

## **Strategies to Integrate Communities and Geo Spatial Technologies for Sustainable Development along Tarkarli - Devbag Coast, Maharashtra (India)**

**Dr. Yogesh Pisolkar**

Symbiosis Centre for Management Studies, Symbiosis International University  
Viman Nagar, Pune 411014, yogesh.pisolkar@scmspune.ac.in

**Dr. Navendu Chaudhary**

Symbiosis Institute of Geoinformatics, Symbiosis International University  
Model Colony, Pune 411016, navendu@sig.ac.in

### **Abstract**

Maharashtra coast is popularly known as 'Konkan'. The Konkan with an approximately 720 km long coastline and a narrow coastal plain stretching from north to south is a distinct physiographic region of Maharashtra (India). The coast lies to the west. On the east, the Konkan is separated from upland Maharashtra by the west facing escarpment of the Sahayadri mountain range. Plateaus and hills dominate the landscape in the narrow stretch of land between the coastal plain on the east and the Sahyadri on the west.

Towards the southern end of Maharashtra's coastline lies the Sindhudurg coastal district. This region along the Sahyadri Range on India's west coast is internationally acclaimed for its sun and sand. Apart from the beautiful beaches and island forts, the coast is also well known for fruits — mangoes, cashew nuts and kokum—which in turn attracts a lot of tourists and traders, making this a busy stretch all through the year. The area is also notable for its unique coastal and marine biodiversity (UNDP 2011).

The Arabian Sea is slowly eroding some of the seashores in Sindhudurg district. Frequency and intensity of beach and creek erosion events has increased along the Sindhudurg coast in

general and along Tarkarli-Devbag spit in particular. Tarkarli-Devbag Spit (15°57' N to 16°1'N latitude) and (73°29' E to 73°31' E longitude) is a 6 km. long sand spit about 16 km. South of Malvan on Maharashtra coast. The spit bar is connected to main land near Tarkarli. Southern end of the bar abruptly ends in sea near Mobarwadi. The eastern edge of the spit is bordered by tidal stretch of river Karli. The western margin faces Arabian Sea. Rapidly growing tourism activities on Tarkarli-Devbag spit are creating additional stress on ecosystem services. Deteriorating ground water quality is another major threat. Community people are not realizing the importance of ecosystems services for sustainable development. An attempt is made here to study the spatio-temporal changes in the study area and create a matrix of issues and potential strategies for sustainable development of Tarkarli-Devbag.

**Key Words** - Erosion, Geospatial Technologies, Tourism, Sustainable Development (SD)

**JEL classification code: Z32 (Tourism and Development)**

### **Introduction**

Coastal communities world-wide are faced with difficult problems of shoreline erosion control because of the high land values inherent in the shore zones. Chronic erosion as well as storm erosion can be viewed as important management problems (Pilarczyk, 1990). Beaches and dunes have very important recreational value. Beaches are generally not affected by coastal erosion. In principle coastal erosion only causes beach problems if a fixed structure such as sea wall lies behind the beach. In the dune areas there are recreational facilities such as camp grounds, structures such as hotels and restaurants in the first dune-row area, of course, endangered by erosion (Cess, 1990). Tarkarli-Devbag sand spit is a 6 km long detached type of beach about 16 km South of Malvan on Maharashtra coast. The spit bar is connected to main land near Tarkarli. The southern end of the bar abruptly ends in the sea near Mobarwadi. The eastern edge of the spit is bordered by a tidal stretch of river Karli. The western margin faces the Arabian Sea. (Pisolkar, 2008, Fig1A, B).

Fig 1A Trakarli Devbag Administrative

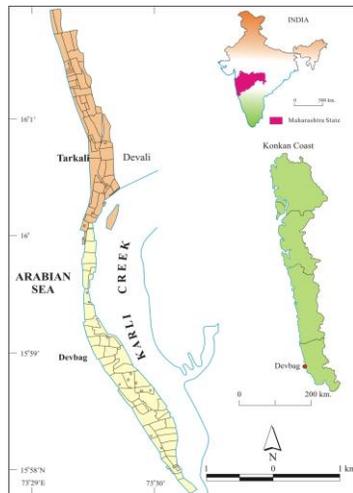
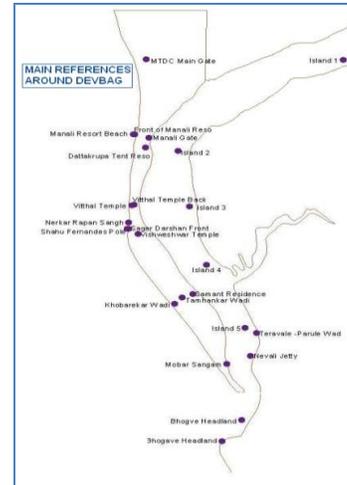


Fig1B Tarkarli – Devbag Spit



The area is showing a tendency of severe breaching and erosion of shorefront since last century Fig (2). Field visits (for last 20 years) show that encroachment and erosion by sea have accelerated after December 2004. The tendency of creek infill is a recent phenomenon as reported by the locals and supported by satellite images & the Naval Hydrographic Chart of the Karli Creek of last few years. The constructional work, along the banks of the upstream sector of river has definitely enhanced the rate of fluvial sediment supply from the catchment. In addition to this factor, the relative balance of wave, fluvial and tidal influence as well as ecological changes and overall development are also reported from other places by many authors. (Roy, 1984). The islands, plumes and shoals at the entrance of Karli creek are shaped by waves. Sand moves into the inlet by flood tide forming an extensive flood tide delta which infills most of the lower part of creek. The shoals developed some more distance inland into the creek are the results of low tide excursion of water and supply of fluvial sediments to the creek Fig 2.

The complexity of the infill has increased in last two decades leading to shallowing of creek and channelisation of the flow through narrow, elongated shoals. Water level fluctuations within the creek especially in monsoons are determined by tidal prism and fluvial discharge. The fluctuations are responsible for the creek bank cutting and retreat of spit bar from creek side. The lower part of the creek especially between Tarkarli and Mobar is subject to intense

human activity in last decade or so, in the form of recreational facilities for tourists, construction of jetties etc. The tidal creek and surrounding area is extremely sensitive to changes caused by either natural factors or human interferences. The tidal sector up to Nerur Par 30 km. upstream is ecologically very sensitive. Karli creek is facing massive sedimentation and decrease in its depth resulting in formation of sand bars, sand islands and numerous sand lenses. It produces strong currents along creek banks resulting bank cutting and collapse of creek bund (Pisolkar, 2008). Southern section of the beach near Mobarwadi (Fig 1B, Fig2 Image 1997, 2006) has been experiencing severe erosion in monsoon since long. Realizing this fact geo tubes were put by government from 2009 which has protected the beach from severe erosion for last couple of years and also length and width of the beach has increased considerably in southern part Fig 2, Image 2014.

Fig 2. Chronological Changes of Devbag Spit since 1894.



### Objectives of Paper:

This paper is an attempt to highlight the coastal problems of Tarkarli – Devbag, Karli Creek Management and to suggest certain action points to integrate local people and available technologies for SD.

An attempt is made here to highlight

- i) Spatio-temporal changes in villages Tarkarli-Devbag and Karli creek.
- ii) Changing Environment
- ii) Matrix of issues and suggested strategy/plan for mitigation and adaptation with focus on community involvement

However, the authors would like to mention the limitations like data (which can be provided in given limits) while drawing readers' attention to the issue. The paper is based on the Beach and Creek Erosion problem of Devbag beach and Karli creek, a doctoral research of Dr. Yogesh Pisolkar (author), recent field surveys, interactions with communities and Gram Panchayat staff with ongoing research work, literature review and previous works. However, we have included detailed studies of each component before arriving at a final conclusion. While suggesting these approaches authors clearly want to state & emphasize on what should be implemented without adversely affecting livelihood of the people, ignoring flip sides of manner in which development has occurred in village Devbag.

### **Literature Review and Previous works –**

Tarkarli- Devbag coast is facing coastal erosion problem for last five to six decades. There is urgency to mitigate this problem with coastal protection (Pisolkar, 2008). Coastal tourism picked up on Tarkarli–Devabag spit in last two decades (Pisolkar et al.,2013,2014,16).Coastal communities all over the world are getting affected by shoreline erosion problem. Management of these natural disasters is necessary (Pilarczyk,K 1990). There is need to develop new strategies to meet the future challenges. It is not just one factor but a host of factors in combination that need to be addressed to make our coast safe, Planning which takes care of the socio-economic and environmental issues, increasing peoples participation, capacity building are some of the measures to move from a culture of reaction to one of prevention (CEE,2009). A collaborative research project - 'Measuring, monitoring and managing sustainability the coastal dimension' - that set out to understand how societal driving forces impact ecosystems. The research was interdisciplinary, combining the social with the natural sciences. The objective was to integrate across disciplines, examines the environment-development interface, and bridges the divide between the natural and social sciences, building on the strengths and constraints of both. This Indo-European collaboration was able to initiate dialogues on many fronts, across cultures, disciplines, and stakeholders (Noronha et. al. 2003).Realizing the importance of the Sindhudurg Coastal and Marine Ecosystem (SCME), UNDP-GEF with implementing partner Ministry of Environment and Forest (MoEF) has worked on improving the conservation

prospects and sustainable community livelihoods from 2011-16 with local peoples participation (UNDP, 2011)

### Method of investigation

Data Sources	Field Component	Laboratory Component
Formline map of study area published by Survey of India in 1894	Field visits, field measurements	Preparation of base map
S.O.I. Toposheet (47 H/8, 48 E/S and E/9)	Surveying and field mapping	
Cadastral map of Devbag  The Naval Hydrographic Chart of the Karli Creek. (Harbour and Port division at Khar Mumbai)	Interviews with locals	Mapping of history and events
Newspaper's and other media reports		

### Civic Aspects

Apart from geomorphic issues, Tarkarli - Devbag are now facing anthropogenic issues representing many coastal areas on Indian coast. In last century, majority of the people were primarily dependent on fishing for livelihood. Since 2002, coastal tourism has picked up with tourists arriving mainly from Maharashtra, from other Indian states and even abroad recently. This has added to complexity to problems created by geomorphic changes of the area.

Some important aspects are as follows:

1. The problem of erosion at Devbag is due to erosion of seaward edge of the spit due to waves as well as bank cutting from creek side. The areas prone to destruction which are very sensitive from the view point of local people are concentrated near middle part of the spit along the latitude of Vithoba Temple and the southward extent. (Pisolkar, 2008, 2013). In addition to this growing unplanned infrastructure and tourism activities is

adding fuel to already prevalent problem and is measure threat for coastal protection. Karli Creek is now extensively used for tourism activity. There are about 100 people in Mobareshwar sangh and Mahapurush Sangh engaged in boating for tourist. In addition to this private speed boat operators use Karli creek for adventure tourism activities. Collapsing of creek bunds due to waves created by speed boats is a great concern for the people along the banks.

2. Change in land use pattern infesting in increasing constructions and decreasing natural habitats (Photo Plate 1). Construction of more and more hotels closer to sea to encourage beach tourism in spite of coastal disasters (Photo Plate 2).
3. Discussions with local people suggest that more and more bore wells are dug to cater the domestic as well as tourist needs in last 3-4 years. According to local people previously salinity used to be very high from May but now it is very high from the month of March. Deteriorating water quality trend due to increasing demand of water for tourism will increase the competition for water. Already some people in Devbag (near Vithoba Temple and Mobar) and Tarkarli are in search for new water sources for drinking water. There is general awareness regarding ecosystem services but extent of knowledge base needs to be investigated.
4. Local people of Devbag, Tarkarli are shifting their livelihood from traditional trades to service sector. Majority of the community people working in the tourism especially tourist accommodation sector is not professionally trained and hence lack in providing quality services required in modern day.
5. Lack of synergy to integrate resources (both natural and human) for sustainable development.

Interrelation between geomorphic and anthropogenic aspects mentioned above have raised question mark over sustainability of fast developing tourism industry and its long term and short term impacts over local communities as well as ecosystem.

Photo Plate 1: Land Use Land Cover (LULC) is showing increasing trend infesting more and more constructions of hotels.

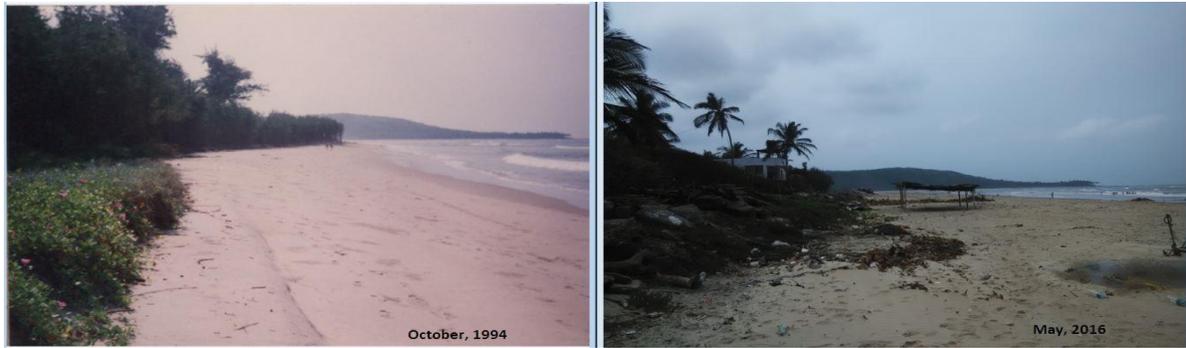


Photo Plate 2: Sea Facing Luxury(A,B), Budget(C) and Underconstruction(D) hotels on Sand dune system on Devbag Spit.



The above context leads to some conclusions like:

Localized human activities may be accelerating coastal erosion but this needs to be investigated,

Coastal erosion and unplanned tourism may adversely impact the local economy and the tourism industry in near future due to competition for resources (especially quality of water).

All human activities anyway need to be planned keeping in mind their actual and potential adverse impacts on communities and ecosystems. Hence, for the sustainable development there is urgent need for training, capacity building, education and awareness among various stake holders in villages Tarkarli and Devbag.

### Efforts so Far

Villages have noticed threats due to coastal erosion and due to loss of property. People in Devabag have raised concerns as and when it was required for at least 30 years. People have been consistently passing resolutions in Gram Panchayat and following up with Government Departments like Harbour and Port Division (*Pattan Vibhag*), Central Water and Power Research Station (CWPRS), for construction of anti-erosion wall and creek bund along different sections of the beach. Subsequently Maharashtra Government built an anti-erosion wall and creek bund in certain sections. However, anti erosion wall subsides in some parts of beach owing to strong wave action during rough weather. Creek bund is also vulnerable. Dredging of Karli creek for last few years has not yielded much.

Here is a suggested matrix of issues and participatory strategy. Brief description of the strategy components is given below. However, authors would like to clearly mention that each of the components in table needs thorough research for adequate database towards implementation.

	<b>Problems and aspects to be examined</b>	<b>Suggested strategies</b>
A	Nature and extent of beach erosion and its impact	Hazard Assessment Matrix (HAM)
B	Allotment of resources during mitigation and adaptation - Prioritize response to various events	Vulnerability Assessment Strict implementation of Environment Impact Assessment (EIA) through independent expert agencies. Research on appropriate options including required modifications in structure and placement.
C	Ecosystem Services – Taken for	Identify types of ecosystems and their services to

	granted leading to unplanned exploitation	communities
D	Inadequate knowledge of local communities and their dependence on Government mechanisms Need for Environment Education (EE), Capacity Building, Training, Awareness	Awareness campaign related to environmental and socio-economic issues Decentralization of Governance
E	Inadequate synergy among Govt departments, academic institutes, Non Government Organizations-Community Based Organizations and communities	Strengthen Maharashtra Coastal Zone Management Authority (MCZMA) Evolve Regional Centre of Expertise (RCE) for sustainable coastal development

**A. Hazard Assessment Matrix (HAM)**

Hazards can become extreme events which could turn into disasters when population/system does not possess adequate capacity to cope up. A technique to keep track of past and present hazards in order to build up resilience is termed as HAM (CEE, 2009). There is urgency to keep records of the past events (especially destruction due to storm surges and creek bank erosion) in case of Tarkarli - Devbag coast to address the local needs of vulnerable communities and to develop Community Based Disaster Risk Reduction (CBDRR).

Hazard type	Origin/ Cause	Warning signs	Speed of onset	Intensity	Frequency	Duration	Geographical extent	Magnitude of damage	Season	Recent Trend

(Source CEE, 2009)

**B. Vulnerability Assessment**

Vulnerability assessment is the process where we identify the problem, quantify it, and assess the risk rate in formulating development strategies to reduce the risk and vulnerabilities. Proper planning and protection strategies for Indian coast must be taken swiftly by the coastal management and policy makers to safeguard coastal ecosystem and livelihoods. In recent years, there has been much focus on coastal vulnerability assessments using various kinds of data. Most of the reported studies over Indian coast are based on remote sensing and GIS methods (Sudha R etc al., 2015). Indigenous people have been living in the same villages and have observed environmental changes for generations. In case of villages Tarkarli - Devbag people's knowledge should be incorporated with modern remote sensing and geospatial technologies to build the resilience especially regarding ecosystem services. Dredging of Karli Creek needs strict implementation of Environment Impact Assessment (EIA) through independent expert agencies. Public participation and hearing is necessary considering Karli Creek is now used for tourism activities. EIA has three core values – Integrity, Utility, and Sustainability. Hence, management of Karli creek for fishing and tourism needs proper planning and protection strategies. Remote sensing data, GIS technologies and The Naval Hydrographic Charts of the Karli Creek for last two decades can be used meaningfully with expert guidance of EIA team and local people's participation. Coastal protection measures and their present condition needs through investigation. Feeding observations to District Level Coastal Committees (DLCCs) and strengthening DLCCs & MCZMA will be first step towards improving coastal defense measures.

### C. Ecosystem Services

The region benefits from its environment in various ways. According to Millennium Ecosystem Assessment (2000), the ecosystem services are grouped in four major categories, namely; Provisioning, Regulating, Supporting and Cultural. These ecosystem services are integral to the sustainability of the region especially in area such as Devbag which is still supported by traditional way of life. The following table illustrates these services in brief.

Ecosystem Services		
1	Provisional	Food- Fishery, Mad Bagayat. Raw material- Stones and wood for building, manure as fertilizer Energy - biomass fuels

2	Regulating	Waste disposal and drinking water purification, pest and disease control.
3	Supporting	Nutrient recycling, Ecosystem sustenance and primary production
4	Cultural	Intangible assets of cultural diversity, folk arts, spiritual and recreational aspects

The traditional profession that sustained Devbag and Tarkarli coast is fishery and Mad Bagayat (Horticulture). People depend on firewood for fuel source and waste disposal and water purification is nonexistent. Intangible assets such as Dashavatari plays, Koli dance and local cuisine and specialties are neither marketed nor perceived as valuable. Considerable efforts are required to assign economic value to these services in order to sustain the development in the region.

#### **D. Education and Awareness**

The region is rapidly undergoing socio-economic change. The people are not adequately educated or trained to survive or benefit from this change. Various issues regarding public health and environmental degradation must be communicated and discussed freely in the society in order to facilitate participation from all the stake holders. Various governmental and non governmental agencies provide support for programs related to public health and sanitation or waste disposal etc. Local NGOs Kille Sindhudurg Prenotsav Samiti, Malvan., Tarkarli Development Sanstha (TDS) are already working on the same with the support of UNDP, MTDC and Government of Maharashtra. People must be made aware of these programs and capacity building in terms of infrastructure and personnel should be undertaken at Gram panchayat in order to get benefits from these programs. People should be sensitized towards their local culture through promotional activities.

#### **E. Synergistic Governance**

Governance at village level is a challenge in itself. But under the onslaught of new development, constant regulatory changes and opaque policy decisions makes it even more so. Both local and state government should formulate and communicate policies that directly affect livelihood and sustainability of local population. The long winding regulatory process

is very daunting for villagers. These villagers lack both intellectual and financial support to navigate through the regulatory system and often gets short end of the developmental benefits that are grabbed by few powerful elements of the society. Strengthening of enforcement agencies such as strengthening Maharashtra Coastal Zone Management Authority (MCZMA) can produce desired effect. Evolving Regional Centre of Expertise (RCE) for sustainable coastal development can integrate the local development with the overall coastal development of the state and can benefit from increase in knowledge exchange and building expertise.

Many coastal villages along the Konkan face similar problems where coastal tourism is flourishing. Hence it is the need of the hour to design site specific strategies which will integrate local stake holders and modern remote sensing and GIS technologies keeping in mind sustainable development. We believe that present study report gaps between previous studies considering the strong potential of Integrated Coastal Zone Management (ICZM) for collective growth of communities along Tarkarli- Devbag coast. Careful implementation by policy makers and administrators integrating local stake holders will strengthen the development of the region in a more meaningful way.

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