	.658
Sand dunes	6.335E-02	-9.149E-02	.280	.117	.369	.534

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 9 iterations.

Table (6-6) summarizes the results of the two countries and the classified factors for the six groups. Ecological integrity, air quality, recycling waste products, and the use of passive energy technology contributed to a major factor in both countries. However, their lesser priority factors differed. These variables indicate a strong link to the variables used in developing the model.

Table (6-6): Factor Analysis for the Independent Variables

SUSTAINABLE DESIGN MODEL The Factor Analysis Sustainability Indicators Grouping, Rotated Component Matrix			
US Model	**C**	**Egypt Model**	**C**
Loading Factor (1)			
Terrestrial wildlife	0.79	Ecological integrity	0.88
Aquatic wildlife	0.77	Using indigenous building materials	0.84
Soils	0.76	Use of passive energy technology	0.80
Maintenance	0.74	Local architecture	0.79
Ground water / wetlands	0.71	Recycling waste products	0.78
Ecological integrity	0.71	Providing for spiritual harmony	0.77
Pollution control	0.68	Local customs and beliefs	0.70
Efficient use of resources	0.67	Use of non-toxic materials	0.56
Air quality	0.67	Preserving cultural resources	0.23
Satisfying basic human needs in the area	0.65	Air quality	0.21
Public participation	0.61		
Recycling waste products	0.57		
Utilizing site nature and climate	0.48		
Use of passive energy technology	0.46		
Loading Factor (2)			
Sand dunes	0.88	Efficient use of resources	0.82
Natural vegetation	0.87	Pollution control	0.79
Streams / drainage ways	0.82	Public participation	0.77
Landform / topography	0.68	Maintenance	0.70
Historic features	0.62	Utilizing site nature and climate	0.63
Loading Factor (3)			
Preserving local customs and traditions	0.84	Preserving local customs and traditions	0.77
Preserving cultural resources	0.78	Local social and health service	0.76
Providing for spiritual harmony	0.73	Beach	0.69
Use of non-toxic materials	0.54	Soils	0.68
		Recycling water	0.65
		Aquatic wildlife	0.62
Loading Factor (4)			
Encourage less consumptive lifestyle	0.85	Streams / drainage ways	0.89
Recycling water	0.76	Terrestrial wildlife	0.89
Using indigenous building materials	0.69	Ground water / wetlands	0.84
Local architecture	0.51	Satisfying basic human needs in the area	0.75
		Landform / topography	0.65
Loading Factor (5)			
Quality of facilities services, and	0.74	Natural vegetation	0.77

activities			
Traffic and transportation	0.72	Sand dunes	0.63
		The local housing stock	0.58
		Local economy / employment	0.55
Loading Factor (6)			
The local housing stock	0.76	Quality of facilities services, and activities	0.61
Local social and health service	0.75	Historic features	0.54
Local economy / employment	0.69	Encourage less consumptive lifestyle	0.51
Beach	0.52	Traffic and transportation	0.49
Local customs and beliefs	0.52		

The factor analysis was applied to analyze priorities of sustainability indicators for each country. The distribution of variables was as follows: the ecological group (12 variables), social group (4 variables), psychological group (4 variables), physical group (6 variables); economic group (4 variables); and managerial group (4 variables).

The same factor analysis procedure was used for each individual group to determine how variables were perceived within their groups, and to determine how these factors construct the answers to the main questions within their category. The test findings will be useful in verifying the variables used in developing a sustainable design model for each country. A summary of the test results for each individual indicator group is shown in the Appendices.

The outcome-deducted variables derived from the above test did not convey enough confidence through the initial regression with the limited reduction variable. This supports the argument presented earlier that the aggregation of sustainability indicators is not applicable in some cases. For instance, it is difficult to aggregate air quality with water supply, or biodiversity; in spite of the interaction that may exist among these variable; it seems each indicator should be considered separately.

While the above analysis was not used to reduce the number of the variables applied to the regression analysis, it will be used as a complementary part of the design model to provide decision-makers with a list of ranked indicators for setting decisions about priorities among variables within each capacity level.

The Regression Analysis

This section presents and discusses the steps used to apply the proposed "Sustainable Design Model" on a sample of beach resorts in the USA and Egypt.

Since Egypt is a developing country and the USA is a developed country; one would expect the impact of cultural differences; differences in environmental laws and regulations; law enforcement; and differences in decision-makers priorities. In addition, the differences in the stakeholders' perceptions were presented in the previous part of the analysis. Therefore, two separate models were developed to identify specific determinations of reality for each country's characteristics and circumstances. Six dependent variables were used including: the ecological, social, psychological, physical, economic, and managerial conceptual perceived carrying capacities. The independent variables included in this analysis were 9 variables relevant to the natural environment, 6 variables relevant to the cultural environment, and 19 variables relevant to the built environment for a total of 34 identified independent variables. These variables are listed by groups in Table (6-7) below:

Table (6-7): Independent Variables by Group

Natural Environment Factors	Cultural Environment Factor	Built Environment and Sustainability
1. Landform / topography 2. Soils 3. Streams / drainage ways 4. Natural vegetation 5. Ground water / wetlands 6. Terrestrial wildlife 7. Aquatic wildlife 8. Sand dunes 9. Beach quality	1. Historic features 2. Local architecture 3. Local customs and beliefs 4. Local social and health service 5. Local economy / employment 6. Local housing stock	1. Recycling waste products 2. Recycling water 3. Use of passive energy technology 4. Preserving local customs& traditions 5. Satisfying basic human needs 6. Ecological integrity 7. Using indigenous building materials 8. Use of non-toxic materials 9. Preserving cultural resources 10. Providing for spiritual harmony 11. Encourage less consumptive lifestyle 12. Efficient use of resources 13. Maintain air quality 14. Utilizing characteristic and climate 15. Public participation 16. Maintenance 17. Traffic and transportation 18. Pollution control 19. Quality of services, and activities

"Stepwise" entry of independent variables was used in the regression analysis method. This step ensures the best "Estimates" and "Model fit" for the outcome model for each individual dependent variable. The confidence level of 0.05 was applied to all the statistic analysis of this study including the regression for modeling. The SPSS (v. 901) for Windows was the primary tool used for analysis. The summary of the modeling analysis for both countries (USA and Egypt) is presented in the following six tables [Table (6-9) to Table (6-13)]. Each table presents the outcomes of the regression for one dependent variable of the six carrying capacities categorized in the conceptual model (ecological, social, psychological, physical, economic, and managerial). The outcome of each capacity and the associated independent variables (sustainability indicators) that best fit in the model and present a significant value were considered. The values of R^2 estimated the proportion of variance due to regression, and the values of B the regression coefficient were included as well.

1. Table (6-8): Ecological Carrying Capacity Modeling

SUSTAINABLE DESIGN MODEL			
USA MODEL		**EGYPT MODEL**	
Dependent Variable: Ecological Carrying Capacity			
R^2 = 0.7562	**B**	**R^2 = 0.5143**	**B**
(Constant)+ **18 Independent Variables** are:	3.83	(Constant)+ **5 Independent variables** are:	2.54
Traffic and transportation	0.67	Quality of facilities, services, and activities	0.30
Air quality	-0.57	Public participation	-0.43
Terrestrial wildlife	0.19	Traffic and transportation	0.30
Preserving cultural resources	0.53	Historic features	0.18
Providing for spiritual harmony	-0.35	Streams / drainage ways	0.14
Streams / drainage ways	-0.28		
Efficient use of resources	0.29		
Local economy / employment	-0.27		
Encouraging less consumptive lifestyle	0.14		
Ecological integrity	-0.30		
Satisfying basic human needs in the area	0.27		
Public participation	-0.29		
Maintenance	0.30		
Utilizing site nature and climate characteristics	-0.19		
Pollution control	-0.24		
Ground water / wetlands	0.19		

2. Table (6-9): Social Carrying Capacity Modeling

SUSTAINABLE DESIGN MODEL			
USA MODEL		**EGYPT MODEL**	
Dependent Variable: Social carrying capacity			
R^2 = 0.5086	**B**	**R^2= 0.2844**	**B**
(Constant)+ 9 Independent Variables are:	3.39	(Constant) =+ 6 Independent Variables are:	2.96
Terrestrial wildlife	0.31	Historic features	0.26
Air quality	-0.95	Preserving cultural resources	-0.27
Efficient use of resources	0.50	Local architecture	0.46
Traffic and transportation	0.32	Local social and health services	0.38
Use of non-toxic materials	-0.30	Preserving local customs and traditions	-0.27
The local housing stock	-0.19	Ecological integrity	-0.32
Streams / drainage ways	-0.43		
Sand dunes	0.36		
Using indigenous building materials	0.50		

3. Table (6-10): Psychological Carrying Capacity Modeling

SUSTAINABLE DESIGN MODEL			
USA MODEL		**EGYPT MODEL**	
Dependent Variable: Psychological Carrying Capacity			
R^2 = 0.6583	**B**	**R^2 = 0.2112**	**B**
(Constant) + **14 Independent Variables**:	2.92	(Constant) + **4 Independent Variables**:	4.41
Traffic and transportation	0.76	Preserving cultural resources	-0.31
Pollution control	-0.81	Local architecture	0.18
Satisfying basic human needs in the area	0.61	Utilizing site nature and climate characteristics	-0.23
Ecological integrity	-0.49	Encouraging less consumptive lifestyle	0.12
Maintenance	0.39		
Quality of facilities, services, and activities	-0.27		
Encouraging less consumptive lifestyle	0.32		
Providing for spiritual harmony	-0.45		
Recycling water	-0.25		
Preserving cultural resources	0.34		
Local social and health services	0.21		
Local economy / employment	-0.15		
Terrestrial wildlife	0.14		
The local housing stock	-0.13		

4. Table (6-11): Physical Carrying Capacity Modeling

SUSTAINABLE DESIGN MODEL			
USA MODEL		**EGYPT MODEL**	
Dependent Variable: Physical Carrying Capacity			
R^2 = 0.5421	**B**	**R^2 = 0.4907**	B
(Constant) + 12 Independent Variables are:	3.57	(Constant) + 6 Independent Variables are:	2.5317
Ground water / wetlands	0.48	Use of passive energy technology	0.2834
Maintenance	0.34	Recycling water	-0.3638
Beach quality	-0.25	Aquatic wildlife	0.6688
Utilizing site nature and climate characteristics	-0.34	Encourage less consumptive lifestyle	0.17
Recycling waste products	-0.28	Preserving local customs and traditions	-0.1902
Streams / drainage ways	-0.72	Soils	-0.1083
Natural vegetation	0.75		
Satisfying basic human needs in the area	0.34		
Efficient use of resources	0.33		
Use of passive energy technology	-0.20		
Ecological integrity	-0.23		
Quality of facilities, services, and activities	-0.15		

5. Table (6-12): Economic Carrying Capacity Modeling

SUSTAINABLE DESIGN MODEL			
USA MODEL		EGYPT MODEL	
Dependent Variable: Economic Carrying Capacity			
R^2 = 0.0675	**B**	**R^2 = 0.1440**	**B**
(Constant) +6 Independent Variables are:	4.07	(Constant) +2 Independent Variables are:	4.95
Using indigenous building materials	-0.42	Pollution control	-0.20
Providing for spiritual harmony	0.28	Utilizing site nature and climate characteristics	-0.20
Local social and health services	0.15		
Ecological integrity	-0.21		
Utilizing site nature and climate characteristics	0.26		

6. Table (6-13): Managerial Carrying Capacity Modeling

SUSTAINABLE DESIGN MODEL			
USA MODEL		EGYPT MODEL	
Dependent Variable: Managerial Carrying Capacity			
R^2 = 0.5000	**B**	**R^2 = 0.1315**	**B**
(Constant) +9 Independent Variables are:	2.82	(Constant) +2 Independent Variables are:	2.45
Sand dunes	0.32	Quality of facilities, services, and activities	0.17
Landform / topography	-0.23	Local customs and beliefs	0.19
Pollution control	0.35		
Beach quality	-0.12		
Soils	0.31		
Aquatic wildlife	-0.35		
Public participation	-0.18		
Ecological integrity	-0.12		
Terrestrial wildlife	0.21		

Detection for Multicollinearity

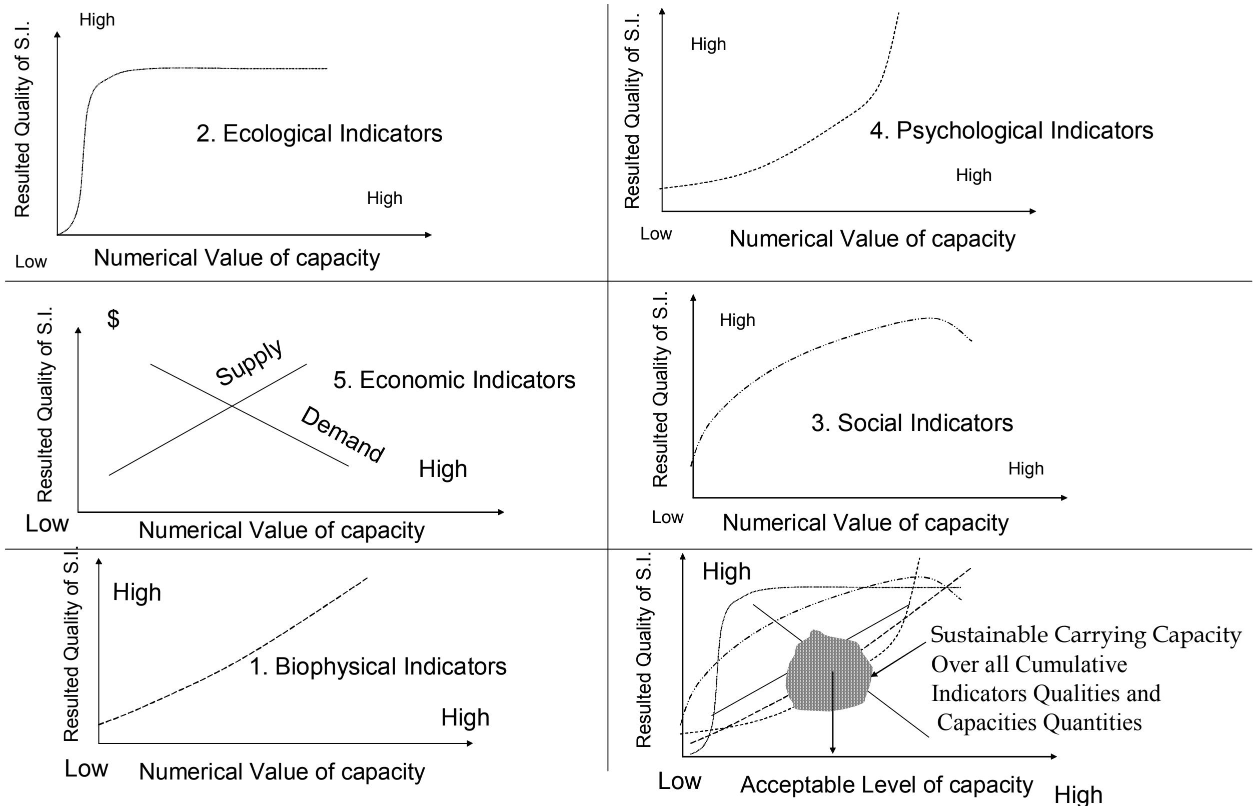
The above multiple regression analysis shows negative values for the coefficient B, this indicates multicollinearity among the independent variables. Multicollinearity is defined as a strong linear relationship between factors within the questions. When this strong correlation becomes perfect, multicollinearity exists (Lomax, 2001). With multicollinearity, adverse effects of intercorrelation among independent variables can create problems for data analysis and affect results interpretation (Pedhazur & Schmelkin, 1991). According to Wampold & Freund (1987) highly correlated independent variables can not make substantial contributions to the prediction of the dependent variables. Multicollinearity would cause computation error in regression analysis. Moreover, partial regression coefficients can be highly unstable and decrease the possibly of gaining statistically significant results if multicollinearity among the independent variables exist. Therefore, a diagnostic analysis of multicollinearity was conducted to detect the intercorrelation among all independent variables included in the study. The bivariate correlation matrix did not show a multicollinearity problem at 0.80 between each pair of variables.For all thirty-four independent variables at the maximum value, the correlation coefficient was .788 and the minimum was 0.159 for all the independent variables included in this study (Pedhazur, 1982). However, an advanced analysis of the multicollinearity using the "Conditional Index Diagnostic" test reveals that there a number of the independent variables involved in the strong relationship (the value of the CI > 30) and with a "Coefficient of Variance Proportion" higher than 0.5. This means that those variables are strongly involved in a linear relationship. This is reflected in the negative values of the outcomes coefficient values of the Bs.

The multicollinearity problem, where independent sustainability indicator variables are so highly correlated that it is impossible to come up with reliable estimates of their individual regression coefficients, provides a "wrong sign" problem of the coefficient B values, since we can't distinguish between the effect of each individual factor. Several trials have been made to drop some of the variables that cause this problem. Also, the confidence intervals on the regression coefficients are very wide. The confidence intervals may even include zero, which means you cannot be confident about whether an increase in the X value is associated with an increase, or a decrease, in Y. Because the confidence intervals are so wide, excluding a subject (or adding a new one) can change the coefficients dramatically – and may even change their signs. However, multicollinearity is a problem with the data, not with the model, at least for the model forecasting the significant independent variables for each dependant predictor. Moreover, there needs to be more detailed data of variables that are closely related, also, increasing the sample size, narrowing the confidence intervals with wider range for some of the X variables. What happens if we ignore the multicollinearity problem? What happens if we do simple linear regression instead of multiple regressions? Collinearity does not affect the ability of a regression equation to predict the response. It poses a real problem if the purpose of the study is to estimate the contributions of individual predictors. While a strong linear association between sustainability indicators and each of the carrying capacities is highly desirable, a strong linear association between (or among) sustainability indicators is highly undesirable since it is indicative of the presence of collinearity or multicollinearity problem in the model. If the goal is simply to predict Y, carrying capacity from a set of X variables, and sustainability indicators, then multicollinearity is not a problem. The predictions are still accurate, and the overall R2 (or adjusted R2) quantifies how well the model predicts the Y values. If the goal is to understand how the various X variables impact Y, then multicollinearity is a big problem and the simple linear regression of Y on each individual variables of X. Reducing the impact of multicollinearity by removing or combining variables may not be a useful solution and it might be best to recognize the impact of each individual sustainability indicator on the resulting value of carrying capacity by the simple linear regression. Then, decisions can be made for each individual independent variable that showed signs of degradation in the value of the capacity.

6.5.1. ADJUSTED SUSTAINABLE CARRYING CAPACITY (SCC)

In the investigation of the role of the carrying capacity in achieving sustainable development for beach resort developments, Figure (6-7) below summarizes the concept of Sustainable Carrying Capacity (SCC) that derives its value from accumulative physical, social, psychological, economic, and ecological thresholds. Quantification of SCC is difficult to determine and SCC limits should not be viewed as absolute values, overruling social, cultural and economic considerations. Rather, such limits should be dynamic and flexible and, even more importantly, correspond closely to the needs and peculiarities of a specific area. The concept of carrying capacity cannot be used in planning and practice as an absolute tool offering exact measurements but, instead, as one which is under continuous revision (Aly Ahmed, 1998).

In this case, the detailed study of the environment should include the following steps: 1) evaluate each indicator by criteria; 2) analyze feasibility of indicator solutions; 3) recommend a feasible indicator as the target sustainable design model; 4) prepare model guidelines; 5) establish the mechanisms to evaluate the alternatives; 6) evaluate proposals and quotes to determine the best acceptable values; and finally 7) make recommendations to the project designers, managers, and other decision-makers as well.



Source: after Stankey (1990) & Steele 1995.

Figure (6- 7): Carrying Capacity Thresholds and Sustainability Indicators Sustainable Threshold Components

The approach suggested in this study does not represent sustainability implementation mathematically, rather, it provides a graphic representation that provides decision-makers with a broader vision. The vertical axis represents the quality value, how the settings meet a specific sustainability indicator and the horizontal axis presents the quantitative value of carrying capacity, the measure of how much is too much. Therefore, as the number of visitors increases, the resulting value of indicators will change. By using this procedure the correlation of each sustainability indicator could be measured with the corresponding values of carrying capacity changes. In the tourism field, the most common measurable numerical value of carrying capacity is the number of visitors and the associated activities. The physical development of beach resorts could be represented by the number of rooms and their associated built environment that reflect the impacts and changes to the tourism destination. "Sustainable carrying capacity" is the cross zone, the outcome of the cumulative values of all the dimensions of the environment capacity, which takes into account sustainability principles in measuring a destination capacity. The outcome numerical value of the proposed sustainable carrying capacity is not a static number but a dynamic one based on visitors' number, activities, behaviors, and the quality of the built environment; and in the first place on the biophysical, ecological, social, psychological, economic, and managerial existing circumstances of the area under investigation. In this case, designers/planners, managers/owners, and visitors/local community will be greatly involved and responsible for the implementation of sustainability related actions. This approach, from a decision-making point of view, provides policy-makers with a broad perspective to weigh the importance of each individual sustainability indicator, and also, to make a decision on the priorities and weight of the capacity thresholds and its acceptable limits.

The integrative methodological framework is developed for application to worldwide coastal settings, however, the specific factors under consideration and resulting equation values may be applied only to projects within the predetermined coastal zones. To use these equations for other zones where circumstances, considerations, and priorities are different is inappropriate; however the process to develop the model is the same.

SDM APPLICATION

To visualize the differences of the outcomes for the two countries, the following matrix [Table (6-14)] was developed to present the six dependent carrying capacities in one dimension and the thirty-four independent variables in the other dimension. The symbols determine whether the variable was included or not in the model of each country.

Table (6-14): The Sustainable Design Model: Included Independent Variables

Variables Included in the Model EG= Egypt Model US = USA Model	Ecological carrying capacity		Social carrying capacity		Psychological carrying capacity		Physical carrying capacity		Economic carrying capacity		Managerial carrying capacity		
All Independent Variables	EG	US	EG	US	EG	US	EG	US	EG	US	EG	US	
Landform / topography												□	1
Soils												□	1
Streams / drainage ways	□	□		□			□	□					5
Natural vegetation								□					1
Ground water / wetlands		□						□					2
Terrestrial wildlife		□		□		□						□	4
Aquatic wildlife												□	1
Sand dunes				□			□					□	3
Beach quality								□				□	2
Historic features	□		□										2
Local architecture			□		□								2
Local customs and beliefs											□		1
Local social and health service			□			□				□			3
Local economy / employment		□				□							2
The local housing stock				□		□							2
Recycling waste products								□					1
Recycling water						□	□						2
Use of passive energy technology							□	□					2
Preserving local customs & traditions			□				□						2
Satisfying basic human needs		□				□		□					3
Ecological integrity		□	□			□		□		□		□	6
Using indigenous building materials				□						□			2
Use of non-toxic materials				□									1
Preserving cultural resources		□	□		□	□							4
Providing for spiritual harmony		□				□				□			3
Encourage less consumptive lifestyle		□			□	□	□						4
Efficient use of resources		□		□				□					3
Maintain air quality		□		□									2
Utilizing characteristic and climate		□			□				□	□			4
Public participation	□	□										□	3
Maintenance		□				□		□					3
Traffic and transportation	□	□		□		□							4
Pollution control		□				□			□			□	4
Quality of services, and activities	□					□		□			□		4
Total Account of Variable	5	18	6	9	4	14	6	12	2	6	2	9	93

□ = means independents variable that is significant and included as a determining factor in the regression analysis; otherwise the variable was not significant and was not included as a determining factor to this capacity.

Summary of the Model Application

The matrix above assists readers in visualizing the differences between the outcomes of the application for the proposed models in Egypt and the USA. In summary, there were 93 entries from the 34 variables to the six dimensional capacities. The most frequently entered variables were:

1) The "ecological integrity" variable showed the highest frequency of consideration among the six dimensions of capacity. It was entered 6 times.
2) Seven other variables were considered with high levels of frequency too. They were: "terrestrial wildlife"; "preserving cultural resources"; "encourage less consumptive lifestyle"; "utilizing characteristic and climate"; "traffic and transportation"; "pollution control"; and "quality of services and activities."
3) All other variables were included within one of the six capacities analysis at least once.

The frequencies of variables included are presented in Table (6-15) below.

Table (6-15): Variable Frequencies

USA Model, Frequency of Variables Included	Egypt Model, Frequency of Variables Included
Air quality (2)	Aquatic wildlife (1)
Aquatic wildlife (1)	Ecological integrity (1)
Beach (2)	Encourage less consumptive lifestyle (2)
Ecological integrity (5)	Historic features (2)
Efficient use of resources (3)	Local architecture (2)
Encouraging less consumptive lifestyle (2)	Local customs and beliefs (1)
Ground water / wetlands (2)	Local social and health services (1)
Landform / topography (1)	Pollution control (1)
Local economy / employment (2)	Preserving cultural resources (2)
Local social and health services (2)	Preserving local customs and traditions (2)
Maintenance (3)	Public participation (1)
Natural vegetation (1)	Quality of facilities, services, and activities (2)
Pollution control (3)	Recycling water (1)
Preserving cultural resources (2)	Soils (1)
Providing for spiritual harmony (3)	Streams / drainage ways (1)
Public participation (2)	Traffic and transportation (1)
Quality of facilities, services, and activities (2)	Use of passive energy technology (1)
Recycling waste products (1)	Utilizing site nature and climate characteristics (2)
Recycling water (1)	
Sand dunes (2)	
Satisfying basic human needs in the area (3)	
Soils (1)	
Streams / drainage ways (3)	
Terrestrial wildlife (4)	
The local housing stock (2)	
Traffic and transportation (3)	
Use of non-toxic materials (1)	
Use of passive energy technology (1)	
Using indigenous building materials (2)	
Utilizing site nature and climate characteristics (3)	

Egyptian Model

In the Egyptian Model there were 18 independent variables included; the most frequently entered variables (7 in total) and their corresponding carrying capacities were:

Ecological:

- Utilizing site nature and climate characteristics.

Social/Cultural:

- Historic features,
- Local architecture,
- Preserving cultural resources,
- Preserving local customs and traditions;

Economic:

- Encourage less consumptive lifestyle;

Managerial:

- Quality of facilities, services, and activities.

United States Model

In the American model there were 30 independent variables included, and the most frequently entered variables (10 in total) and their corresponding carrying capacities were:

Ecological:

- Ecological integrity,
- Terrestrial wildlife,
- Utilizing site nature and climate characteristics; and
- Streams / drainage ways;

Psychological:

- Providing for spiritual harmony;

Physical:

- Efficient use of resources;
- Pollution control;

Economic:

- Satisfying basic human needs in the area;

Managerial:

- Traffic and transportation,
- Maintenance.

6.8. CHAPTER SUMMARY

In the past 20 years, the concept of sustainability has been encouraged in our daily lives. Sustainable design recognizes the integral part nature plays in the human community, and stresses the principles of conservation. Sustainable design recognizes the impact of design choice on the natural and cultural resources of the local, regional, and environmental environments. Sustainable design holds that the capability of natural and cultural systems to continue over time is based on their ability to maintain biodiversity, environmental integrity, and incorporate facilities planning, design, construction, and operations that reduce the impacts of human use. Sustainability requires a change in mind-set that leads to less consumptive responsible lifestyles.

There is little research that investigates the applicability of sustainability concept in the planning and design of coastal resorts. Further, the issues related to a sustainable coastal development such as carrying capacity have not been addressed in a systematic manner. A gap exists between the theoretical concepts of sustainability and real world developments. There is a clear need for an implementation tool to examine sustainability application and the role that carrying capacity approach within the context of sustainability could contribute in coastal resort developments. The model presented in this chapter can begin to meet this need.