Peer Reviewed International Research Journal of Geography
Maharashtra Bhugolshastra Sanshodhan Patrika
ISSN : 0971-6785 {Impact Factor 3.687 (IIFS)} Vol. 34, No.2, Jul-Dec. 2017. pp 76-84

IDENTIFICATION OF PRIORITY SITES FOR AQUACULTURE DEVELOPMENT IN MHASALA CREEK AREA, MAHARASHTRA: A GEOMORPHOLOGICAL, MULTICRITERIA APPROACH

Priya Kanojia Shrikant Karlekar

ABSTRACT

Aquaculture is an art of cultivating and raising of fish in enclosed ponds. In spite of environmental dangers due to improperly run aquaculture projects, practices like right management and precautions can help aquaculture farms to operate with minimal environmental impact. Present paper attempts to identify the potential sites of the coastal fish farming around Mhasala creek on Maharashtra coast. Multicriteria analysis technique is used to identify potential and priority sites for developing aquaculture ponds. It focuses mainly on site selection that depends on the geomorphic criteria variables. A positive response to all these variables suggests most suitable sites for the aquaculture practices. A decrease in the response (count) suggests decreasing suitability of the area for aquaculture. Sites were classified on the basis of ascertained priorities. The multicriteria, locational query technique could be used effectively for the selection of aquaculture sites especially in inter tidal environment of the creek. Google earth Satellite image of the Mhasala creek area was used for the measurement of criteria variables.

On the basis of the analysis carried out, it was seen that the inter tidal region of Mhasala creek has a great potential for its development as a brackish water aquaculture farms on Maharashtra coast. Multicriteria analysis technique could be used effectively in this assessment.

Keywords: *Aquaculture, Multicriteria technique, Criteria variables.*

INTRODUCTION

Aquaculture is the farming of various aquatic organisms by stocking, feeding and protection. The farming undertaken in coastal waters is generally known as coastal aquaculture. Mostly aquaculture activity is practiced in the areas just near the limit of creeks or slightly upstream sectors, inter tidal or supra tidal mud flats and mangrove swamps. It was found that each area has its own site-specific problems that result in the degradation of nearby environment. The intertidal mud flats and the near shore terraces were found to be best suited for fish farming. The upstream sectors, mangroves and the beaches were ill suited. The aquaculture is banned within 500 m from high water level according to CRZ (Coastal Regulation Zone) act in India. (Karlekar, 2000) Like elsewhere in India, government has banned fish farming in CRZ on Konkan coast.

Location or the selection of farm site is the crucial factor in all aquaculture practices, especially the brackish water aquaculture. The site selection should normally be area specific considering ecology and environment of that region. Presently fish farming is practiced without any consideration to whether a necessary road link exists up to the site, exchange of fresh water and saline water can be done effectively at the site of fish farming, and how much damage can be caused to the existing agricultural land.

Present paper attempts to identify the potential sites for the coastal fish farming in Mhasala creek area on Maharashtra coast. Multicriteria analysis technique has been used to study the favourable locations and to give future potential sites of aquaculture. In particular it focuses mainly on site selection which depends on the geomorphic criteria variables.

The geomorphology of the coast of Maharashtra influences the ingress of tidal water in the numerous creeks and estuaries of the region. The tidal range, the salinity of the water and the morphology of the inter tidal zones, all these factors are site specific and create a specific estuarine

environment. It appears from the field studies that the area of Mhasala creek is most favorable for brackish water fish farming. Therefore an attempt was made to assess the potential and prospect of brackish water fish farming in this area.

STUDY AREA

Mhasala creek is located on the southern shore of Raigad district and extends between 180 8' N and 180 15' N latitudes. The total length of this creek is 30km.It is basically an arm of the main creek called Rajpuri creek. Rajpuri is a tidal creek system joined by river Mandad from north and Mhasala creek from south. (Fig. 1)

Field observations showed that the tidal creek has thick growth of mangroves all along its banks. The hill slopes are within 200 to 300 distances from the creek. Some areas are cultivated but the high salinity and salt encrustation are the major problems of the agricultural terraces. The creek banks have large potential for aquaculture as they have good road linkages and the tide provides better quality prawns and shrimps. Intertidal area within the estuary is an extensive flat and therefore suitable for aquaculture. The breeding of shrimps and prawns is possible in the area as they can sustain the salt levels of the tidal water.

Tidal water in Rajpuri and Mhasala creek penetrates upto Village Mhasala located to a distance of 30 km upstream. The entrance of Mhasala creek can be identified near Turumbadi, whereas the entrance of the Rajpuri creek is 5km seaward of Dighi and Dande. The creek is bordered by mud and mangrove swamps on its seaward margin. The geomorphic map of the creek prepared from 1:50000 S.O.I. toposheet is given in (Fig.3) which shows the topographic positions and extent of various sedimentary environments in the creek.

The morphology of the creek mnfrom north to south clearly shows steep creek side escarpments. These modified escarpments suggest subsidence of land. The bed profile of the creek has virtually no slope and the creek is filled at high tide and converted to a tidal sea at every flood. (Karlekar 1995)

SITE SELECTION IN COASTAL AQUACULTURE

It has been already stated that beaches, mangrove swamps, intertidal areas as well as upstream areas are used for coastal aquaculture. Table 1 gives relative importance of each site.Careful selection of suitable sites is an essential prerequisite for successful coastal fish farming. Failure to realize this before any project is commenced is likely to cause the ultimate failure of the project , which not only has unfortunate consequences for the farmer and investor(s) involved but may also cause serious damage to the prawn farming, both nationally and even internationally.

TABLE: 1 Site specific problems of Coastal Aquaculture

SR. NO	SITE	DESCRIPTION	SUITABILITY AND PROBLEMS FOR COASTAL AQUACULTURE	ENVIRONMENTAL PROBLEMS
1.	Beach area	Landward area of coastal zone above high tide level; sandy soils	Highly percolating soil; will require additional pumping of sea water; salinity on higher side for tiger shrimp growth; needs groundwater extraction to dilute sea water	Salinisation of ground water in surrounding areas; contamination of groundwater with pond sediments over time due to seepage; where seepage too high it can affect floors and walls of fishermen huts.
2.	Mangrove area		High reclamation costs; acidic soil will cause failure after 2-3 crops	Destruction of nursery grounds for fin fish and shell fish; destruction of natural barrier against cyclones
3.	Supratidal / Intertidal area	Mud flats or vacant lands surrounded by natural brackish water resources (estuarine creeks, river mouths, back waters)	Best site for coastal culture with suitable salinity and each drainage of waste water; if too many farms using same water source, will lead to deterioration of inlet water quality and affects coastal crop	Organic pollution of creek waters if too many farms; if ponds put up on mud flats that provide outlet for flood water, then flooding of nearby agriculture farms and villages possible during monsoon
4.	Upstream area	Beyond coastal zone and having agriculture lands with alluvial soil	Low salinity causing stress to shrimp; pesticide residues may also cause stress to shrimp	Loss of good soils, salinisation of nearby agricultural lands and freshwater aquifers

SOURCE: Survey of the enviror

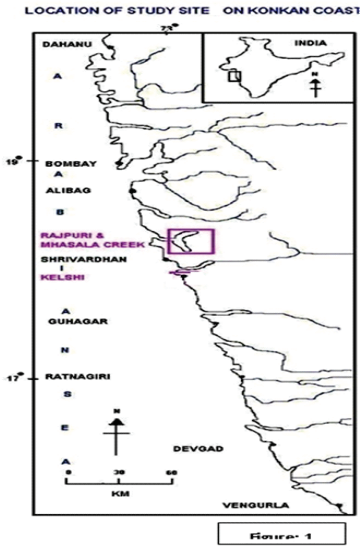


Figure: 1

GEOMORPHIC MAP OF MHASALA

Creek Name	Rajapuri	Mhasala	Mhasala
Location	18^0 15' N Lat. 73^0 04' E Long.	18^0 13' N Lat. 73^0 04' E Long.	18^0 11' N Lat. 72^0 59' E Long.
Maximum Width	4.30km	4.30 km	4.30 km
Tidal Range	2.5 m	2.5 m	2.5 m
Creek Length	24.75km	24.75 km	24.75 km
Hight of northen head land	352 m	352 m	352 m
Hight of sounthern head land	336 m	336 m	336 m
Hight of aquacultural site	6 m	8 m	6 m
Nearby villages	Rowala	Tala, Majgaon	Borli, Vadawali

METHODOLOGY:-

The geomorphic assessment of the creek was done on the basis of field observations and satellite image analysis of the area. The satellite image was inserted with the help of Global Mapper and employed for the image analysis. This helped in precise identification of criteria variables selected for assigning fish farming priority to different sites along the creek. A grid with the 1 square kilometer cell was superimposed on the satellite image of the area. Nine different criteria variables given below were identified and used to assign suitability count for each grid area (Photo 1 and 2) as suggested by Karlekar (2000).

1. Proximity to Mud flats.
2. No mangroves in the unit.
3. Area not cultivated.
4. Terrain height < 10m.
5. Road links.
6. Terrace
7. Part of estuary.
8. Downstream location.
9. In CRZ limits.

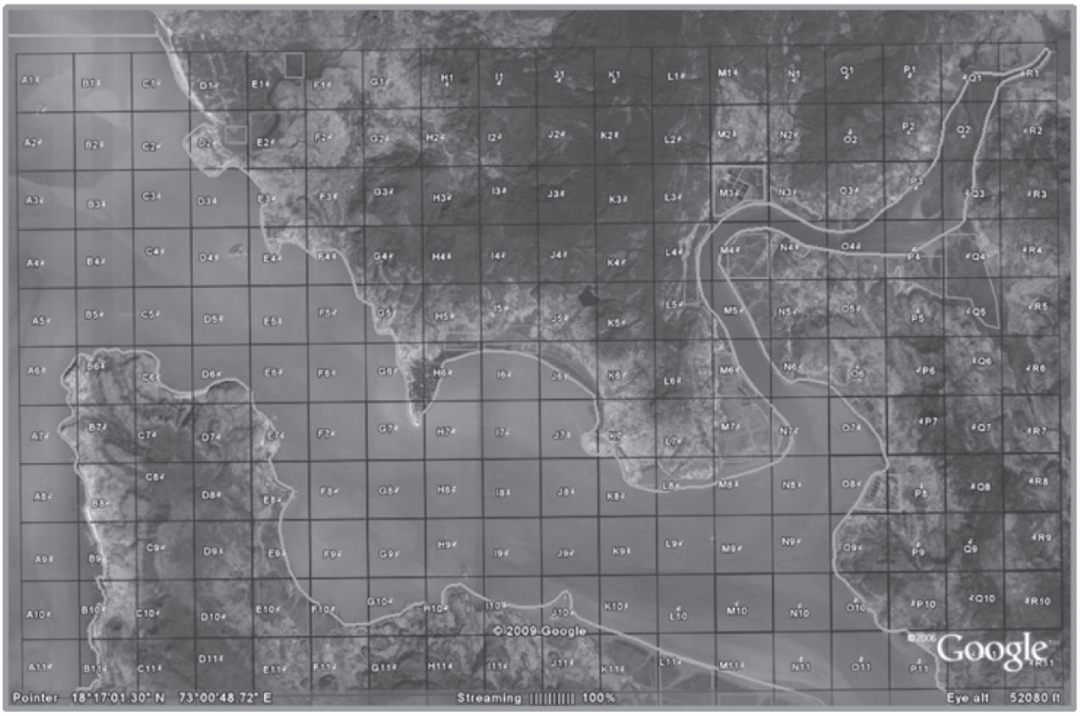
CRITERIA VARIABLES:-

1. Proximity to Mudflats: - The inter-tidal mud flats are more conductive for the construction of earthen bunds of aquaculture ponds. Rectangular ponds can be easily built as little space is wanted between the ponds (Landau 1992).
2. No Mangroves in the unit area: - Aquaculture should not be practiced at the cost of mangroves because it can destroy nursery grounds for fish and prawns. Moreover these low-lying areas will demand high reclamation costs.
3. Area not cultivated: - If the areas are already cultivated they should not be used.
4. Terrain height < 10m: - The flat land below 10 m height is found to be most suitable for the construction of ponds.
5. Road links: - Facility of road links for the quick transport of farm fishes is very essential.

6. Terrace: - A narrow terrace on rocky coast can be used for the activity by constructing bunds and lifting the tidal water from nearby creek.
7. Part of estuary: - The preferred location should be a part of estuary. Inter tidal and supra tidal flats are the best sites for shrimp aquaculture. (Vivekananda 1998).
8. Downstream location: - The site, as far as possible, must be close to the confluence of the tributary stream with the creek and thus have a downstream location.
9. In CRZ limits: - The farm site can be in a buffer section of CRZ zone.

TABLE: 3 MULTICRITERIA ANALYSES OF RAJPURI AND MHASALA CREEK

Multicriteria Analysis of Rajpuri And Mhasala Creek												
Sr.No	Grid Square	Criteria Variables as Indicated in methodology									Total Count	Priority
0	0	1	2	3	4	5	6	7	8	9	0	0
1	B7	0	0	0	0	1	0	0	0	1	2	4
2	B8	0	0	0	0	1	0	0	0	1	2	4
3	B9	0	0	0	1	1	0	0	0	1	3	4
4	B10	0	0	0	0	1	1	0	0	1	3	4
5	B11	0	0	0	0	1	1	0	0	1	3	4
6	B12	0	0	0	0	1	1	0	0	1	3	4
7	B13	0	0	0	0	0	1	0	0	1	2	4
8	C6	0	0	1	1	0	0	0	0	1	3	4
9	C7	0	0	0	0	1	0	0	0	0	1	4
10	C13	0	0	0	1	1	0	0	0	1	3	4
11	D1	0	0	0	1	1	0	0	0	1	3	4
12	D2	1	0	1	1	1	1	1	1	1	8	2
13	D7	0	0	0	0	1	0	0	0	0	1	4
14	D8	0	0	0	0	1	0	0	0	0	1	4
15	D10	0	0	0	0	1	0	0	0	0	1	4
16	D13	0	0	0	1	1	0	0	0	1	3	4
17	D14	0	0	0	0	1	0	0	0	0	1	4
18	E1	1	0	1	1	1	1	1	1	1	8	2
19	E2	1	1	1	1	1	1	1	1	1	9	1
20	E3	0	0	1	1	1	0	0	1	1	5	4
21	E4	0	0	0	0	1	0	0	1	1	3	4
22	E7	1	1	1	1	1	0	1	1	1	8	2
23	E8	1	1	1	1	1	1	1	1	1	9	1
24	E9	1	1	1	1	1	1	1	1	1	9	1
25	E10	1	1	1	1	1	1	1	1	1	9	1
26	E11	1	0	0	1	1	1	0	1	1	6	4
27	E12	0	0	0	0	1	1	0	0	0	2	4
28	E13	0	0	0	0	1	0	0	0	0	1	4
29	E14	0	0	0	0	1	0	0	0	1	2	4
30	E15	0	0	0	0	1	0	0	0	1	2	4
31	F1	0	0	0	1	1	1	1	1	1	6	4
32	F2	0	1	1	0	1	1	0	1	1	6	4
33	F3	0	0	0	0	1	0	0	0	0	1	4
34	F4	0	0	0	0	1	0	0	1	1	3	4
35	F5	0	0	0	0	1	0	0	0	1	2	4
36	F10	1	1	1	1	1	1	1	1	1	9	1
37	F11	1	1	1	1	1	1	1	1	1	9	1
38	F13	0	0	0	0	1	0	0	0	0	1	4
39	F14	0	0	0	0	1	0	0	0	0	1	4
40	F15	0	1	0	1	1	1	1	1	1	7	3



GRID SUPERIMPOSITION ON MHASALA CREEK AREA

P: 1

DISCUSSION:-

Aquaculture farms are built in the inter-tidal sectors of the creek or on the nearby terraces so as to become more profitable (R.S.R.R., 1980). However, type of terrain is an important factor in the selection of aquaculture sites. It is a crucial factor in brackish water aquaculture (Landau 1992).

Selection of such sites is now possible with the use of satellite image of the area and the multi-criteria locational query technique. The effectiveness of site selection depends on the criteria variables used (Dhavalikar 2000). The criteria variables used in this work are given above. Positive responses to all the criteria variables (count 9) suggest most suitable sites for the aquaculture practices. Decreases in the response (count 8 to 5) suggest decreasing suitability of the area for aquaculture. Sites were classified on the basis of priority.

MHASALA CREEK:-

Priority 1 Sites: - These sites are the best sites for aquaculture and fulfill all the requirements designed by criteria variables. Count 9 sites are included in this category. The sites are located on the supra tidal flats, mainly on the southern bank of the creek. Out of 185, 34 sites (18.38%) are included in this category. (Table 3 and Figure 4)

Priority 2 Sites: - The sites with count 8 are included in this category. These are most frequent sites (21.62%) in the area. The location of such sites is on the narrow terraces bordering the creek and also in the mangroves area. They are in effect the "Buffer sites" as they are above high tide level but at the foot of nearby hills. Although the sites are within CRZ limits, aquaculture farms developed here are less likely to affect the natural environment (Vivekananda and Kurien 1998). These areas are not the

agricultural lands and can be used profitably for fish farming. Some of these sites do have scanty mangrove cover, which can be cleared considering their depleted condition. Few sites are in the stream courses where salinity of water level is below desired level and can cause stress to the shrimps (Landau 1992). In such areas pumping the water from the creek can increase salinity of the ponds.

Priority 3 Sites: - Most of the sites with count 7 (8.65%) are included in this type. The site are sand covered, narrow mudflats, covered by mangroves but can be used for aquaculture, by properly maintaining the salinity and temperature of the pond water. (Figure 5)

Priority 4 sites: - Such sites are the areas with count below 7 (51.35%). The sites are either on the lower segment of hill slopes or in the upper courses of the stream courses. In few cases they are even cultivated. For the aquaculture road linkage is also an important factor. In the priority 4 sites mostly road linkage is not there. Aquaculture can be practiced even here but it will not be profitable. Cost factor will play an important role.

TABLE: 4 CRITERIA TABLE

	Mhasala Creek		
Criteria	**Count**	**T Count**	**Area %**
Most Suitable	9	34	18.38 %
Suitable	8	40	21.62 %
Average	7	16	8.65 %
Poor	<7	95	51.35 %

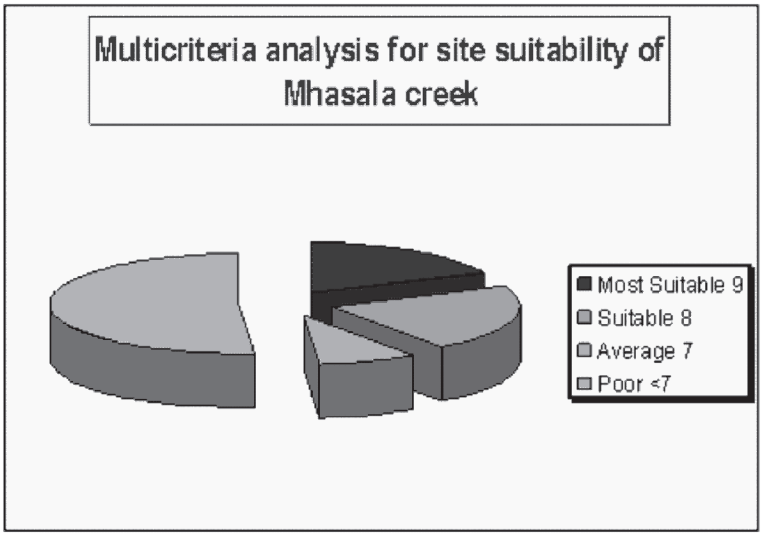


Figure: 4

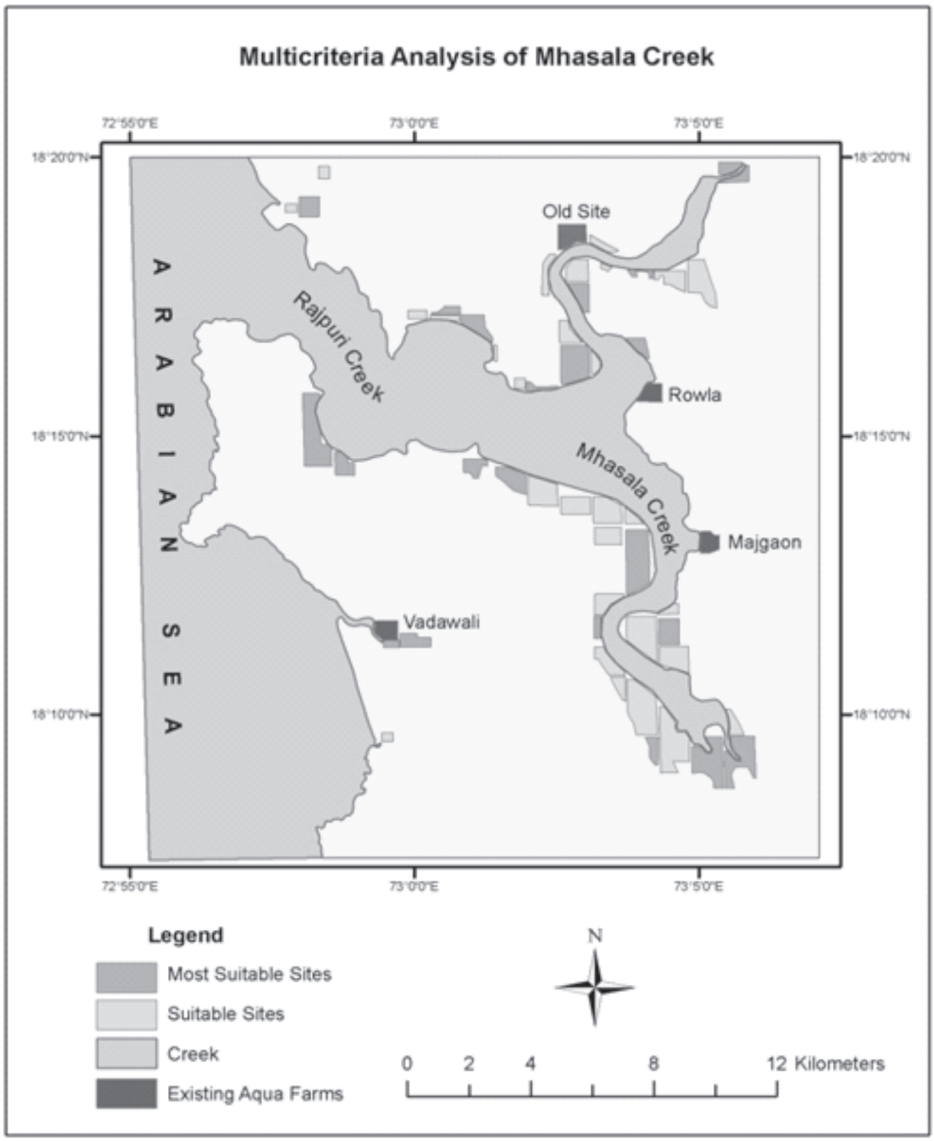


Figure. 3

CONCLUSION:-

The multicriteria, locational query technique could be used effectively for the selection of aquaculture sites. Satellite images of the Mhasala creek area were used for the identification of criteria variables. It was found that the computer assisted image analysis technique used has many advantages over conventional methods.

The detection of criteria variables is easier on the image. Various land facet and

terrain details could be segregated, mapped and field checked afterwards. The site selection that is a crucial factor in aquaculture was best achieved by this method. It also assisted in assigning priority counts to the sites. The work suggested that the Mhasala creek has a great potential (Figure 5) for its development as a brackish water aquaculture center on Maharashtra coast.

The techniques take into account all the relevant and important factors controlling aquaculture activity. It can be used for selection of best suited sites from other creeks on Konkan coast also. In the same way this techniques can be used to identify distinctive sites for different coastal activities and in coastal biodiversity studies.

They are used mainly for prawns or shrimp farming. The area along the creek bank has large potential for aquaculture as it has good roads linkages and the creek provides better quality prawns and shrimps. The intertidal area within the estuary is extensive flat and therefore suitable for aquaculture. The breeding of shrimps and prawns is possible in the area as they can sustain the salt levels of the tidal water.

The work shows that the aquaculture site should have good accessibility for easy and fast transportation of prawns to the market. Hilly region, uneven terrains, sloppy region should be avoided as far as possible. Human resources also play an important role in aquaculture. Most suitable sites are found to be associated with creek banks and in some cases even in upstream sectors. These sites being area specific may change from creek to creek. It is therefore essential that multicriteria analysis is carried out separately for each creek, since the coastal environment and sedimentary environment of every creek are specific and controlled by tidal factors at that site.

It is very interesting to note that some of the priority sites suggested in work are being presently used as profitable and eco friendly sites of aquaculture farming along the banks of Mhasala Creek in Maharashtra.

BIBLIOGRAPHY

1. Dhavalikar, L. (2000): Use of IRS - IC image in the identification of suitable aquaculture site. A case study of Kochare creek, Maharashtra, in Applications of Remote Sensing Techniques, a special issue,ed Karlekar, S.N. Maeer's MIT Pune Jr. pp. 37 - 42
2. Karlekar, S.N. (1995): The Morphological assessment and the scheme for the development of Kharlands of Mhasala creek (Maharashtra), ICSSR financed research project.
3. Karlekar, S.N. (2000): A Geographic assessment of the potential prospect of aquaculture in Majgaon Creek on Konkan coast, Indian Journal Of Geomorphology, Volume 5, Number 1 & 2, pp. 161 -167.
4. Kirk, R. (1987): A history of Marine fish culture in Europe and North America, Fishing books Ltd., England.
5. Kutty, M.N. (1980): Aquaculture in South East Asia, pp. 159 – 168.
6. Landau, M. (1992): Introduction to aquaculture, John Wiley and Sons, pp. 3 -38.
7. R.S.R.R. (1980): Ratnagiri Sindhudurg Resource Region, Vol.1, survey paper, pp. 62 -63.
8. Rhodes, R.J. (1986): Status of world aquaculture, Aquaculture Magazine, Buyer"s Guide, pp. 62 - 63.
9. Survey of the environment(1998): The Hindu publication Page 29.
10. Vivekanandan, V. and Kurian, J. (1980): Aquaculture - Where greed overrides need, in The Hindu, Survey of the environment, Chennai, pp. 27- 29.

***Ms. Priya Kanojia**
Research Scholar,
Department of Geography,
University of Pune.

****Dr. Shrikant Karlekar**
Former Dean, Faculty of Earth sciences,
Tilak Maharashtra Vidyapeeth, Pune