

Review Article

Coastal Anthropology: A Future Dynamics in India

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Abstract Indian coastline is a crucial natural resource and important economic asset which extends around 7500 km and nurtures vast human population. Indian coastline is primarily dichotomized into east and west coastline. India's east coastline covers West Bengal, Orissa, Andhra Pradesh and Tamil Nadu and west coastline encompasses Gujarat, Maharashtra, Goa, Karnataka and Kerala.

Owing to rich coastal biodiversity, people are involved in fishing, agriculture and other economic activities so as to fulfil their daily-life necessities. A strong and elaborate sexual division of labour prevails in most fishing communities in world. Human populations inhabit these diverse ecological zones and have adapted to the climatic conditions of these zones. This adaptation is manifested in health, physiological, cultural, cognitive and genetic aspects of coastal populations.

A limited number of researches have been conducted to provide a narrow understanding of coastal populations. It has been observed that work has been done from zoological, marine and other medical science point of view on the coastal aspect. This paper attempts to propound the term 'Coastal Anthropology' which provides comprehensive understanding of human populations inhabiting various coastal terrains. It lays emphasis upon anthropological input to coastal research which provides scientific insight into human adaptation in the coastal regions. Few suggestions have also been given to highlight the relevance of coastal anthropology in the present scenario.

Keywords: Coastline, natural resource, adaptation, physique, biodiversity

Introduction

Coastal areas constitute transitional zone between land and sea. Indian coastline is an important natural resource and paramount economic asset. Indian coastline encompasses a vast range of marine ecosystems such as estuaries, coral reefs, lagoons, marshes, sandy and rocky beaches, mangrove forests and sea grass beds characterized by their high biological productivity, and they provide a wide range of habitats for many marine floral and faunal forms.

Coastal regime yields important food resources and numerous ecological services to human beings. Owing to rich coastal biodiversity, people are involved in fishing, agriculture, coastal aquaculture and other economic activities so as to fulfil their daily-life necessities. But the rapid economic growth and demographic change in the area has adversely affected the coastal natural habitat.

Indian coastline is constituted by east and west coastline. The east coastline is one of the most densely populated regions of the world and covers the coastline of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu. The west coastline, characterized by immense fisheries production, encompasses the coastline of states of Gujarat, Maharashtra, Goa, Karnataka and Kerala with union territory Daman & Diu.

The east and west coastlines of India are dotted with estuaries, having a significant effect on the coastal and marine floral and faunal forms and are often sites of human settlements and targets for expanding urban development, tourism, aquaculture and related activities (Saravanan et al. 2013).

Fishing is an important economic activity integral to coastal areas and several fishing communities in east and west

coastline in India are intensively engaged in this principle economic activity. Table I lists various fishing communities inhabiting east and west coast of India. A strong and elaborate sexual division of labour prevails in most fishing communities in world. The fishing community institutions mainly organized along caste, relationship or religious lines plays an important role in resolving conflicts, besides regulating and allocating resource use, ensuring equitable access to resources and providing some form of social insurance (Biswas and Rao, 2014).

Table I: Fishing communities in east and west coast of India

Coastal domain	Fishing States	Communities
West Coast	Gujarat	Waghers, Kharwas, Kolis, Machhi and Machhiyaras
	Maharashtra	Kolis, Kharvi, Bhandari, Dalda and Machhi
	Goa	Gawde, Kharvi, Bhandari, Gabit, Arrikar and Nayaks
	Karnataka	Moghaveeras, Thandila, Ambiga, Bhoi, Karwis and Japthis
	Kerala	Mukkuvars, Anjootty, Dheeveras and Pooislan
East Coast	Tamil Nadu	Pattinavars, Mukkuvars and Paravas
	Andhra Pradesh	Vadabaliyas, Jalaris, Pattapu, Palles and Neyyala

	Odisha	Jalaris, Nolias, Kevitos, Vadabaliyas, Telis, Bariks Kaibartas, Khandayats and Rajbhansis
	West Bengal	Kaibartas, Tantis, Mahishya, Malo and Malakars

Coastal areas are experiencing high human pressures as human populations continue to dwell in these varied coastal ecological regimes and dictate the rate of economic development in coastal zones. The health, physiological, cultural, cognitive, demographic and genetic aspects of coastal populations may show adaptation in response to the climatic conditions of these coastal zones but no research work has been carried out in this direction.

Extensive research has been conducted on the coastal aspect from zoological, marine, environmental and other medical science point of view but the research work with anthropological insight in order to provide holistic understanding of coastal populations is limited. The present paper proposes the term 'Coastal Anthropology' and stresses upon anthropological input to coastal research which provides holistic insight into human adaptation in the coastal regions. Few suggestions have also been given to highlight the significance of coastal anthropology in the present scenario.

Methodological framework

The present study has primarily focussed on the fishing communities or coastal human populations of the coastal states in India. The fieldwork was conducted in Goa, Gujarat, Orissa and Kerala by AKK (2012-2016). The data was also collected from several secondary sources such as government, non-government publications and research publications.

Coastal studies: Overview

Indian subcontinent harbours a wide array of coastal ecosystems such as lagoons, rocky coast, coral reefs, sand stretches, backwaters, rocky coasts, coral reefs and mangroves represented by distinct biotic and abiotic processes. It is essential to explore and examine researches conducted in coastal setting. The overview of the studies helps to develop insight about the rich coastal biodiversity existing in Indian subcontinent. Researchers have examined coastal regimes from a wide scientific framework ranging from geographical, zoological, marine ecological to coastal vulnerability studies.

Venkataraman and Wafar (2005) addressed coastal and marine biodiversity in India. The authors reviewed the literature in relation to the objective of the study and addressed various natural and anthropogenic constraints to sustainability of coastal and marine biodiversity. The authors emphasized that Indian coastline is abode of myriad of marine faunal and floral taxonomic classes but so far major studies had been conducted on commercially significant organisms such as crustaceans, molluscs and high vertebrates and but limited research had been conducted on minor phyla. It was concluded that awareness programmes can play a crucial role in conservation and management of marine biodiversity.

Ansari et al. (2006) highlighted the overexploitation of fishery resources, with special mention to Goa (a maritime state of India). The analysis and observation of catch-data of the earlier years revealed that catches had exceeded maximum sustainable yield (MSY) during peak fishing season, leading to decrease in fish production in subsequent years. The authors emphasized that marine living resources are finite and former

are facing depletion with technological advancement in fishing. It is a serious issue in the fisheries sector in world and Goan coast is no exception to this pervasive problem. Authors suggested that high demand and heavy dependence of people on these resources were principle economic factors linked with overexploitation and focus was required on allocation of fish resources both within and between nation states so to avoid cross-jurisdictional fight and attain sustainable development.

Sandilyan et al. (2010) highlighted the negative impact of increasing salinity levels on coastal biodiversity in Indian mangrove vegetation. It was emphasized that higher salinity levels led to nutrient depletion which further affected several marine faunal forms which inhabited mangrove region. Poor nutrient availability and high salinity severely affected the marine food web in mangrove ecosystem in particular and productivity of entire tropical region in general.

Kumar et al. (2010) attempted to formulate coastal vulnerability index (CVI) for Orissa (north-eastern coast of India) with the help of eight relative risk variables. Orissan coastal stretches were categorized as low, medium, and high risk on the basis of their vulnerability to the risk variables under study and the resultant CVI was computed and the vulnerability zones along the coastal shoreline were depicted on the map. Since the coastal areas of Orissa are vulnerable to erosion hazards and flood events, the methodological framework could aid to characterize risk linked with coastal hazards and this could facilitate the state and district administration to efficiently plan disaster mitigation and management strategies.

Kumar and Kunte (2012) developed a Coastal Vulnerability Index (CVI) to assess coastal erosion along Chennai coast using eight relative risk variables and quantified the spatial extent of the inundation caused by composite hazards along coastal areas of Chennai. The authors conducted geographic information system (GIS) and remote sensing based study and found that residential and recreational areas, port and fishery facilities and the natural ecosystem were most severely affected sectors. It was identified that 11.01 km of the coastline was low vulnerable, 16.66 km was medium vulnerable and 27.79 km was high vulnerable to composite hazards in the study area. The developed map of the Chennai coast can play a crucial role in disaster mitigation and management strategies and also as a tool to identify areas where physical changes are most likely to occur.

Anjusha et al. (2013) examined the plankton food web structure and organic carbon distribution in several plankton components in the marine environments of the Gulf of Mannar (GoM) and the Palk Bay (PB), North Indian Ocean. The field sampling session were conducted for three seasons (Spring Intermonsoon – SIM, Southwest Monsoon – SWM and Northeast Monsoon - NEM) so as to understand trophic efficiency and structure of plankton food web in the two marine environments. It was observed that the GoM was more productive than the PB waters in terms of phytoplankton and zooplankton stock but the carbon contribution of the microbial loop in the PB was significantly higher than in the GoM. It was highlighted that only an increase in the microbial loop in natural waters alone is not enough to upsurge the meso-zooplankton stock until efficient microbial loop consumers are abundant in the environment.

Batvari et al. (2013) assessed the level of heavy metal (lead (Pb), iron (Fe), zinc (Zn), cadmium (Cd), Copper (Cu) and chromium (Cr)) contamination in crab (*Scylla serrata*) and

shrimp species (*Penaeus semisulcatus*, *Penaeus indicus*, and *Penaeus monodon*) collected from Pulicat lake that received effluents from industries situated in north Chennai, southeast coast of India. The level of heavy accumulation in muscle, gills, intestine, and hepato-pancreas of crab and shrimp species was evaluated during pre-monsoon and post-monsoon seasons. The results exhibited that the metal accumulation differed significantly between the organs of crab and shrimps. Lead and copper were the highly accumulated and least accumulated metal in both crab and shrimps (except *P. monodon*) respectively and the hepato-pancreas tissue was found to be the major storage site for heavy metals in comparison to other tissues. The results highlighted the biomagnification of Pb and other metals in aquatic biota of Pulicat Lake.

Elevated accumulation of trace metals in aquatic faunal and floral forms (frequently linked with anthropogenic activities) negatively affect their metabolic pathways, nutritional uptake and enzyme functioning. Since this leads to enhanced toxicity level in the food web, it has serious implications on human nutrition and health as well.

Vignesh et al. (2016) evaluated the spatial and temporal variations of chemical and biological pollutants (23 in total) from water and sediment (144 samples) of three distinct ecotones (beach, fishing harbor, and estuary) for one year in Cuddalore and Pondicherry (prominent coastal cities), Southern India and assessed their effect on the organism nexus to human health in the coastal zone. 120 marine *Pseudomonas* isolates were investigated against different concentrations of copper solutions and 10 different antibiotics in heavy metal and antibiotic resistance approaches, respectively and comprehensive statistical parameters were utilised to assess sources, pathways, disparities and interactions of environmental pollutants. The study showed that most of the marine *Pseudomonas* isolates were resistant to at least one antibiotic. The results of comprehensive statistical analysis revealed that geochemical and biological parameters were not strongly linked with each other (except a few) and were influenced by different sources.

Several researches have been conducted to address medical aspects of coastal human population in India so as to highlight the prevalence of diseases, disorders and congenital deformities in the population (Upadhyay and Shah, 2015, Gupta et al. 2011, Singh et al. 2009, Kumar et al. 2007, Kar et al. 2007, Jaikrishan et al.1999).

Anthropological input to coastal research

Human populations has dwelled in varied coastal ecological regimes and successfully adapted to diverse climatic conditions in coastal zones. Limited number of studies has been conducted in coastal domain focussing on few adaptational aspect of human population. The term 'coastal anthropology' caters to scientific holistic study of coastal populations. It views adaptation not only from physiological and genetic aspects but incorporates socio-cultural modifications in lifestyle of coastal population. Thus coastal anthropology, as a discipline, has the potential to reveal the comprehensive all round development of human society inhabiting coastal terrains. Certain researches have incorporated anthropological input to coastal research.

Reddy and Chopra (1999) analysed biological affinities between the migrant groups of fishermen in Puri and their parental counterparts using genetic markers, anthropometric

measurements and quantitative dermatoglyphics and attempted to deduce the probable micro--evolutionary implications of the observed pattern of genetic and biological divergence between them. The results indicated that the distance configurations of the Puri populations reflect ethno-historical or geographic affiliations and regression analysis exhibited a significant migration effect (diversifying migrants from their parental populations), particularly remarkable for the anthropometric measurements. It was concluded that the roles of external gene flow and founder effects may have been crucial in an intricate way in diversifying the migrants from their parental counterparts, with an additional contribution of phenotypic plasticity for the anthropometric dimensions. However, the change in biological composition of the migrants is such that it has not affected the configuration of inter- population distances in Puri vis-à-vis their parental groups.

Kusuma et al. (2009) assessed variability in blood pressure levels across four population groups from rural and urban domain in Andhra Pradesh (India) and examined the effect of acculturation/modernization on blood pressure levels. The blood pressure levels among 1316 individuals (646 men and 670 women) belonging to two tribal (Khondh and Valmiki) and two caste groups (Wadabaliya and Settibaliya) from rural and urban areas from Andhra Pradesh were collected. It was concluded that acculturizing tribal population, Valmiki, exhibited higher blood pressure levels in comparison to non-acculturizing group, Khondh and age had a significant effect on blood pressure levels. There was no significant variation between rural and urban slum dwellers.

Busi and Rao (2003) conducted a cross sectional growth study on 640 Relli boys and 671 Relli girls age between 0⁺ to 18⁺ years in Visakhapatnam district (Andhra Pradesh, South India) to examine patterns of change in select physical and physiological traits with advancement of age. It was found that there was progressively accelerating trend in all the body dimensions with advancement in age (except skin fold thicknesses) and all the measurements exhibited significant differences by sex in accordance to age. Blood pressure and pulse rate also progressively accelerated with age advancement with few fluctuations.

Chand and Rao (2007) assessed the impact of modernization and urbanization on cardiovascular disease (CVD) risk factors, specifically the Body Mass Index (BMI), blood pressure, lipids and cholesterol among a endogamous fishermen community of Jalari (N=132 individuals), Andhra Pradesh. The study suggested that modernization, urbanization and industrialization resulted in an increase in CVD risk factors. This conclusion was supported by statistical outcome which revealed that the studied population group had high BMI and showed significant correlation with blood pressure and lipids.

Kapoor et al. (2010) conducted a cross-sectional study to compare the changes in nutritional status with advancing age among Car Nicobarese and Nolias (two underprivileged population groups) of India. The study was conducted on 320 individuals (165 Car Nicobarese and 155 Nolias) in the age range of 20-80 years. Four anthropometric measurements (Stature, weight, upper-arm circumference and hand grip strength) were taken on all the subjects and their nutritional status was evaluated using body mass index and upper arm circumference. It was found that among Nolias there was an increase in prevalence of underweight with advancing age and among Car Nicobarese none of the elderly was found to be underweight. Better socio economic status, food habits and awareness among the Car Nicobarese were possible cause of

this peculiar disparity. Both the population groups exhibited a decline in stature and hand grip strength with age.

Kapoor et al. (2012) examined and discussed the nature and the extent of variation in selection indices based on select demographic indicators among the coastal and non-coastal populations living in the eastern coast (Bay of Bengal) and western coast (Arabian Sea) of India. Bi-variate linear regression analysis revealed that among the coastal population the contribution of index of mortality (I_m) is higher (92.5%) in total selection index (I_t) in comparison to non-coastal populations (56.4%). It was concluded that there was a significant difference in the extent and process of natural selection among coastal and non-coastal populations and mortality played a crucial role in the total selection intensity of coastal populations, but over the years the trend had witnessed a gradual decline in the entire region and reversal in the roles of I_m and index of fertility (I_f).

Kapoor and Verma (2013) assessed genetic diversity and proximity in seven populations sampled from Maharashtra, Goa (western coastal zone) and Odisha (eastern coastal zone) of India using five genetic markers (ABO, MN, Rh, Se and tasters/non-tasters). The genetic distance (estimated by the DISPAN program) exhibited that geographic differentiation resulted in genetic divergence among the population of similar ethnicity while population inhabiting same geographical region had higher genetic affinity despite their ethnic origin. Among all genetic markers, ABO locus exhibited maximum genetic divergence between the population groups.

The role of the women in fisheries sector is an important issue linked with sexual-division of labour and former is primarily based upon the socio-economic conditions of the households. Besides, malnutrition and dietary imbalances are crucial health problems faced by fisher women in India.

Modassir and Ansari (2011) conducted a survey related to health and hygiene status of fisherwomen (age range 25-55 years) in Britona and Dona Paula village, Goa (India). It was found that fisherwomen were undernourished as they lack nutritious food in their dietary pattern. Moreover due to preference of male child in the community, multiple pregnancies were observed and pre-natal and post-natal care was not adequate. As a result, women became anaemic. Vitamin A and B-complex deficiencies were commonly observed among fisherwomen. Inadequate and poor personal hygiene, sanitation and waste disposal mechanism in the coastal villages in Goa resulted in prevalence of several water-borne diseases (Cholera, Typhoid and Diarrhoea).

Biswas and Rao (2014) addressed the role of fisherwomen in fishing industry along east coast of India and highlighted social, economic, political, education and health related issues experienced by them. It was emphasized that although the women play crucial role in fishing sector but their conditions and quality of life is deprived across different fishing groups and communities. This was indicated by long working hours and poor wages in comparison to the men and in addition the burden of household maintenance. Limited mobility, poor education and health facilities, increased competition, decaying resources and complex working conditions made work challenging for the fisherwomen but still they expressed interest to learn new skills and attend trainings to elevate their status in the fishing sector and to empower themselves. It was concluded that social and economic empowerment of fisherwomen is essential to ensure sustainability of India's fisheries sector and this could be accomplished through proper

education, health, sanitation, and child care, and training on current technologies along with financial assistance.

Coastal anthropology: Implications and suggestions

Extensive research with anthropological input has been conducted among human populations residing in high altitude. These researches help to understand various virtues of adaptation and acclimatization in humans dwelling in such harsh environment conditions. Similarly more research should be conducted among coastal human population residing in coastal environment.

Since it is essential to address the mechanism of influence of societal driving forces (social and demographic, political and institutional, economic and commercial, cultural and technological) upon the nature and distribution of human activities in coastal domains of India and its repercussion on coastal ecosystems linked with the prevailing and possible alternative patterns of human activity. Coastal anthropology will therefore present an integrative approach for human-environment syntheses so as to properly perceive the biophysical and social driving forces.

Further, a comparative account of adaptation in human populations residing in different terrains can be developed. This can aid in better understanding of different population groups residing in diverse ecological regimes and such reports can help state and national authorities to formulate development strategies for these populations.

The eventual motive of coastal anthropology is to address man-environment inter-relationship and to formulate a unified system where impact of the economic, biological, hydro-geological, ecological dimensions upon coastal human population can be delineated. It incorporates the concept of sustainable development for proper allocation of resources (economic and natural) to human population for their socio-economic development without disturbing the balance of coastal environment assets.

Coastal anthropology has the potential to address prominent issues related to principle societal driving forces- urbanisation, coastal tourism and industrial and port activity and interactions of human, built environment and biophysical vulnerability. This will help policy makers and administrators to develop a framework for decision-making regarding development of fishing communities and coastal human populations in the direction of sustainable development.

The discipline should incorporate following research avenues:

- Studies on fertility from birth and death records of various fishing communities and other human coastal population groups.
- Extensive dietary survey in human coastal population (especially the fisherwomen) and evaluation of their nutritional status and health seeking behaviour.
- Studying adaptive mechanism of various population groups to coastal climatic stress and comparing their ethnological characteristics. Comparison of physical, physiological, cultural and genetic adaptations among human populations inhabiting different ecological regimes (such as high altitude and coastal zones) to build coherent picture of adaptive processes that have been operational in shaping different population groups.

- Analysis of disease and disorder that prevail in human coastal population along with their causative factors and peculiarities in treatment.
- Studies focussing on health aspect of local residents of coastal zones indicating the difference in health perspectives w. r. t. difference in ecological setting.
- Studies on maternal and child health in coastal zones.
- Analysis of mental health status of various fishing communities and other coastal human populations to reveal the symptoms of stress and depression linked with urbanisation and globalisation.
- Growth studies in different coastal environment conditions and nutritive patterns; Anthropometric and Radiographic. Comparison of nutritive pattern of population groups residing in east and west coastal zones of India.
- Studies on work capacity of local residents of coastal zones and comparing it with those of new comers.
- Studies on body build/ somato-types in preponderance in extreme climates (such as deep sea) and different geographical conditions with focus on bone density.
- Body build its probable role in acclimatisation to coastal regime
- Correlation of physique with susceptibility to disease in different environmental conditions.
- Studies on skin-fold thickness of adapted and non-adapted anthropological groups in association to age and nutritive factors in extreme climates.
- Study of haemoglobin variants in the people living in coastal zones.
- Study of various socio-cultural institutions of various fishing communities and other coastal populations.
- Assessment of the role of fisher-women in socio-economic institution of fishing communities.
- Systematic assessment of social and economic attributes that govern human vulnerability at the individual and community level in different coastal locations.

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