A resource is anything useful and needed. Resources are a form of energy and/or matter, which are highly essential for the functioning of organisms, inhabitants, human populace and various ecosystems. Coastal and marine zones provide a wealth of resources, wide range of goods and products, including food, as also, multiple services. Most of the world's highly diverse resources are found in marine and coastal environments.

The coastal resources are defined as natural area or feature or commodity on which the coastal community depends. Further, it has direct relation to the economic, environmental, recreational, cultural, aesthetic or any other value of the region. Fishing, of near shore waters, tourism and farming of low-lying lands are the major economic activities along the coast. Coast is also a provider for marine transportation, recreation, and salt production. Rajagopalan and Lawrence (1996) have argued that there exists a dichotomous on the utility of the coastal resources, as there exists, a paradox of human priorities along the coast, which are influenced by resource utility from the coastal land, and coastal sea. The coastal resources are under severe pressure and the exploitation of the resources, goods and services, has resulted in transformation of the fragile coastal ecosystems, causing resource depletion, economic fraternity, pollution, impact on costal habitats, thereby making these areas vulnerable. The resources are grouped as living, non-living, and services.

**Living Resources**

The coastal and marine resources harbor a variety of flora and fauna, which are globally used as delicacies and nutritious food. Living resources are available under diverse geographic, physical and biological conditions, and in various ecosystems, such as; coastal
wetlands, beaches, inter tidal zones, off shore pelagic, mid water, benthic zone and reefs. The living resources along the coast have a direct relation to the diverse ocean parameters.

Various interface zones also play an important role in the reserves of resources. The interface zone between air and water supports planktons, which are either phytoplanktons or zooplanktons. Whereas, within the seabed, where land and water intersect benthons are found. Likewise, in the zone where land, water and air interact, both benthic and planktons are found, while the nektons, are located far and wide in the ocean waters due to the horizontal and vertical ocean profile.

The living resources are important as they form a strong bond in the ocean food chain, from primary producers, secondary consumers and tertiary consumers. The most exploited living coastal resources is the nekton which is divided into pelagic, which swim near the sea surface and comprises of oil sardines, crabs, prawns, clams, mussels and others, whilst, in the demersal area, there are snakes and turtles. Grasses, seaweeds, mangroves and hydrophytes, also form part of the living resources. Sea grass and mangroves are the major marine and coastal resources. In addition, coconut palms, orchard plantation and other forest plantations also form part of the living resources.

Sea grasses are submerged marine angiosperms growing well in tidal and sub tidal areas of all seas, except the Polar Regions. Sea grasses have a well-developed creeper rhizome bearing branched or unbranched roots at each nod and have several foliage leaves. These plants (Usha et al., 2001) belonging to monocotyledonous families' and sea grass beds are highly productive and act as breeding ground for many epiphyllitic fauna and feeding grounds for sea cow. Sea grass
roots, bind sediments, which improve the water quality, and prevent erosion. Sea grasses are also involved in cycling of nutrients in their environment and provide food and shelter for diverse groups of organisms. The sea grasses have high growth rate producing organic matter about 300-600g dry wt/m²/year, which excluded root production (Thayer et al., 1975). Das (1996) opines that geographic distribution of sea grass is well know in south East Asian countries, as well as, in Australian and Caribbean coasts.

Mangroves are salt tolerant forest ecosystems, which support marine fisheries, provide a valuable physical habitat for a variety of important coastal species and are important coastal stabilizers and shelter belt areas, as they protect coastal zones. Due to their unique characteristics, and important ecological functions, play a significant role in the green house and climatic changes, which are linked to ecological balance, biological diversity, environmental stability and soil conservation (Raganath et al., 2000).

They are tropical and sub tropical swampy forests comprising of trees of many unrelated genera that share the common ability to grow in saline coastal environments. The less evident but equally important inhabitants are crab, shrimp, and the important juvenile stages of commercial and sport fishes, along with numerous forage species of fish and invertebrate (Clark et al., 1980). In addition, they act as nurseries and feeding grounds for many habitats and also protect the adjoining regions from flooding and storms, as they act as barrier.

Coconut Palms, Orchards and Forest plantation also form part of the coastal plantations. Coconut plantations, besides providing its fruits, nuts and toddy, its entire system have domestic and commercial utility.
In addition, it acts as windbreaker during storm and protects the hinterlands from any disaster. Orchard plantations provide fruit yields and also various other bye products like gum, resins, whilst the forest plantations have numerous ecological and economic values and help in climatic changes, soil binding and largely used commercially.

Fishery and Aquaculture - Fishery is a major source of nutrition, as well as an important economic activity. The multi fishery species resources can be grouped as saline and fresh, deep or shallow, depending upon the salinity and depth. The fishery resources are harvested using mechanized and non-mechanized boats, trawlers, long liners, pursier, and various commercial and artesian fishing gears. Fish catch is an important source of income and generate employment and foreign exchange. This primarily will depend upon the nature and type of technique and gears deployed as also, post harvest storage and processing facilities. In addition, non-conventional fisheries and aquaculture, mari-culture, pisciculture, through culture techniques are used to increase fish production.

Day (1889) described 1418 species of fish under 342 genera from the British India. Talwar (1991) reported 2546 species of fish belonging to 969 genera, 254 families and 40 orders. There are various estimates on the fish production based on primary production (Silas, 1969; Jones and Banerjee, 1973; Mitra, 1973; George et al., 1977). An understanding of upwelling eddies, a salinity nutrient is also important (SAC, 1992) to estimate fish production. In the recent years, fishery forecasting is attempted using remote sensing which is based on various biological, physical, and chemical processes of oceanic waters.
Pearl is a living resource, formed through a biological process in oyster shell, living in the benthic environment. When a grain of sand or dust enters the system, and when the oysters secrete a chemical substance called nacre around the grain, the pearl grows over a grain, which has very attractive value and has ornamental utility and highly priced.

Aquaculture covers a wide variety of production systems in coastal areas aiming not only at production of edible products, but also generating raw material for a number of other economic sectors within the food industry. In the recent years, aquaculture has rapidly expanded in coastal areas with a variety of cultures such as seaweed, oyster and mussel farming by bottom raft and long line systems (Harald, 1996).

Coral reefs provide a home for a variety of fishes and benthic organisms, with a vast array of ecological niches, and they represent one of the highly productive natural ecosystems.

Total number of species of scleratinian corals as reported by (Venkatraman, NBSP inputs), may increase up to 265 species. Further, it is estimated that a total of 199 species of scleratinian fauna belonging to 71 genera are hitherto recorded in India, including the Lakshadweep, Gulf of Kutchch, Palk Bay and Gulf of Mannar and Andaman and Nicobar Islands. Of these, 155 species belong to hermatypes and 44 species belong to ashermatypes. ICMAM PD, (1998-2001), has reported that 214 species of corals are present along the Indian coast.

There are various reptiles like turtles, crocodiles and sea snakes; similarly, numerous mammals like whales, dolphins, dugongs, sea lions,
walruses and seals; marine sea otters and polar bears, which also form part of the system. In addition, many birds also live along the coast.

**Pressures, Drivers and Responses.**

Global climatic changes and local human activities are the major pressures on the depletion of marine and coastal resources. Anthropogenic pressures are severally degrading the biological diversity of coastal areas in particular, through profound modification of habitats and ecosystems.

Exploitation of the resources, results in depletion and extinction of some of the marine species. For example, chemicals and drugs are also being harvested from the sea. In addition, large amounts of products and by product like, glue, china grass, are being developed from the marine organisms.

Use of renewable natural resources especially in extractive industries such as, forestry and fisheries usually involves decrease in species diversity as stocks are depleted and unwanted species are introduced. It has been reported by IUCN (1991) that if the current trend of destructive practices continues, up to one quarter of the world species by year 2050, may vanish. The present population is consuming directly or indirectly 40% of the energy fixed on land as food and exceeds 50% when the ocean is included. Monoculture practice also has an impact on the resources. Nalyor et al. (2000) have estimated a reduction in fish biomass of about 434 g for every kg of farmed shrimp due to monoculture.
Land based activities including sewage, industrial effluents and agricultural chemicals notably fertilizers; and pesticide contribute to the degradation of the coastal waters, affecting coastal and marine living resources. Likewise fish culture through aquaculture, has also affected the marine and coastal resources through high inputs of organic matter, fish feed and artificial partitioning of the water bodies. Oil pollution, ballast water discharge of maritime transport system also causes pressures on the marine resources. Over fishing of resources beyond their regenerating rate can contribute to the un-sustainability of the marine resources. FAO (1991) reported that 44% of worlds marine stocks are fully exploited, 16% over exploited, 6% depleted and 3% are very slowly recovering.

All along the coastal plains, agriculture is the main occupation in coastal India, as also rice the staple food, of the coastal community. Distribution of other cash and agricultural crops depend on climatic regions. In Goa, khazan lands, were traditionally community managed integrated agro-aqua ecosystems (Sonak, et al., 2005) and were saline flood plains in tidal estuaries which have been reclaimed over centuries with intricate system of bunds and sluice gates, (Almeida, 1967; Dhandar and Subramanian, 1998; Rubinoff, 1998; Alvares, 2002.)

Non-Living Resources

The coastal non-living resources are innumerable. These include, water resources, both saline and fresh; minerals viz; placers, lime shells, sand, pebbles, salt, chemicals, drugs and medicine; energy resources viz; solar, tidal, wind, wave and fuels viz; petroleum, coal and gas. Likewise, other non-living class includes ports, harbor, jetties heritage, cultural, archeological, coastal tourism and demographic pattern.
Water Resources, are essential for life sustenance. There are various sources of water, spring, waterfall, precipitation, snow, glaciers, which form part of the water resources. A water resource, in addition to domestic usage, is also being used for agriculture, navigation and transport, recreational as also commercial purposes (De Souza and Varde, 2001). The saline water is also used as resource in energy production. Coastal waters provide wide scope for navigation, transport and fishing.

Energy, Fuels and Minerals - Coastal regions produce a wealth of minerals. The non-living resources of the coast are placers deposits, common salt, energy and rarely petroleum and gas. Coasts have numerous deposits of sands, gravel, corals, lime shells and relatively small quantities of tin, titanium and iron.

Chemicals, Drugs and Medicines - The sea is an important source of chemicals and drugs, which are used for the welfare of human well-being. Several drugs extracted from the numerous flora and fauna from the sea, have potential usage in medicine, used as antibiotics, anti coagulant and drugs, for treating various diseases and other alignments. Therefore it is a very important resource.

Energy is the basic need for sustenance and is used in three major sectors, industry, household and transport. These resources can be grouped as renewable, and non-renewable. The renewable resources are wind, solar, waves, tide, which apparently, do not generate any environmental impacts, and therefore need to be promoted. It is evident that non-renewable energy resources are getting depleted and becoming un-affordable.
There are several devices based on which solar energy is being worked, like solar cooker, solar heater, solar still, solar cells, desalinization plants. Wind energy is trapped from the high speed of the winds. Wind is captured through windmills and converted to energy through power stations. The oscillation of the water column periodically breaking on shore helps in the generation of energy. Tides also help in generating energy.

Ocean Thermal Energy Conversion (OTEC), exploits the temperature of the sea. Temperature difference between the surface of the sea and 1,000 m depth or more is considered for extraction of energy.

The non-renewable fuel resources include liquids, gaseous and solid. Petroleum, a liquid, fuel, is a mixture of three hydrocarbons, butane, propane and ethane. Liquefied petroleum, gas (LPG), is a gaseous fuel. Oil and gas extraction onshore and in shallow coastal waters, has been well established over last 100 years.

Minerals and placers minerals are zircon, garnet, monazite and ilmenite. Placers have industrial utility. Some minerals have radioactive elements associated with them. Beaches and continental shelf have placer deposits. Polymetallic nodules and phosphorites are also found in the ocean beds. Common salt is a product having economic value and widely extracted along the coasts.

Through maritime trade, coastal areas bring countries economically together and such trade brought prosperity to coastal settlements. Advent of modern surface transportation systems changed the trade pattern, both inland and international, during this century. An efficient commutation system is necessary to bridge the gap, between
production and consumption, so also as service provider for navigation and transportation of goods and services.

Harbours are platforms for anchoring of ships, which are used for trade, tourism and recreational activities. They provide facilities and services and facilitate transportation of goods and influence to a large extent, the natural economic growth and development. The sea transportation is one of the cheapest transport systems.

Coastal Tourism - Tourism is one of the key sustainable resources of the coastal region. Facilities like scuba diving, water sports, para sailing, aid in attracting the tourists. The concept of eco-tourism is also being promoted. The main activities attributed towards tourism are heritage sites, sports activities, entertainment, relaxation and yoga, including ayurvedic activities and shopping trade. Tourism is a major sustainable resource. The beaches have multiple uses such as, sun bathing, swimming, fishing, sailing, surfing, golfing shooting football and cricket.

**Goa State**

The coastal and marine resources in the coastal talukas of the State of Goa, which includes living, non-living and economic sectors, are depicted in Chart 5.1. The spatial location of fishery, aquaculture and mineral resources are depicted in Plate 5.1. Whereas, Plate 5.2 depicts the tourism and eco-tourism locations and Plate 5.3 depicts the transportation-economic sectors of the state. The marine fish catch in tones, during the year 1998-2005 for the State of Goa is placed at Table 5.1.
Methodology

IRS-ID, LISS-III, digital satellite data was loaded, analyzed and rectified on ERDAS Imagine 8.4 software, in accordance to the survey of India co-ordinates and DGPS data. Image enhancement, image transformation and image analysis techniques were adopted to the image. The Digital data was analyzed assigning appropriate training sets, using supervised classification. After interpreting the image, post classification, data refinement and accuracy estimation were carried out for the respective resource maps. The land resources for the 500m, 200m and 100m or width or river corridors under CRZ were computed. The methodology adopted for mapping the land resources for the designated CRZ corridor, of the coastal talukas, is elucidated in Chart 5.2.

Result and Discussion

Based on the characteristics, nature, occurrence and geographic location, the resources namely living, non-living and economic sectors have been further grouped into coastal and estuarine. The coastal living resources class comprises of fishing - demersal and pelagic. It also includes agriculture, and forestry. Similarly, the estuarine living resources including fish culture, like aquaculture, and traditional fishing, and also water, forests and agriculture. The forest class includes forest plantation, orchards and hydrophytes-mangroves, whilst, agriculture include, paddy fields and khazans.

Under coastal non-living resources class, energy, fuels and minerals, islands, sea and landscape, shells, sediments, silica sand, rocky out
crops, have been recorded. Under the estuarine non-living class, minerals, salt, pebbles, sand, lime shell, silt, clay, and industrial and urban development have been recorded.

Economic sector and service category has been classified as coastal and estuarine. The coastal class includes infrastructure and services (off shore and on shore); marine transport (ports and harbours); recreation and tourism, which includes archeological, cultural, historical and heritage areas, also jetties, loading points and workshops, have been reported. Further, under the tourism and recreational sector, aqua sports and facilities like hotels, eat houses, restaurants, pubs, yoga spas and are added.

The economic sector, class under estuarine tidal comprise of marine transport, which includes loading point, ports, fishing jetties, passenger jetties; under the recreational sector, aqua sports, hotels, restaurants and shacks, have been reported. Likewise, heritage and historic sites, hotels and resorts, workshops and allied infrastructural and supplementary services have been mapped. The road, air, rail and waterways transport facility, and infrastructural works, wherever available and mappable, have been reported for all the talukas.

Aerial photographs, coupled with Survey of India Topo sheets have been used to map the land resources of the coastal talukas. The resources mapped are presented as North Block, comprising of the Talukas of Pernem and Bardez, (Fig. 5.1), Central Block, with the talukas of Tiswadi, Mormugao and Salcete (Fig. 5.2) and South Block (Fig. 5.3), with the talukas of Quepem and Canacona. In addition, digital remote sensing data has been used for computing the surface land utilization resources, for a designated coastal corridor of 500 m, under
the categories of built up + vegetation, agriculture, fallow land, water bodies, wetland / khazans, mangroves, mining area, sandy area and barren rocky, have been presented for all the coastal talukas.

**Pernem Taluka**

Both coastal and estuarine resources are present in this taluka. Three fishing jetties are located at Arambol, Morjim and Mandrem Village, which provide a catch of around 637 tonnes of fish as reported in the year 2005. Aquaculture sites are located at Chopdem, Tuem and Paliem Village and small pisciculture is practiced at Morjim and Agar Vaddo, which also contribute to the fishery resources. Traditional shell fishing is practiced, in addition to khazan fish culture. Likewise, saltpans provide salt and also fish culture.

As regards to the marine transport system, two ferry jetties, facilitate commutation of passengers to Maharashtra State, to and from Goa State. These are located at Tiracol and Kiranpani Village; however, the ferry service available from Chopdem to Siolim Village has been discontinued after Chapora Bridge construction.

The mineral resources in this taluka are the river sand, which is extracted from the Tiracol and Chapora River, and used as a building raw material. Due to this activity, supplementary infrastructure within the periphery of the bank of the rivers, like canoe houses, squatter settlements for migrant laborers engaged in this trade, also form part of the infrastructure support system. In addition, laterite and road metal, used as construction material is also found in this taluka. There are small pocket extractions of lime shells. In addition, the silt from the river is used as organic manure for the plants. Agriculture is a major resource
here; both conventional and Khazan type of farming practice are adopted, wherein rabi and khariff crops are sowed, with occasional mixed crops like, chilies and onions. Forest Resources comprise of forest plantations, orchards and mangroves. Water resources, through open wells, tanks and also through public water system, are available, which apparently is adequate. The urban settlement pattern is well established with the traditional rural village architecture. Various industrial units, religious places, academic and technical institutions, hospitals, workshops and related facilities are present. The N.H 17 connects the State to Maharashtra with also The Konkan Railway, which serves a major mode of commutation. Major state highways and village roads are also present.

Adequate natural and scenic resources like, sandy and rocky beaches, landscape and waterscape promote tourism resources. The presence of turtle nesting grounds, also makes this taluka unique. An added asset is the Tiracol Fort, which also attracts a number of tourists. The unique scenic beauty of Kerim Beach, with the lustrous Cajurina plantations compounded with the backwaters of Tiracol and Chapora Rivers, are added resources. Around 17,696 domestic and 4,586 foreign tourists have visited this taluka in 2005. The taluka has 57 hotels and 24 shacks, so as to cater to the tourism industry.

In addition, mangrove, khazan lands also form part of the resources. Under the human resources component, the human population count of this taluka is 71,999 and households are 14,967 as per the census of 2001.

Using digital remote sensing techniques, a 500 m coastal corridor has been computed for the surface land utilization pattern (Plate 5.4).
this corridor, built up + vegetation is 02.10 sq km, agriculture 00.90 sq km, fallow land is 00.65 sq km, water bodies are 00.92 sq km, forests 01.10 sq km, wetlands/khazans occupy 1.00 sq km, sandy area is 01.10 sq km, area under mangroves is 00.52 sq km and barren rocky occupy 00.65 sq km of area, (Fig. 5.4), however, the mining class is absent.

Bardez Taluka

The resources in this taluka comprise of coastal and estuarine resources, further grouped as aquatic and terrestrial. Fishing jetties are located at Siolim, Chapora, Malim, Calangute and Candolim; provide a catch of around 27,847 tonnes of fish as reported in the year 2005. At Malim, the Mandovi Fishermen Co-op Society Ltd, and a major fishing jetty is located. Like wise the Chapora Fishing Boat owners federation Co-op Society Ltd, is located at Chapora Jetty. Four Aquaculture sites are located at Pilerne and one each at Betim, Siolim and Camurlim Village. At Arpora and Pilerne Villages saltpans produce salt and these saltpans are also used for fish culture.

As regards to the marine transport system, the taluka has a number of ferry services to commute passengers to and from Aldona - Corjuem, Betim - Panaji, Siolim - Chopdem, Pomburpa - Charao, and Carona - Calvim. In addition, iron ore transportation barge jetties are located at Calvi and Sircaim Villages.

The river sand, which is extracted from the Chapora River, is a major resource, which is used as a raw material in the building industry. Due to this activity, supplementary infrastructure like canoe houses, squatter settlements for migrant laborers engaged in this trade, also form part of the infrastructure support system. Laterite and road metal used as
construction material is also found in this taluka. There are small extractions of lime shells deposits as also other ancillary resources. In this taluka agriculture is a major resource with both; conventional and Khazan type of farming being adopted, wherein rabi and khariff crops are sowed, with occasional mixed crops. Irrigation facilities are available for the agriculture sector. Khazan lands are alternatively used for rice and fish farming. Plantations, orchards and mangroves form part of the forest resources. Open wells, tanks and also public water system are the sources of drinking water, whilst irrigation facilities are available for agriculture. The urban settlement pattern is well established with the traditional rural village architecture and high concentrations in the coastal belts. Various industrial units, religious places, academic and technical institutions, hospitals, workshops and related facilities are present. The N.H 17 passes through this taluka, and also The Konkan Railway, which serves a major mode of inter state commutation. Likewise, major state highways, and village roads are also present.

Adequate natural and scenic resources like, sandy and rocky beaches, landscape and waterscape enhance the tourism sector. An added attraction is the Chapora, Aguada, Colvale and Reis Magos Fort, which provide a picturesque panorama. The unique scenic beauty in this taluka are the famous beaches, at Vagator, Anjuna, Baga, Calangute, Candolim, and also the backwaters of the Tidal Mandovi and Chapora which enhances the beauty of the taluka. The Calangute beach has large Cajurina plantations. Around 5,11,766 domestic and 1,27,110 foreign tourists have visited this taluka as reported in 2005. The taluka has 285 hotels and 110 shacks, to cater to the tourism industry. Supplementary recreational facilities like aqua sports, scuba diving, para sailing are also available. The human
population count of this taluka is 2,27,695 and households are 51,392 as per the census of 2001.

Using digital remote sensing techniques, a coastal corridor of 500 m has been computed for the surface land utilization pattern (Plate 5.5). In this corridor, built up + vegetation is 03.25 sq km, agriculture 0.30 sq km, fallow land 00.95 sq km, water bodies 0.56 sq km, forests 01.20 sq km, wetlands/khazans occupy 00.62 sq km, sandy area 00.90 sq km, mangroves 00.25 sq km and barren rocky occupy 00.67 sq km of area, however, area under mining is absent (Fig. 5.5).

Tiswadi Taluka

The resources in this taluka comprise primarily of estuarine resources. Fishing jetties are located at Siridao and Nauxi Village with a catch of 376 tonnes of fish as reported in the year 2005. There are thirteen aquaculture sites, of which ten farms are located at Chorao Island, two at Diwar and one at Marcel Village. Coupled with salt farming at Ribandar, Jua and at Siridao Village, fish culture is also promoted in the saltpans. Traditional fishing activity is also practiced. The criss-cross riverine network in this taluka facilitates unique waterways communication system. As such, ferry services are developed to commute passenger to and from Panaji - Betim, Diwar - Naroa, Ribandar - Charao, Vanxi - Old Goa, Vaxi - Itagem, Old Goa - Diwar and Donapaula - Vasco da Gama. The entire Mandovi and Zuari River basin and the Cumberjua Canal are navigable and used to transport ore through barges. Likewise, at Panaji, a Jetty near the Captain of Ports exists, with two minor jetties below the Mandovi Bridge, which are used, for river boat cruise entertainment.
A few road metal quarries are located in this taluka. Though agriculture through the traditional Khazan cultivation system was once a prime occupation, the poor maintenance of the sluice gates, destruction of river bunds, and shift in occupation, the Khazan lands have now become un-productive. However, squatter conventional agricultural practices and Khazan type farm practices are adopted, wherein rabi and khariff crops are sowed, with occasional mixed crops. Forest Resources comprising of plantations, orchards and mangroves are present. Public water distribution system is predominant, despite availability of water through open wells. The urban settlement pattern is well developed, maintaining the Portuguese and Goan type architecture. Several public offices and corporate houses are located in the capital city of Panaji in this taluka. The new constructions are designed with modern state-of-the-art architecture and facilities like parking bays. Various industrial units, religious places, academic and technical and research institutions, hospitals, workshops and related facilities are present. Barge jetties are also located on the bank of Zuar and Mandovi River. The N.H 17 and 4A connecting the adjoining state, pass through this taluka. Like wise, the Konkan Railway, serves a major mode of commutation. Major state highways, and village roads are also present.

Adequate natural and scenic resources like, sandy and rocky beaches, landscape and waterscape promote tourism resources. An added attraction is the Donapaula Headland where the Cabo Raj Niwas is located. The picturesque beauty of the temples and churches at Old Goa, are added attractions. The unique scenic beauty is the Bambolim, Miramar, Dona paula beaches, as also, the backwaters of the Tidal Mandovi and Zuar Rivers which enhances the beauty of the taluka. Around 6,39,177 domestic and 75,456 foreign tourists have
visited this taluka as reported in 2005. The taluka has a number of hotels and restaurants to cater to the tourist and general public. Supplementary recreational facilities like aqua sports, scuba diving, para sailing, boat cruises are being promoted along with tourist guides.

Under the human Resources, the human population count of this taluka is 1,60,091 and households are 35,492 as per the census of 2001. This taluka also has a large floating population comprising of regular working class employees, general public and tourists.

Using digital remote sensing techniques, a coastal corridor of 500 m has been computed for the surface land utilization pattern (Plate 5.6). In this corridor, built up + vegetation is 00.90 sq km, forests 00.56 sq km and water bodies 00.21sq km. However, agriculture, fallow land, wetlands/khazans, sandy area, mangroves, barren rocky and mining classes are absent. In addition, the resources for Tidal Mandovi, Tidal Zuari Rivers and Tidal Cumbarjua Canal, have been computed and elucidated in Figure 5.6 a,b,c.

**Murmugao Taluka**

This taluka has both estuarine and coastal resources. To facilitate fish harvest, fishing jetties are located at Velsao, Cansaulim, Baina, Bogmalo and Cortalim Village. These have produced around 11,508 tonnes of fish as reported in the year 2005. At Vasco a major jetty exists, with the offices of Zuari Fishermen marketing Co-operative Society Ltd and the Vasco fishing boat owner’s Co-op Society Ltd. Unique shell fish collection is observed at Sancole Village, wherein the shells are collected at low tide. Six aquaculture sites are located five at Quellosim and one at Sancole village. A ferry service to commute
passengers from Donapaula to Vasco is available. In this Taluka, khazan farming has been destroyed due to inundation of saline water and poor maintenance of the agrarian system. However, agriculture is still practiced in small areas for rabi and khariff crops. Forest plantations, orchards and mangroves are present. Open wells, tanks and also public water distribution system is available, which is apparently adequate.

The urban settlement pattern is well established with the traditional urban/rural village architecture. Various industrial units, religious places, academic and technical and research institutions, hospitals, workshops and corporate houses are located in this taluka. The N.H 17 connects this taluka to other states as also The Konkan Railway and South Central Railway, which serves a major mode of commutation. Major state highways and village roads are also present. The International as also the domestic airport is located at Vasco de Gama and the natural port at Mormugao. A ferry service from Cortalim to Madkai and from Rassai to Dhurbat Village aids in commuting passengers. Barge jetties and workshops are located along the Zuari River.

Adequate natural and scenic resources like, sandy and rocky beaches, landscape and waterscape promote tourism. An added attraction is the panoramic view of the entire harbour and port area with the famous beaches of Bogmalo and Baina. This taluka has accounted for 2,33,915 domestic and 25,389 foreign tourists in 2005. The taluka has a number of hotels and shacks to cater to the tourism industry and general public. The 2001 census data has enumerated that the population count is 1,44,949 and households are 32,299.
Using digital remote sensing techniques, a coastal corridor of 500 m has been computed for the surface land utilization pattern (Plate 5.7). In this corridor, built up + vegetation is 05.31 sq km, agriculture 00.40 sq km, fallow land 00.59 sq km, water bodies 00.55 sq km, forests 00.97 sq km, wetlands/khazans 0.63 sq km and sandy area occupy 00.55 sq km. Further, mangroves cover 00.68 sq km and barren rocky occupy 00.65 sq km of area, however area under mining is absent (Fig. 5.7 a). Figure 5.7 b presents the resources along the Tidal Zuari River for the 100m corridor.

**Salcete Taluka**

Both coastal and estuarine resources are present in this taluka. Fishing jetties are located within this taluka at Issorcim, Majorda, Colva, Benaulim, Cavollosim and Varca Villages, which provided a catch of around 25,315 tonnes of fish, as reported in the year 2005. Seven aquaculture sites are located at Chichinim, six at Curtorim, four each at Cavollosim and Deusan, three at Carmona, two at Benaulim, one each at Navaelim, Sirlim, Velim and Assolna Village. Traditional fishing practices are also adopted in this taluka. The Rio Sal Fishermen Co-op society at Colva and the South Goa Mechanized Boat owners Co-op Marketing Society at Velim are located in this taluka. Common salt is extracted at Varca, Assolna and Chichnim Villages. Laterite and basalt used as construction material is also found in this taluka. There are small extractions of lime shells. Rabi and Khariff crops with mixed cropping system are grown here. Forest plantations, orchards and mangroves, form part of the forest resources. Drinking water resources are harvested from open wells and tanks. Likewise, the public water system is available, which is apparently adequate. The urban settlement pattern is unique with higher concentrations of settlement being in the
coastal belts and, Margao Town and its surrounding areas. The settlement has both modern state of art architecture and also Portuguese - Goan type. Various service sectors like industrial units, religious places, academic and technical institutions, hospitals, workshops and related facilities are present. The N.H 17 and 4A, connects the State to Maharashtra and Karnataka. Similarly, the Konkan Railway and South Central Railway also serve as mode of rail communication. Major state highways, and village roads are also present.

Adequate natural and scenic resources like, sandy beaches, landscape and waterscape promote tourism economy. The unique scenic beauty of Colva, Majorda, Banaulim, Cavalossim beaches and all other beaches in this taluka are of immense attraction. The backwaters specifically of the Sal River give a panoramic waterscape view. Around 5,37,736 domestic and 1,15,905 foreign tourists have visited this taluka as reported in the year 2005. The taluka has 78 hotels and 45 shacks so as to cater to the tourism industry.

Khazan lands are also present in this taluka and used for agriculture and fish culture. The human population as reported in census 2001 is 2,62,035 and households are 59,063.

Using digital remote sensing techniques, a coastal corridor of 500 m has been computed for the surface land utilization pattern (Plate 5.8). In this corridor, built up + vegetation is 09.21 sq km, agriculture 01.50 sq km, fallow land 02.00 sq km, water bodies 01.01 sq km, forests 01.00 sq km, wetlands/khazans 01.21 sq km, sandy area 03.07 sq km, and mangroves occupy 00.20 sq km. However, rocky barren and mining class is absent (Fig. 5.8).
Quepem Taluka

Only coastal resources are present in this taluka. Fishing jetties are located at Cutombi, and Betul Villages, with a fish catch of 17081 tonnes as reported in the year 2005. The Cutbona fishermen Co-op Society is located in this taluka at Cutomba Jetty. Agriculture is not very prominent; however, rice and mixed crops are also sowed. This taluka is dominant by forest plantations and orchards. As regards to water; open wells, tanks and also public water system is available.

The rural - urban settlement pattern is well established with the traditional rural village architecture. Various industrial units, religious places, academic and technical institutions, hospitals, workshops and related facilities are present. The N.H 17 passes through this taluka, which connects the State to Karnataka. The Konkan Railway also serves as a major mode of commutation. Major state highways and village roads are also present.

Adequate natural and scenic resources like rocky shores, landscape and waterscape promote tourism resources. An added attraction is the Cabe De Ram Fort, which also attracts a number of tourists. No records of tourists visiting this taluka are available. The human population count of this taluka is 74,034 and households are 16,136 as per the census of 2001.

Using digital remote sensing techniques, a coastal corridor of 500 m has been computed for the surface land utilization pattern (Plate 5.9). In this corridor, forests occupy 01.39 sq km, barren rocky 01.10 sq km and water body occupy 0.31 sq km. However, sandy areas, built up +
vegetation, agriculture, fallow lands, mangroves and mining areas are absent (Fig. 5.9).

**Canacona Taluka**

Both coastal and estuarine resources are present in this taluka. Fishing jetties are located at Saleri, Agonda, Pallolem, Talpona, Galgibag, Polem and Mashem Villages, which provide a catch of around 2,309 tonnes of fish as reported in the year 2005. Two aquaculture sites are located one each at Canacona and Loliem Village. Laterite and road metals used as construction material are found in this taluka. There are small extractions of lime shells.

Agriculture of a lesser magnitude is being practiced. Large forest resources comprising of forest plantations, orchards are present. Mangroves are present in small pockets. Water resources, through open wells, tanks and also through public water system is available.

The rural - urban settlement pattern is well established with the traditional rural village architecture. Various service sectors like industrial units, religious places, academic and technical institutions, hospitals, workshops and related facilities are present. The NH 17 passes through this taluka, and The Konkan Railway, which connects this talukas with intra and inter-state commutation. Major state highways, and village roads are also present.

Adequate natural and scenic resources like, sandy beaches and rocky shores, landscape and waterscape promote tourism activities. The Palolem and Polem beach are unique in their settings and these beaches attract a number of tourists. Around 13,910 domestic and
13,783 foreign tourists have visited this taluka as reported in the year 2005. The taluka has 47 hotels and 09 shacks so as to cater to the tourism industry. Supplementary recreational facilities like aqua sports, scuba diving, para sailing are also promoted along with tourist guiding facilities. The human population count of this taluka is 43,997 and households are 9,206 as per the census of 2001.

Using digital remote sensing techniques, a coastal corridor of 500 m has been computed for the surface land utilization pattern (Plate 5.10). In this corridor, built up + vegetation occupy 07.21 sq km, agriculture 00.82 sq km, fallow land 00.65 sq Km, water bodies 00.21 sq km, forests 12.11 sq km, wetlands/khazans occupy 00.11 sq km, sandy area 01.22 sq km and barren rocky occupy 01.06 sq km area. However, mangroves and mining class is absent (Fig. 5.10).
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(Source: Directorate of Fisheries, Govt. of Goa)
Coastal Zone Information System
(Goa State)

METHODOLOGY – DIGITAL IMAGE CLASSIFICATION
COASTAL LAND RESOURCE MAPPING

SOI TOPOGRAPHICAL MAPS ON 1:50,000 SCALE

Load Data
Extract Area of Interest
Digital Satellite Image
IRS-1D LISS-III (2002)

Rectification

Enhancement of Satellite Data
Using ERDAS Ver 8.4

Supervised classification

Accuracy Checking

Ground verification of doubtful areas

Thematic Map

Land Resource Map (Taluka Wise)

Area Calculation
HWL
CRZ - 100 m (RIVER)
CRZ - 200 m (COAST)
CRZ - 500 m (COAST)

TALUKA WISE MAPS WITH CRZ CORRIDORS

Differential Global Positioning System

DGPS based Ground Control Points

Identification of Training Sites

Generation of Signatures

Various Spectral & Spatial Enhancement Techniques
Like Generation of tray sets
Refining tray sets

Digital Cartographic Techniques

Chart 5.2
Coastal Zone Information System
(Goa State)
Land Resources – North Goa

Fig. 5.1

Source: Aerial Surveillance (1971) + Topomap
Coastal Zone Information System
(Goa State)
Land Resources – Central Goa

LEGEND

Source: Aerial Surveillance (1971) + Topomap

Fig. 5.2
Coastal Zone Information System
(Goa State)
Land Resources - South Goa

LEGEND

AGRICULTURE LAND
HORTICULTURE LAND
ORCHARD
ORCHARD + FOREST
MANGROVES
MUD/TIDAL FLATS
SANDY AREA
ROCK OUTCROP
BARREN ROCKY
LAND WITH/WITHOUT SCRUB
URBAN LAND + ORCHARD
RECLAIMED LAND
GREEN COVER (FOREST)
WETLAND/MARSHY LAND

Source: Aerial Surveillance (1971) + Topomap

Fig. 5.3
Coastal Zone Information System
(Goa State)
Coastal Resources - PERNEM TALUKA

Fig 5.4

Coastal Resources - BARDEZ TALUKA

Fig 5.5
Coastal Zone Information System
(Goa State)
Coastal Resources - TISWADI TALUKA - TIDAL CUMBARJUA

Fig 5.6 c

Coastal Resources - MORMUGOA TALUKA

Fig 5.7 a
Coastal Zone Information System
(Goa State)

Coastal Resources - MORMUGOA TALUKA - TIDAL ZUARI

Fig 5.7 b

Coastal Resources - SALCETE TALUKA

Fig 5.8
Coastal Zone Information System
(Goa State)
Tourism / Eco Tourism Resources

Plate 5.2
Coastal Zone Information System
(Goa State)
Coastal CRZ Buffer With Landuse – PERNEM TALUKA

Scale:

Source: SCI Toposheet & IRS ID LISS III

Plate 5.4
Coastal Zone Information System  
(Goa State)  
Coastal CRZ Buffer with Land use – BARDEZ TALUKA

Source: ISRO Toposheet & IRS ID LISS III

Plate 5.5
Coastal Zone Information System
(Goa State)
Coastal CRZ Buffer with Land use – TISWADI TALUKA

LEGEND
[BUILT-UP WITH VEGETATION]
[AGRICULTURE]
[FALLOW LAND]
[WATER BODY/KHAZANS]
[FORESTS]
[WETLAND]
[MANGROVES]
[MINING AREA]
[SANDY AREA]
[BARREN LANDS]

HWL
100 m CRZ LINE
200 m CRZ LINE
500 m CRZ LINE

Scale:
2
2 Kilometers
1:125000

Source: IRS ID LISS III

Plate 5.6
Coastal Zone Information System
(Goa State)
Coastal CRZ Buffer with Land use - SALCETE TALUKA

Source: SOI Toposheet & IRS ID LISS III

Plate 5.8
Coastal Zone Information System
(Goa State)
Coastal CRZ Buffer With Landuse - CANACONA TALUKA

Source: SOI Toposheet & IRS ID LISS III

Plate 5.10