ISSN: 2278-4632
Vol-10 Issue-5 No. 15 May 2020

Impacts of Changing Coastal Regulations on Sustainable Tourism in Goa: A Case study of North Goa Shoreline using Geospatial Techniques.

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Abstract

Goa is a coastal paradise blessed with a long coastline of 105km in length consisting of number of pristine beaches. It is this lengthy coastline which has put Goa on the world map as an important tourist destination. To sustain long time tourism in the State there is a need of proper implementation of plans and action with regards to CRZ. The changing CRZ will not only take away the area of traditional fisher folk and bifurcate coastal zones along rural area based on population density but Goa will be lost to development making coastline a concrete jungle. The land-ocean interaction in the coastal zone produces a complex range of landforms and organisms which evolve special forms of adaptation. The 2019 notification of the MoEF which has proposed to reduce the existing HTL from 200mts to 50mts will change not only the fragile coastal zone of Goa but will put Tourism at stake. The pristine beaches will be lost for development leading to coastal hazards. A question arises whether a small State like Goa will be able to withstand the pressures of handling CRZ regulations due to influx of tourist which is far more than the total population of Goa. More over whether the State can afford to do away with the biggest industry called tourism. An attempt is made in this study to understand and highlight the implication of changing CRZ if implemented, on the existing coastal zone and its impact on tourism.For research, primary data has been collected through personal interviews and field observations were made for ground truthing. The Secondary data includes, the reviews of existing publication available through books and tourism brochures and Satellite images from GloVis and Earth Explorer. Toposheets and NIO data were used to demarcate the existing HTL. A handheld software like Erdas Imagine, ArcGIS 10.3 and Idrisi Selva has been used to get the results more accurate. GIS generated maps and Statistical diagrams like bar graphs, pie is drawn to provide bird's eye view of the data used in the study.

Key words: *Coastal Regulation Zone (CRZ), Coastal Zone, High Tide Line (HTL), Sustainable Tourism.*

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Introduction: The coastal zone is particularly important from a human perspective. A large proportion of the world population is concentrated in the coastal zone, including almost all of the major cities. The State attracts tourists within and internationally due to its pristine beaches and places of worship. Tourism in Goa is generally focusedin the coastal areas rather than as a hinterland activity. The sea front is marked by a combination of beaches, rocky shores and headlands. Out of 105km long coast, more than 70km comprises of linear and wide sandy beaches all backed by 1 to 10 meters high dunes; sandy pockets and secluded coves backed by rocky cliff are also found (Mascarenhas, 2005).

Till early 70's,coastline remained pristine. Human pressure on the coastal ecosystem started in late 1970's when tourism became a major source of revenue. Thus, leading to a substantial change in the coastal area. Unchecked tourism pressure resulted in 80% of the urban growth in coastal talukas of Goa.

The main purpose CRZ notification was to control and minimize environmental damage to coastal ecosystem. Ministry of Environment and Forest, Government of India enacted the Costal Regulation Zone (CRZ) notification issued under Environment Protection Act of 1986, which was notified through Gazette in 1991. The No development zone was confined upto 500mts from HTL in the 1991, with respect to imposed restrictions on setting up and expansion of Industries, operations or processes etc., in the said Coastal Regulation Zone (CRZ) (Government of India, 2018).

Subsequently, the CRZ was brought to 200mts from HTL through a notification in 2011. Recently, the new affirming rule of reducing HTL from 200mts to 50mts will procure the ecological area into urbanization. Monitoring the LULC change along the Coastal Regulation Zone (CRZ) areas is essential to understand the current status of ecologically sensitive areas in order to conserve the ecosystems from deleterious impacts (Guru B., 2014).

In recent era, Remote sensing and GIS techniques are excessively used to inventory, monitor and management of natural resources in the coastal areas due to its repetitive, multispectral andsynoptic nature. Geographic Information Systems (GIS) at other side provide suitable platform for data analysis, update and retrieval (Dale, 1997). Space borne remotely sensed data may be particularly useful in developing countries where recent and reliable spatial information

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is lacking (Deng et al., 2009). These tools will help in studying the change in any form of land use through both the external forces and the pressure built-up within the system.

Justification: The coastal areas of North Goa are already stressed with development implicated to boosts tourism in the state. Coastal Zone is not only a concrete jungle but water is highly turbid, polluted due to other tourism related activities. Ministry of Environment and Forest's (MoEF) Draft CRZ Notification 2018, which has reduced the CRZ area, measured from HTL, from the current 200 meters to just 50 meters. This will affect fragile and overburdened coastal ecosystem of Goa.

The stakeholders of tourism have already encroached the public spaces and with the new notification the stakeholders will encroach the waters too. The study will help to understand how much area will remain sustained and how much area will be in gain for commercialization in the name of development.

Objective: The main purpose of paper is to understand and highlight the implication of changing CRZ if implemented, on the existing coastal zone and its impact on tourism as the local media, local newspapers, environmentalist are continuously buzzing on this issue where tourism industry is draining the State's economy in terms of environment protection and resources. Tourists visiting the State also have also raised issues related to ecology of Goa hence a study was undertaken on changing CRZ with objective in mind.

Study Region: The study area consists of coastal zone of North Goa, mainly Pernem and Bardez Taluka, Goa. The full-fledged areas characterized by sandy stretches and an intricate network of water bodies across lowlands.The talukasextend from $15^0$30'N to $15^0$50'N latitude and $73^0$40'E to $74^0$00'E longitude with a total area of 510.28sq. kmsand is flanked by Arabian seaon the western side. The coastal zone is undergoing constant changes either naturally or due to anthropogenic interferences. Hence constant monitoring is required to understand the constantly changing coastline and the influence of anthropogenic activities on environment especiallyin ecologically sensitive areas.

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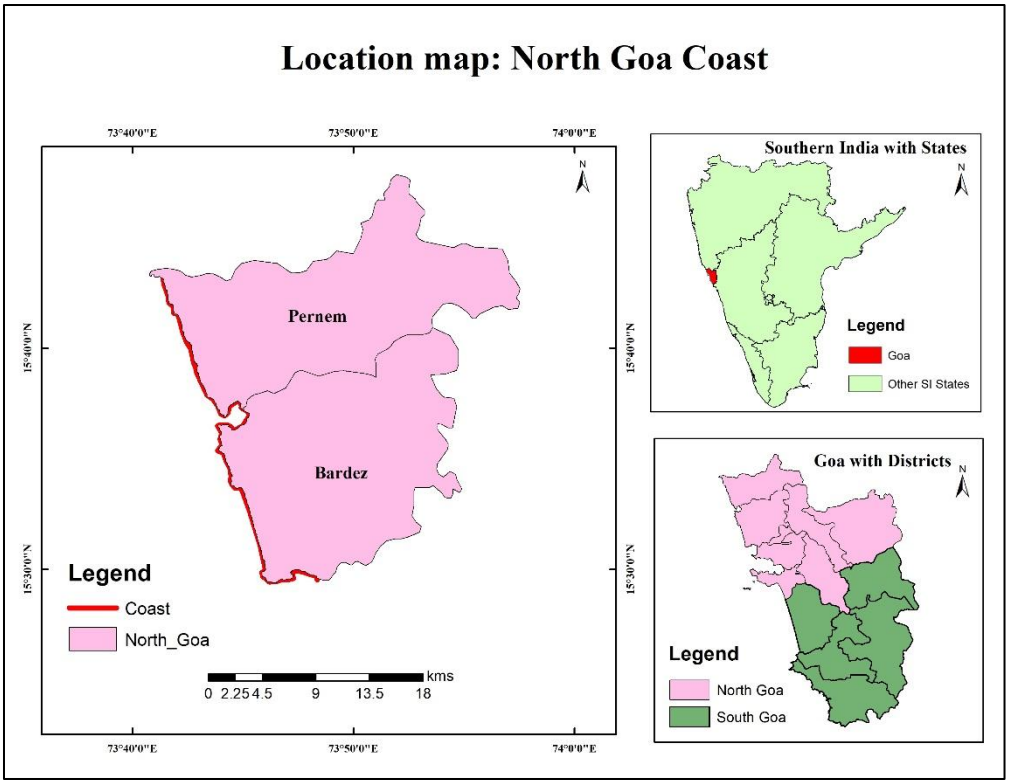

Figure 1: Location Map of Study Area (2019)

The North Goa comprises of high flexibility in terms of coastal tourism. The flourishing coastline with major beaches namelyArambol, Mandrem, Morjim, Vagator, Anjunem, Baga, Calangute, Candolim etc. are flooded with local, national and international tourists who frequent visit these areas for leisure activities. It is the frequency of tourists that have altered the coastline drastically.

Database and Methodology: The present study is a collaboration of primary and secondary data. Primary data consist of opinions gathered, personal interviews, visits to North Goa Coastline and tourist spots.Various research documents, research institutes, satellite images, multi-temporal satellite data has been used as a secondary source (Table 1).The required satellite imageries were obtained from http://earthexplorer.usgs.gov. Level 1 classification has been followed to determine the coast as per the guidelines of Ministry of Environment, Forest and Climate Change and National Centre for SustainableCoastal Management (NCSCM). ERDAS Imagine 14 version, a strong GIS desktop application having powerful potentials in image processing have been used for classifying land use land cover classes and comparative study of

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Spatio-temporal changes of an area. Google earth has been used as a base reference to do the classification.HTL data of 2003 has been opted from National Institute of Oceanography, Dona-Paula, Goa. Toposheets also has been used as a base map to validate coastal landscape. Processing satellite utilized with geometric calculation and symmetrical difference field option to understand land cover units. The data is presented in terms of GIS based maps, tables and graphs.

Table 1: Data Source

Sr. No.	Satellite	Sensor	Acquisition Date	Resolution	Data Source
1	LANDSAT 4-5	TM	17-02-1991	30m	USGS, Earth Explorer
2	LANDSAT08	OLI_TIRS	19-02-2015	30m	

Result and Discussion

Coastal Zone is ecologically sensitive and it is a confluence of land and water. Coastal Zone Management is a major consternation for decision-makers, land use planners and environmentalists. Coastal zones fluctuate between the land-water interfaces, due to influences of climate, physiography, ecology on land and water. All the tourism related activities in the coastal areas have given rise to violations of CRZ. Implementation of CRZ regulations on the part of the government will lead to loss of fragile coastal environment which is the major attraction of the State.The land use land cover change along the coastline is an peer view to appreciate the spatial distribution and CRZ violation from HTL.

Land use Land Cover change with a buffer from HTL: 1991 and 2015

The tabulated data, figures and maps were generated and used for further analysis to understand the changing scenario of LULC and CRZ violation along the coast for the period of 1991 and 2015.

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Table 2: LULC change detection: CRZ violation within 200mts and 50mts from HTL of Pernem.

Pernem (Area in sq.km.)								
Years	**Classes/ CRZ zones**	**Built-up**	**Agriculture**	**Vegetation Cover**	**Water Bodies**	**Others**	**Category-wise Total**	**Overall Total**
1991	200mts from HTL	0.63	0.069	0.864	0.239	0.994	2.797	**5.59**
	50mts from HTL	0.15	0	0.181	0.051	0.330	0.710	
	50mts-200mts	0.48	0.069	0.683	0.187	0.665	2.087	
2015	200mts from HTL	1.29	0.01	0.92	0.14	0.44	2.795	**5.59**
	50mts from HTL	0.28	0	0.18	0.03	0.23	0.710	
	50mts-200mts	1.01	0.01	0.75	0.11	0.21	2.08	

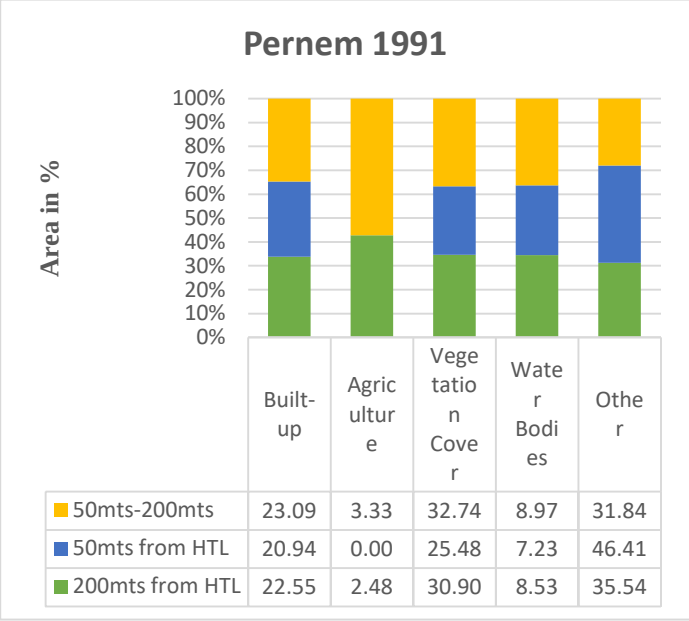

Figure 2: Graph, Pernem Coastal Area in %

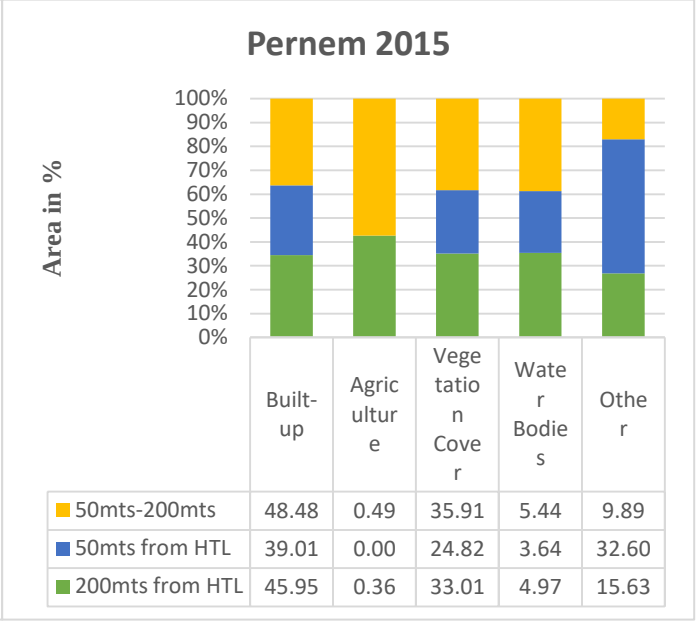

Figure 3: Graph, Pernem Coastal Area in %

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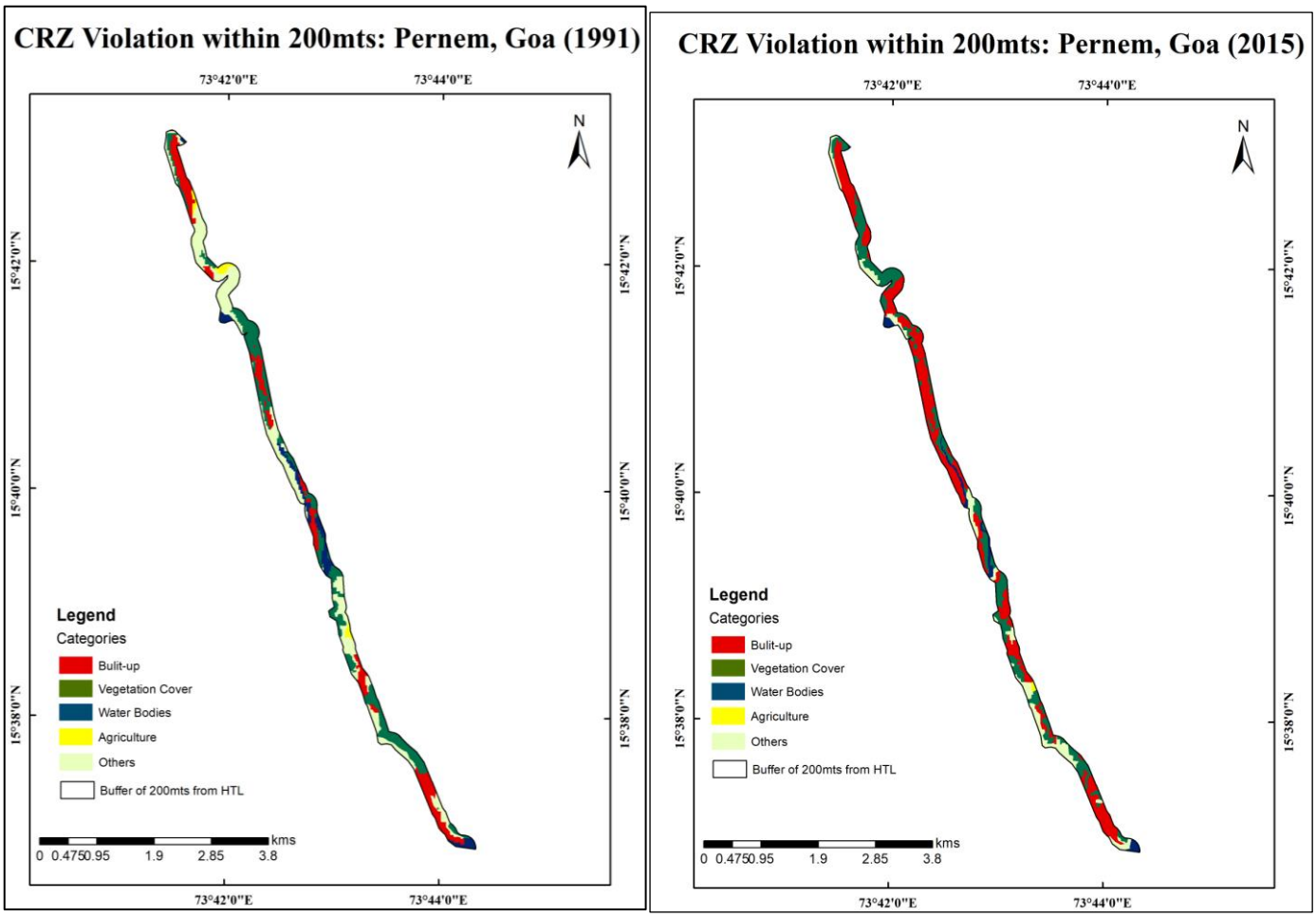

Figure 4: LULC with CRZ violation of Bardez for 1991 and 2015

It can be inferred (table 2 and figure 2, 3 and 4) that built upand vegetation has increased over a period of 1991 to 2015 from 23%to 45 % and 30 % to 33% respectively. The declined in agriculture and other category can be observed from the LULC. The implication of No development zone of 50mts from HTL shows that it will procure loss to almost 32 percent of the vegetation. Asthe remaining area from 50mts to 200mts will be probably convertedto developmental zone. Similarly, the already existence of pollution near coast will increase in abundance. The minor existence of agricultural land turning into commercial zone has highest implications.

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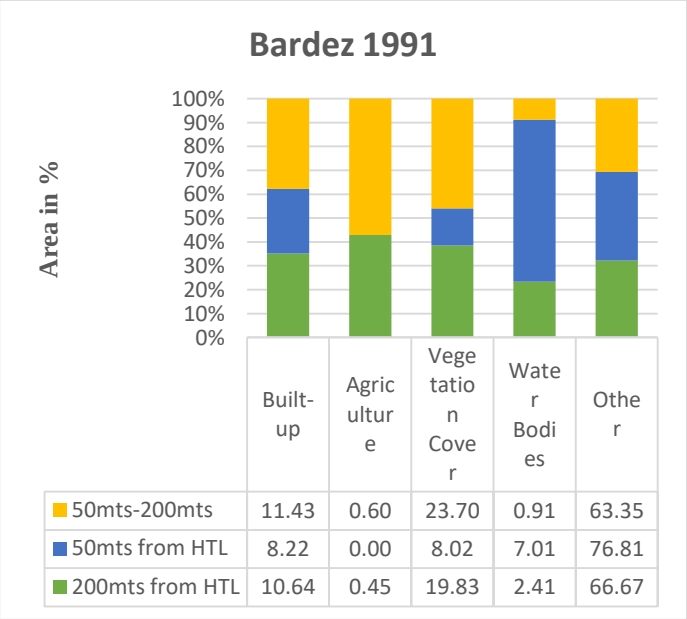
Table 3:LULC change detection: CRZ violation within 200mts and 50mts from HTL of Bardez.

Bardez (Area in sq.km.)								
Years	**Classes/ CRZ zones**	**Built-up**	**Agriculture**	**Vegetation Cover**	**Water Bodies**	**Others**	**Total**	**Overall Total**
1991	200mts from HTL	0.83	0.04	1.55	0.19	5.21	7.82	**15.64**
	50mts from HTL	0.16	0.00	0.15	0.14	1.48	1.93	
	50mts-200mts	0.67	0.04	1.40	0.05	3.73	5.89	
2015	200mts from HTL	2.46	0.01	1.41	0.18	3.77	7.82	**15.64**
	50mts from HTL	0.40	0.00	0.17	0.13	1.23	1.93	
	50mts-200mts	2.06	0.01	1.24	0.05	2.54	5.89	



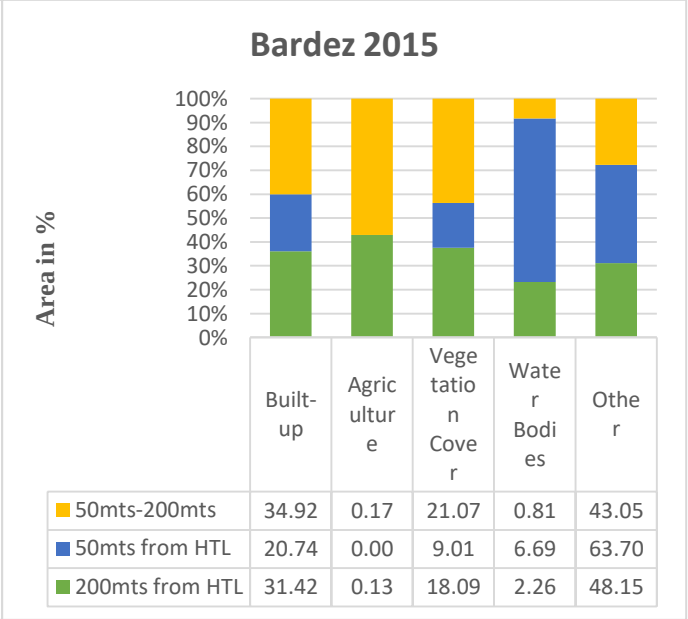


Figure 5:Graph, Bardez Coastal Area in % Figure 6:Graph, Bardez Coastal Area in %

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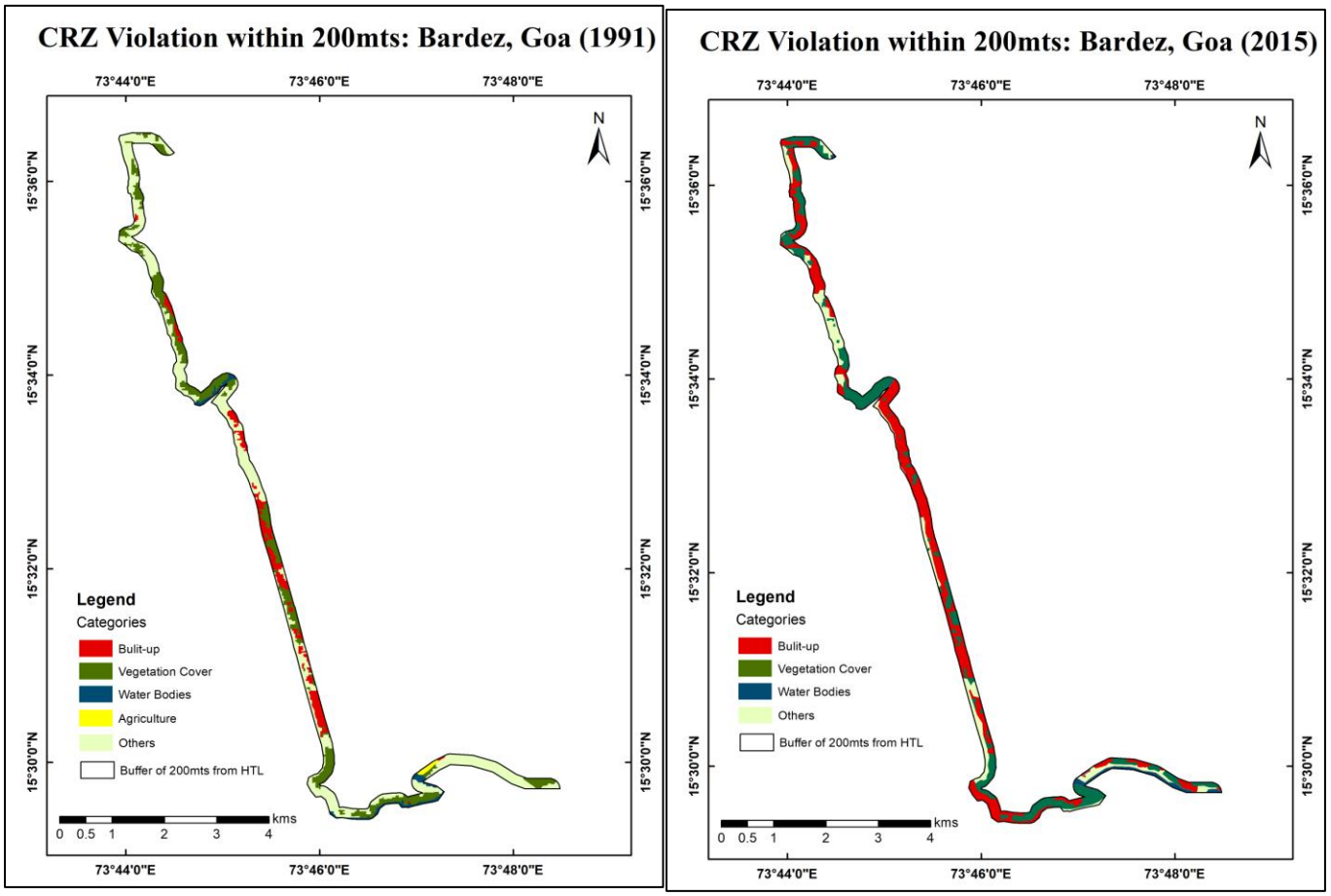

Figure 7: LULC with CRZ violation of Bardez for 1991 and 2015

The violation of CRZ can be clearly seen (figure 7), even though there was No development zone under HTL from 200mts for Bardez.Inspite of decreasing the commercial or residential developmental activity, the built-up has increased from 11% to 31% respectively from the year 1991 to 2015. This includes permanent residents and temporary shacks. Whereas, rest of the classified areas shows decline in the percentage of spatial cover as per the 200mts buffer. The 50mts from HTL shows that built-up and vegetation 12%and 1%respectively.

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The study shows that if the CRZ declines from 200mts to 50mts the presence of vegetation and other category beyond 50mts of around 21%while 43% can be susceptible to be used for commercialization (table 3, figure 5 and 6).

Conclusion

Man and Environment interaction are more interactive in the coastal ecosystems and its effects are seen on basically on coastline. The study of coastline of Pernem and Bardez taluka has a grave violation not only interms of geomorphology but also with reference to CRZ.The recent notification has changed this scenario completely. The long considered no development zone of the coastal areas will be brought under development bring the public spaces into private domain. The general public, be it locals or tourists will not be able to get access to the beaches. Therefore, the question arises as to whether the Government has any right to stop people from enjoying and appreciating the beauty of the nature.In an effort to attract more and more tourist and to earn more profit sprawling resort are built by bulldozing thousands of Casuarina trees along the coast beaches. These resorts have destroyed scenic beauty of a place and ecology. The study clearly showed the loss of natural habitat at the higher scale. The 35 percent of vegetation in Pernem and 21 percent of vegetation in Bardez are more susceptible to lossesof harsh commercialization. Similarly, Commericialization and residential needs of the beaches will not only led to erosion but also CRZ violation which in long run could affect beach formation itself.

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