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Environmental management of Nagapattinam region on se coast of Tamil Nadu, India

J Rajesh[1], C Lakshumanan[2]
[1] Research Scientist, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist-Ahmednagar, Maharashtra, India
[2] Associate Professor, Dept. of. Remote sensing, Bharathidasan University, Tiruchirapalli, Tamil Nadu, India

Abstract
Coastal areas like Nagapattinam with high population growth, migration potential, and higher population density. Further, adverse impacts of human and physical, agriculture and industrial activities were examined along the Nagapattinam coast. In this study to assess the strengths, weaknesses, opportunities, and threats in the coastal zone, the specific method is used for the evaluation of the environmental condition for the integrated coastal zone management. In this regard, internal and external factors gained 2.17 and 5.4 scores. This is investigative of the abundance of weaknesses over strengths and it also shows that opportunities are more than threats. Subsequently 20 strategies were developed and quantitative strategic planning matrix method was also used to give score each strategy. The results of quantitative strategic planning matrix method analysis were programmed in strategic position and action evaluation matrix. The present situation falls within "competitive" classification. This is indicative of weakness in coordinating development and environmental strategic plans. The result of present study emphasis on compilation of strategic environmental plans for the control of population, pollution emission, and land use planning changes. The important strategies include development of environmental regulations and better supervision on enforcement of laws.

Keywords: Nagapattinam coastal region, human activities, SWOT method, SPACE matrix

Introduction

Strategic planning is currently an extended tool for regional development and territorial structuring. Cities, regions, and provinces have carried out their strategic plans on the basis of participation processes, which have driven the later development of their territories (Terrados, *et al.*, 2005) [17]. Environmental analysis is a critical part of the strategic management planning process. The strengths, weaknesses, opportunities, and threats (SWOT) framework is proposed by many as an analytical tool that should be used to categorize significant environmental factors both internal and external to the organization (Pickton and Wright, 1998) [12]. In simple words, a coastal region is a site where ocean and sea come together. It encompasses the coastal line environment and neighboring coastal waters. The constructing parts of this scope can include the following cases: coasts, coastal plains, coastal hills, coral reefs, marshes, river deltas, mangrove forests, and other coastal phenomena. According to the planning framework for integral management of coastal regions and rivers which was proposed by the UNEP in 1995, river coasts and basins include very significant natural environments. However, they are severely affected by human activities. Both of these systems support a huge gamut of socio-economical activities (Mohammadizadeh, 2000) [8]. In other words, coastal regions Ready the environment for purification and refining of industrial activities and also furnish appropriate ground for tourism industry development. In effect and from this viewpoint, the advantages of coastal environments become economically important. These regions are different in types of functions, forms and dynamics and one may not easily recognize the boundaries between them. The systems of coastal resources are natural and precious which should be managed for the sake of the present and future generations. The coastal waters are environmentally very versatile and support a high percentage of oceanic life. However, most of coastal regions are international and inhabited by human beings (Ricketts and Harrison, 2007) [13]. The necessity to innovate some methods for management and protection of environment and marine resources has been broadly subjected to various investigations all over the world during 1950s. In the first conference of the national parks in 1962, preserving marine coastal regions was introduced as crucial issue. (Mohammadizadeh, 2000) [8]. In 1958, four conventions were issued regarding the marine rights under the title "Geneva Conventions". These are like 1) continental plateau convention, 2) high marine convention, 3) fishing conventions, and 4) live resources preservation in open seas in the oceans (Sharifipour, 2006) [16]. The integrated coastal zone management (ICZM) effectiveness study was undertaken between 1995 and 1997 to determine how well state coastal management programs in the United States were implementing five of the core objectives of the U.S. coastal zone management act (CZMA), (Hershman, *et al.*, 2007 [3]; Khan, 1997) [7]. It seems that the first preserved coastal marine region in probably the national Fort Jefferson in Florida in America with an area of 18850 ha. Of seaboard and 35 ha. of coastal regions. Though this region was created in 1935, its existence as a preserved marine region was actually taken several years. The number of these regions in 69 countries reached 430and also 298 regions were under consideration in 1985. Now,

More than 120 countries have preserved coastal marine regions (IUCN, 1999) [4], (Table 1). Coastal management aims at eliminating disputations and looks for adjusting the coastal activities with each other. However, coastal environment management looks after for coordination among at matching these activities with ground capabilities. It eliminates the disputations and via providing the actual layout and evaluating the feasibility. Coastal environment management aims at preserving and improving the coastal resources for an increasing world population which undergoes a growing continuous pressure (Salm and Clark, 1984) [14]. In environmental management planning, these procedures should be scrutinized and they should match different agents. The sociology scholars try to somehow consider a set of experiences of various societies in regional planning, especially in natural resources prosperity and management. They also attempt to create a close relationship between the environmental managers and the regional planners the specialist and standard reports are the most precious management tools in the other coastal phenomena. However, development of local and regional groups and sectional approaches.

Study Area Description

Nagapattinam is a Taluk of Nagapattinam Coastal District of Tamil Nadu., 326 K.M, from south of Chennai, lies between Northern Latitude 10.7906 degrees and 79.8428 Degrees Eastern Longitude. A District is known for its Rich Religious Heritage and Communal Harmony. In Nagapattinam Taluk total population 2011 is 282784. Male is 139917 and female is 142867. The number of house hold in Nagapattinam Taluk is 50793. The Taluk receives rainfall under the influence of both southwest and northeast monsoon. A good part of the rainfall occurs as very intensive storms resulting mainly from cyclones generated in the Bay of Bengal especially during northeast monsoon. The rainfall pattern in the district shows interesting features. Annual rainfall, which is1500 mm at Vedaranyam, the southeast corner of the Taluk, rapidly decreases to about1100 mm towards west of the district. The district enjoys humid and tropical climate with hot summers, significant to mild winters and moderate to heavy rainfall. The temperatures various from 40.6 to 19.3° C with sharp fall in night temperatures during monsoon period. The relative humidity ranges from 70 – 77% and it is high during the period of October to November.

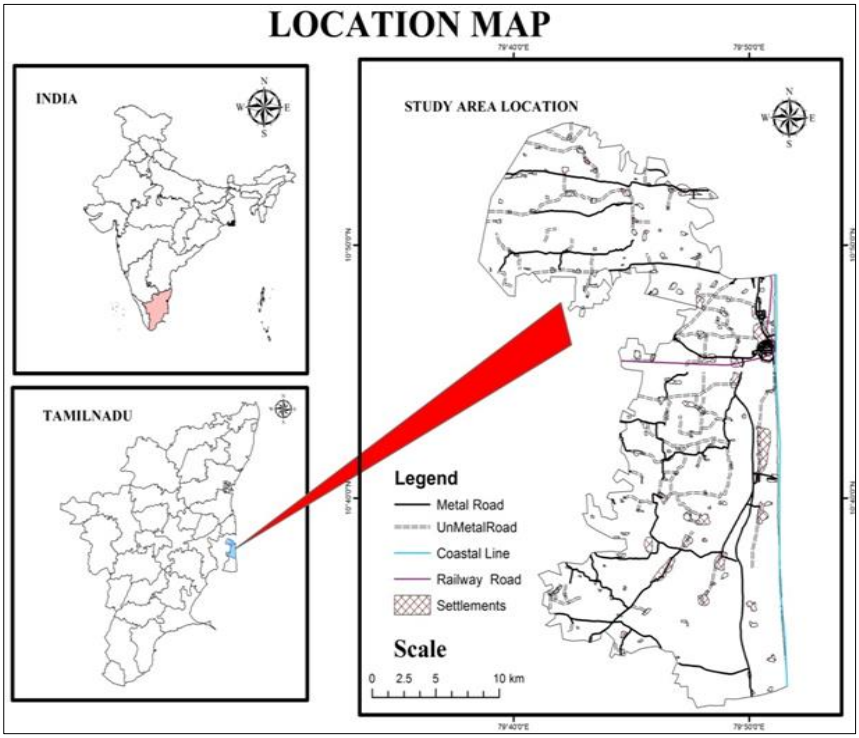

Fig 1: Study area location map

Materials and Methods

The SWOT methodology leads to the obtainment of quantitative results useful in the first two phases of ICZM: in the first phase (initiation) an internal analysis is made through the calculation of environmental quality (strengths) and territory vulnerability (weaknesses) using environmental indicators. Then, an external analysis is made, through the analysis of threats and opportunities: Threats analysis is made by the use of qualitative and quantitative Leopold matrixes that analyze the relation between human activities and natural environment; The opportunities evaluation and analysis is part of the planning phase of ICZM and it is represented by the numerical simulation of various projects on the territory to optimize numerically the results of strengths and threats: This type of numerical analysis leads to a feedback process from the planning phase to the initiation phase: it is possible to calculate the variations of environmental quality (strengths) and of human interactions intensity (weaknesses) due to the simulation of various projects on the territory (opportunities), (Sanò and Fierro, 2003). Table 2

Table 1: stages of ICZM and SWOT analysis

ICZM stage	SWOT stage	System analysis	Evaluation tools
Initiation	Strengths (S)	Internal	Quality indicators
	Weaknesses (W)	Internal	Vulnerability indicators
	Threats (T)	External	Quantitative Leopold matrixes
Planning	Opportunities (O)	External	Change on environmental quality, a decrease of
			human impact
Management	/	/	/

Indicates the stages of ICZM and SWOT analyses. To manage and implement executive plans, initially available resources should be identified. Recognizing the sources is the first step in assessing and planning a land. Without recognizing the parameters relating to the land and marine resources, assessment and planning would be impossible.

Internal factors evaluation (IFE) matrix

Internal factors consist of strengths and weaknesses. Many factors for strengths and weaknesses are determined. These factors are weighted in a way that the sum of these weighs is equal to one. Then, a score is allocated to each factor. These scores range between 1 and 4. Score 1 denotes severe weakness, score 2 shows common weakness, score 3 indicates for a common strength and finally score 4 brings out important strengths. Therefore, there are weights and a score for each factor. Once weight is multiplied by score, attractiveness of the factors can be assessed. If sum of all effective factors is less than 2.5, one can conclude that weaknesses are more than strengths. However, sums more than 2.5 indicate that strengths dominate over weaknesses.

Table 2: Evaluation of internal factors

	Internal factors	No. Weight	Score	Attractiveness
	Strengths			
1	*S_1: Available environmental rules (water, wastes, air, and water boundaries).	0.14	4	0. 56
2	S_2: Presence of Department of the Environment in the province.	0.07	3	0.21
3	S_3: Availability of standard environmental laboratories.	0.03	3	0.09
4	S_4: International collaborations and conventions for preserving the sensitive regions.	0.05	3	0.15
5	S_5: Appropriate implantation patterns for agricultural and garden products.	0.02	2	0.04
6	S_6: Presence of skilful environmental experts in the province.	0.05	3	0.15
7	S_7: Sufficient knowledge about contaminant resources.	0.02	2	0.04
8	S_8: Availability of rules for obligatory reports (EIA).	0.05	3	0.15
	Weaknesses			
10	*W_1: Ignoring the sea boundaries and protected areas in the Developmental and industrial projects.	0.15	2	0.03
11	W_2: Non-Coordination among developmental plans.	0.06	1	0.1
12	W_3: Non-observance of the ecotourism regulations.	0.05	2	0.1
13	W_4: Inaccessibility to the required budgets for environment preservation.	0.1	1	0.01
14	W_5: Unavailability of long-term plans for pollution treatment.	0.08	3	0.24
15	W_6: Excessive concentration on wild life in comparison to human resources by the Department of the Environment.	0.05	2	0.1
16	W_7: Unavailability of strategic plan for environmental preservation.	0.1 1	2	0.2 2.17

S: Strength: W: Weakness

External factors evaluation (EFE) matrix

External factors consist of opportunities and threats. In this regard, all the steps are similar to the IFE matrix.

Table 3: Evaluation of external factors

No.	External factors	Weight	Score	Attractiveness	
		Opportunities			
1		*O_1: tourism attractions	0.08	4	0.32
2		O_2: Legal preparations for collecting environmental penalties	0.02	2	0.04
3		O_3: Preparing the ground to limit the accessibility to sensitive sites.	0.04	3	0.12
4		O_4: Possibility of installing and starting-up systems for collecting and treating sewages.	0.04	3	0.12
5		O_5: Preparing the essential backgrounds to teach people about environmental issues.	0.08	3	0.24
6		O_6: Possibility to categorize coastal areas with regard to tourists and type of usage.	0.08	4	0.32
7		O_7: Receiving tourist costs and its allocation to promote environmental quality.	0.06	4	0.24
8		O_8: Possibility of providing funds as environmental loans to minimize environmental problems.	0.04	4	0.16
9		O_9: Possibility of enhancing and reviewing environmental regulations and supervisions.	0.3	2	0.6
		Threats			
10		*T_1: Discharge of un-treated human wastes and industrial ones in to the environment.	0.10	4	0.4
11		T_2: Unavailability of a central system for collecting litters.	0.05	2	0.1
12		T_3: Excessive consumption of agricultural pesticides and fertilizers	0.08	3	0.24

13	T_4: Congested population per each square km.	0.15	4	0.6
14	T_5: Land use change.	0,16	4	0.64
15	T_6: High ground water tables.	0.05	2	01
16	T_7: High soil erosion.	0.05	3	0.15
17	T_8: Extraordinary concentration of industries in the province compared to other regions of the country.	0.05	2	0.1
18	T_9: Incremental pollution due to flood rivers.	0.05	2	0.01
		1		5.4

O: opportunities; T: Threats

Table 4: Priorities of the executive Strategies for managing the coastal region of Nagapattinam.

No	Strategies	Rate	%
1	Strategies environmental planning to control the population concentration, pollution distribution, and land use planning	7.56	8.27
2	Long-term monitoring programs to recognize the pollution conditions	5.36	5.87
3	Effective application of rules to avoid excessive concentration of industries in one region	5.45	5.97
4	Observance of environmental boundaries on the basis of the type of contaminant combination	5.55	6.07
5	Limiting the establishment of industries on the basis of types of contaminant combinations	5.15	5.64
6	Raising the environmental budgets to control the pollution	4.84	5.30
7	Exact enforcement of environmental rules to act against pollution of producing centers	4.84	5.30
8	Environmental supervision to avoid pollution evacuation around the flooding rivers	4.86	5.32
9	Using the possibilities and experiences of the international organizations in categorizing the coasts, enhancing the financial resources for supporting environment, and executing the environmental penalties	4.15	4.54
10	Dividing the supervision capabilities of the Department of the Environment to balance the required control of the human environment compared to the wild life	4.28	4.68
1	Take more effective results out of EIA reports to identify and categorize the sensitive coastal regions and offering the Environmental training to local communities and the industrial owners	4.68	5.12
12	Matching the developmental plans to promote the quality of coastal environment	4.14	4.53
13	Enacting ecotourism regulations to limit the development of contaminants	4.79	5.24
14	Determining the amount of the required treatment of urban and industrial wastes on the basis of the types of contaminants	4.85	5.31
15	Applying the patterns of garden and agricultural implementation to reduce the consumption of pesticides, to avoid soil erosion, to change the lands functions, and to reduce the contamination of the underground waters	3.58	3.92
16	Using the potential for tourism attraction to accelerate establishing the strategic environmental system and applying ecotourism regulations	3.85	4.21
17	Enacting and supervising the observance of guidelines for considering environmental boundaries	3.56	3.90
18	Providing and starting up monetary fund's to overcome budget problems	2.86	3.13
19	Providing the required budgets for environmental preservation via determining and receiving the tourism costs	3.15	3.45
20	Revising the rules and regulations specific to the coastal regions for better observance of ecotourism regulations.	3.86	4.23
	Total	∑=91.36	∑=100

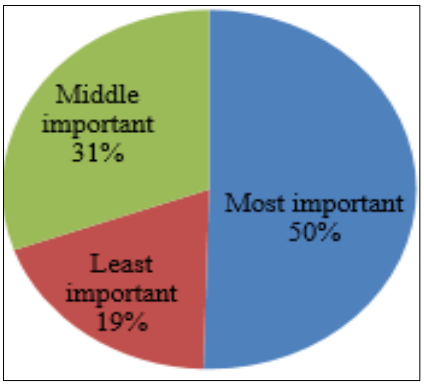

Fig 2: The importance of the strategies for most of the least important

Strategic position and action evaluation (SPACE) matrix

Considering the factors of IFE and EFE matrix for aquaculture, variables that introduce "financial strengths (FS), competitive advantage (CA), environmental stability (ES) and industry strength (IS) are determined. IS and FS are scored between+1 (worst) to +6 (the best). Then the mean of IS factor and the mean of FS factors are distinct on IS and FS axes. ES and CA are scored from -6 (the worst) to -1(the best). The mean of ES factors and the mean of CA factors are averaged on ES and CA axes. Furthermore, algebraic sum of values on the X axes and algebraic sum of values on the Y axes are averaged. These two points determine the Cartesian coordinate of position point. With zero points and position point, the diagram of position evaluation is drawn.

Table 5: SPACE matrix; the matrix for evaluating situations and strategic measures

	Items	Score
	Financial Status (FS)	
1.	There are no legal backgrounds for receiving the environmental penalties	+2
2.	Receiving the tourism penalties and in allocation for the promotion of environmental quality	+4
3.	Providing financial resources for environment preservation	+5
	Industrial Status (IS)	11: 3=3
1.	Feasibility of categorizing the coastal regions regarding the tourist's returns and the usage type	+2
2.	Possibility of enhancing and reviewing the regulations and environmental supervision specific to coastal regions	+3

3.	Tourism attractions	+6
4.	Making use of international collaborations	+2
5.	Environmental rules	+4
	Environmental Stability (ES)	15: 5= 3
1.	Ignoring the environmental boundaries	-4
2.	Excessive concentration of industries in the province compared to other regions in the country	-4
3.	High water surface	-2
4.	Presence of flood rivers	-3
	Competitive Advantage (CA)	-13: 4= -3.2
1.	Unavailability of strategic environmental plans	-4
2.	There is not any coordination among at the developmental plans	-4 -8: 2= -4

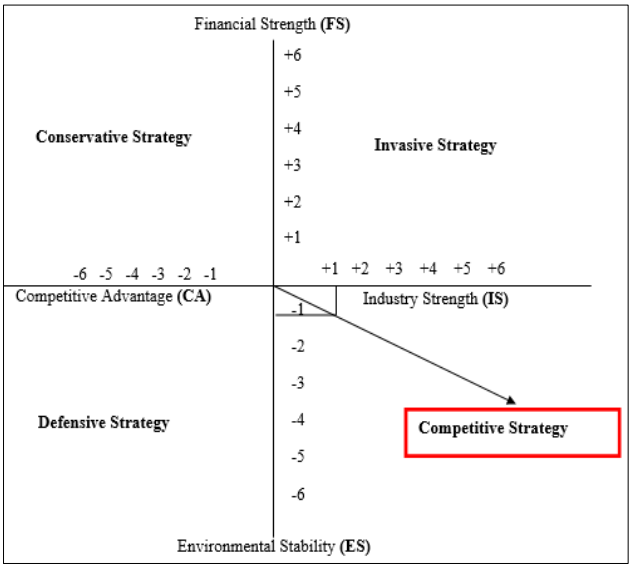

Fig 3: Position evaluation diagram of the SPACE matrix

Quantitative strategic planning matrix (QSPM)

Witnessed judgment is used for the quantitative strategic planning matrix. Determination of cumulative effects of each important internal and external factors can show the proportional attractiveness of each strategy. For presenting a quantitative strategic matrix, quadric factors (strength, weaknesses, opportunities, and threats) from IFE and EFE matrixes are extracted. Allocated weight is written in the following column. Strategies are written in the first row. For score determination, internal and external factors that have a role in success are evaluated. A score from 1 to 4 is allocated to each factor s. If a factor has not any important role in the strategy selection process, it will not receive any score. This method considers collection of strategies simultaneously. With this matrix, infinite strategies can be evaluated. In the next step, sum of attractiveness of each strategy is computed. In this way, a collection of strategies can be considered simultaneously (Parsayan and Aarabi, 2004) [11].

Result and Discussion

SWOT analysis has been praised for its simplicity and practicality. As a framework, it has been widely adopted but, generally, its application has been accepted uncritically. It is timely to reappraise its value as a strategic management tool (Pickton and Wright, 1998) [12]. As Park and Farajzadeh, (2007) [10] have mentioned, due to the different problems that southeast coastal areas, different policies are considered for solving these problems. The policies for the Bay Of Bengal Sea coastlines that are based on the strengths and weaknesses can be categorized as 1.equalization of distribution of population and activities along the coast consistent with the existing ecological capacities, 2. Strengthening potential tourism capabilities and promoting its management efficiency at the national and international levels and giving priority to the private sector, 3. Preventing irregular expansion of coastal cities and considering the shoreline's limitations for establishing new human settlements, 4. Preventing marine environment pollution, prevention of forest destruction, protection of soil-water resources and enhancing shoreline eco-tourism via strengthening environmental management. Water pollution in the rivers flowing into the Sea is slowly detroiting its highly sensitive marine life (Karbassi, *et al.*,[5] a: in press and Karbassi, *etal.*,[6] b: in press). Scientists estimate that each year about 60,000 metric tons of petroleum by products, 24,000 tons of sulfites and 400,000 tons of chlorine are discharged into the Caspian Sea (Aghai, 2003 [1]; Nadim, *et al.*, 2006)[9], 5. Expansion of fishing ports, fishing fleet, fishing industries and increasing aquaculture production and export, 6. Development and equipment of marine terminals and ports and providing required facilities to meet with the increasing demand for cargo transit, 7. Land allocation consistent with coastal environment's potentials and capabilities and 8. Appropriate utilization of soil water resources to increase quality of agricultural products. Hakanson and Blenckner (in press) reported that for coastal management, it is important to defining permissible ranges (lower and upper values), thresholds and points of no return for all bio indicators. This should be done to minimize risks related to changes in ecosystem structure and biodiversity and keeping an open dialogue between scientists, policy makers, administrators and the general public based on facts and reason rather than feelings and emotions, which are ingredients in many "environmental" debates and discussions. In Tables 2 and 3, the external elements and the internal factor matrix along with the relative coefficient and scores are presented. As can be concluded from the results of (Table 2) the sum of the internal factors equals 2.35 which is evident in the dominance of weaknesses over the strengths in the area of study. Moreover, the sum of the coefficients in (Table 3) equals 3.76 that indicates opportunities and the threats are present in the region. In addition to relationship among strengths, weaknesses, opportunities, and threats, the possible strategies were identified. In other words, QSPM can determine the quality of strategy that can successfully use the internal and external effective factors. The associative effects of each one of such internal and external effective factors could determine the relative interaction of each strategy within the application strategy aggregate. Finally by applying appropriate scores and coefficients, strategies were set in accordance with their attractiveness (Table 4). After arrangements of the strategies by their importance, they were categorized into three groups:

important, average and weak. (Table 4) based such categorization. According to (Table 4), it is apparent that about 50% of the strategies are considered as the important strategies, 31% of them are regarded as average strategies, and the remaining 19% is among the weak strategies (Fig. 2). Now, the organization can apply and implement the environmental management strategies in the region, using this prioritization on the basis of time and location. As mentioned in the materials and methods, first of all, the four variables of FS, CA, ES and IS are determined and rated (Table 5). When there is a vector in the matrix invasive position, the organization stands in the possible best status and can take the following measures through using the internal capabilities or strengths: 1. to use internal opportunities, 2. to remove internal weaknesses and 3. To avoid external threats. If the vector stands in the conservative position, it means that organization should preserve its own merits and avoid exposure to high risks. If the vector settles in the defensive position, it means that the internal weak points should be amended and external threats should be avoided. However according to Fig. 3, the position of region does not fall in to the 3 above mentioned zones. The situation of the region under study is using a competitive strategy. This means that special attention must be paid to the competitive strategies, i.e. expressing the strategic environmental planning and matching the plans for development. It should be pointed out that strategic environmental assessment (SEA) is not a common practice in developing countries including India. Thus, development of strategies is considered periodically. Under such situation, the SWOT analysis should be carried out from time to time to meet with new situations. In the present investigation, proper strategies were developed using the SWOT method. These strategies cover wide range of policies that should be implemented at a shorter time. The present study also showed that more clear coordination is needed among various organizations.

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