

Coastal Plain of Kachchh District

Community ecosystem services assessment

Introduction & Summary

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Action plan

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The University of Greenwich
in collaboration with the
Gujarat Institute of Desert Ecology (GUIDE)

present the project

Ecosystem Assessment of the Coastal Plain Natural Area of Kachchh District:

Planning for Biodiversity and Livelihoods into the Future

funded by the British Council

UK-India Education and Research Initiative (UKIERI)

The origin of this project

The initial approach was made to the University of Greenwich by a former student on the MSc in Environmental Conservation who had returned to India and was working at GUIDE. He wanted to collaborate in writing a bid as a prelude to doing a PhD. It is perhaps unfortunate that, by the time the funding was approved, he had left GUIDE.

The original suggestion was that a proposal should be written to carry out research into the perceived problem of the non native invasive species *Prosopis juliflora*. This plant is a problem in many countries across the globe and it is extremely difficult to control. The University of Greenwich team suggested that the most appropriate strategy would be take an integrated approach to land use planning. In England the basis for this is a combination of desk study, landscape assessment and participation of local people to develop a 'Natural Character Area' (NCA) profile for areas identified as having shared biophysical characteristics. These documents are available on the internet and provide the context for decision making at all levels and purposes, from finding the most appropriate location for industry to identifying priorities for resource allocation.

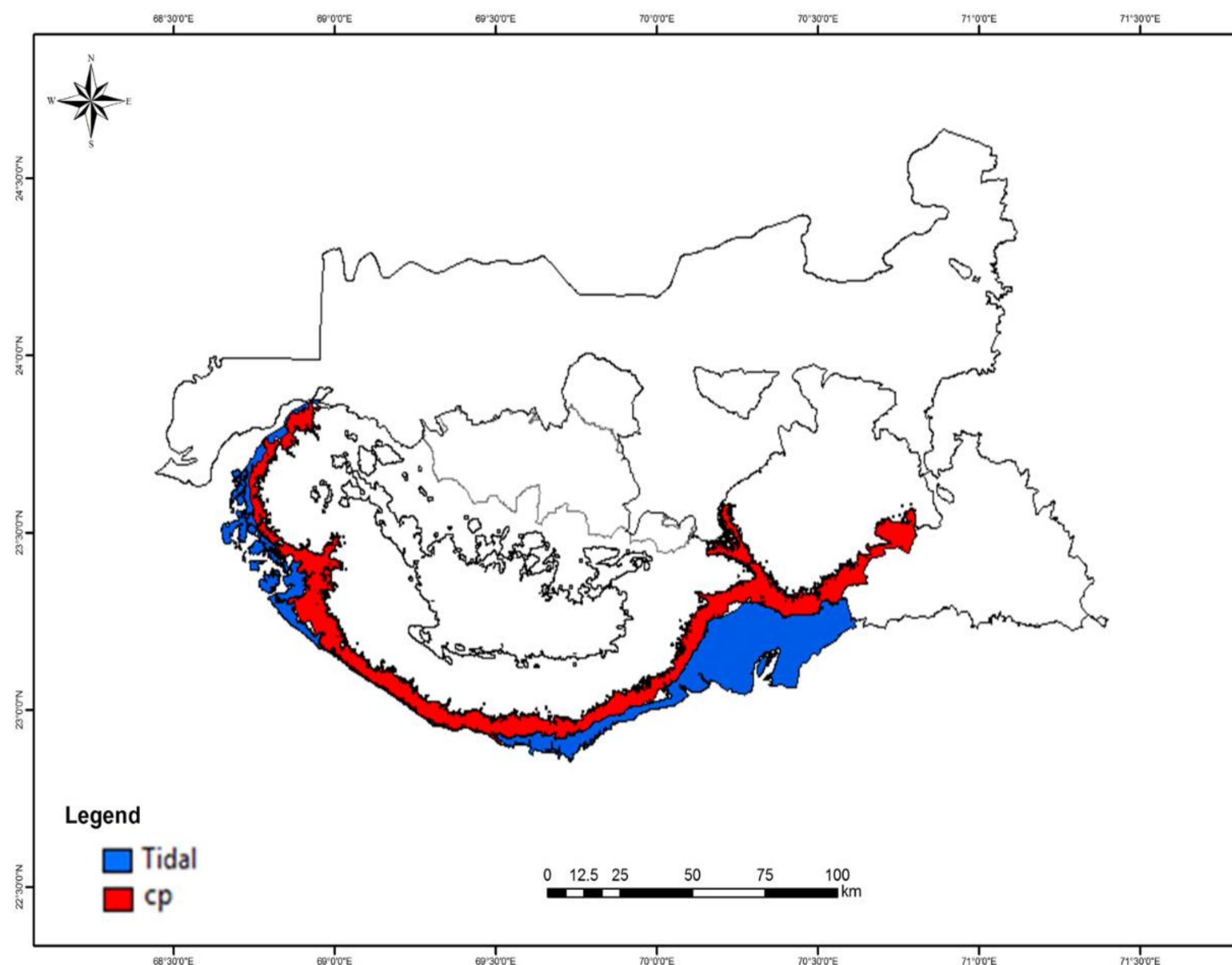
While this document is loosely based on the NCAs produced for every part of England it has been modified to fit the local situation. The process has enabled the identification of some strategic priority areas, and we hope that the approach will prove useful and be applied in other parts of Kachchh.

Introduction

Natural Character Area (NCA) profiles are guidance documents to improve information available to decision-makers. The NCA process divides the territory into 'natural areas' defined by a combination of environmental, cultural and economic features; boundaries follow natural rather than administrative lines. The NCA profile describes how the landscape has changed over time and the drivers behind these changes, and provides an analysis of the ecosystem services.

For efficient landscape management, policy makers should consider the landscape context as consisting of both natural and cultural heritage features, and decisions should be then subjected to public consultation. The NCA profile of the Coastal Plain of Kachchh is a working document which will help to inform how the landscape should be managed and how it may change in the future.

Natural Character Area map



Summary

Kachchh district is located in the northern part of Gujarat, north-west India. The Coastal Plain borders the Kachchh mainland to the north, the Gulf of Kachchh to the south and the Arabian Sea to the west. The 406 km of coast comprises a wide range of habitats such as coral reefs, mangroves, creeks and estuaries.

Many village livelihoods depend on these ecosystems. Salt production and fishing are dependent on the sea, but the flat topography is also appropriate for land-based occupations such as agriculture, horticulture and animal husbandry. This topography and the strategic position of the area for commercial purposes has encouraged the development of industry. The location of industrial infrastructure appears to be *ad hoc* and this has caused a change in the landscape, deterioration of the local ecosystems and loss of the traditional livelihoods.

Water scarcity is increasing with the high water demand of the industry, combined with the removal of key ecosystems such as mangroves. In addition, the water quality is decreasing due to industrial pollution and the release of salt water into the groundwater.

Climate change and rising sea levels exacerbate these problems, as salt water flooding events are more frequent and monsoon rainfall is variable. These factors are severely affecting traditional livelihoods.

The spread of the invasive species *Prosopis juliflora* affects not only the Coastal Plain but also the whole district. This is threatening protected areas, valuable pasture land and local economies that are dependent on livestock. An integrated management plan is needed in order to resolve these issues.

Methodology used in this project

This project was driven by the recent acknowledgement of the threat to the habitats and wildlife of Kachchh District. It was organized in two phases: data collection; and the production of a Natural Character Area profile intended to inform landscape scale landuse planning and management decisions.

Phase 1 Ecosystem Assessment of the habitats in the Kachchh District: This was based on the need to collect both environmental/biological and socio-economic data, to inform future management

- **Mapping and monitoring:** In order to inform future management, the habitats of the region have been determined using Remote Sensing imagery. This was made possible by a grant to this project to purchase up-to-date imagery.
- **Landscape characterization:** Standard techniques have been used to produce profiles for each of the distinct natural areas of the coastal plain. These describe the environmental conditions, physical attributes, such as topography, as well as the vegetation type, and characteristic ecological assembles/communities, including notable wildlife.
- **Socio-economic evaluation of natural resource use (Focus groups):** To identify the environmental, social and economic issues of the coastal plain and ensure that these were acknowledged in the final report, focus groups were carried out using a pre-prepared structured interview schedule.

This was carried out by undertaking the following tasks

- **Desk study:** The objective of this was to form the basis for the fieldwork and to obtain the necessary background knowledge to set relevant question and to comprehend the challenges and issues faced by the local communities.
- **Field work:** Recording and analysing different aspects within the natural area.
 - **Field survey sheets:** Used to record information that was not revealed by the desk study (these are included on the following pages).
 - **Sheet analysis:** Each site was characterised using consensus descriptors. Derived from the field sheets completed by the field team, consisting of both Indian and UK members.



Team completing field survey sheets



Field work challenges

Field survey sheet

ANNEX 1

KACHCHH 2015 FIELD SURVEY SHEET

Surveyor:

Time:

View point No:

Photo No:

Weather:

Date:

Location:

Coordinates:

Direction of view:

Visibility:

Topography

Flat	Plain	Broad valley
Undulating	Plateau	Narrow valley
Hills	Steep	Flood plain
Mountains	Scarp/cliffs	Estuary
	Deep gorge	

Annotated Sketch/ Brief Description

LAND COVER

Cropped land

Field crops

Bare ground

With rocks

With stones

Vegetation

Grass

Mixed herbs

Abundant

Sparse

Medicinal plants

Woodland and scrub

Mixed woodland

Group of trees

Isolated trees

Scrub

Isolated shrubs

Mangrove

Prosopis juliflora

Dominant

Abundant

Frequent

Occasional

Rare

Absent

Water and wetland

Lake

Reservoir

Pond

Running water

River

Canal

Wetland

Marsh

Coastal features

Sea and coastal waters

Inter-tidal sand and mud

Salt marsh

Salt pans

Dunes

Coastal rocks and cliffs

LAND USE

Farming

Field crops (name)

Intercropping

Home garden/s

Market garden/s

Orchard

Pasture

Rough grazing

Fallow

Boundaries

Shelterbelt (windbreak)

Walls

Fences

Built forms

Settlement

Industry

Military

School

Temple

Farm buildings

Temporary buildings

Scattered buildings

Infrastructure

Road

Track

Footpaths

Railway

Pylons

Communication masts

Wind turbines

Power station

Drainage ditch/dyke

Dam

Reservoir

Cultural Heritage

Buildings

Vernacular

Historic

Religious

Other;

Natural Heritage

Significant trees

Landform features

Other:

Livestock

Sheep

<10 10-100 >100

Cattle

<10 10-100 >100

Buffalo

<10 10-100 >100

Camels

<10 10-100 >100

Goats

<10 10-100 >100

Mixed herds

Draft animals

Continued on the following page

Key characteristics/distinctive features and why these are important:

Do you think this landscape is valuable? if so why?

Positives:	Negatives:
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Visual Assessment Criteria

Pattern	Dominant	Strong	Broken	Weak
Scale	Intimate	Small	Medium	Large
Enclosure	Confined	Enclosed	Open	Exposed
Complexity	Uniform	Simple	Diverse	Complex
Texture	Smooth	Textured	Rough	Very Rough
Form	Vertical	Sloping	Rolling	Horizontal
Line	Straight	Angular	Curved	Sinuous
Colour	Monochrome	Muted	Colourful	Garish
Movement	Still	Calm	Active	Frenetic
Unity	Unified	Interrupted	Fragmented	Chaotic
Balance	Balanced	Unbalanced		
Structure	Random	Regular	Formal	
Visual Dynamic	Sweeping	Channelled		

Perception

Security	Comfortable	Safe	Unsettling	Threatening	
Stimulus	Monotonous	Bland	Interesting	Inspiring	Invigorating
Tranquillity	Inaccessible	Remote	Vacant	Peaceful	
Pleasure	Offensive	Unpleasant	Pleasant	Attractive	Beautiful

		Condition →	
Quality ↓	Good		
		Poor	

What is the most appropriate management strategy for this landscape?

Maintain Restore Enhance

How?

How does it make you feel ?

😊 😐 😞

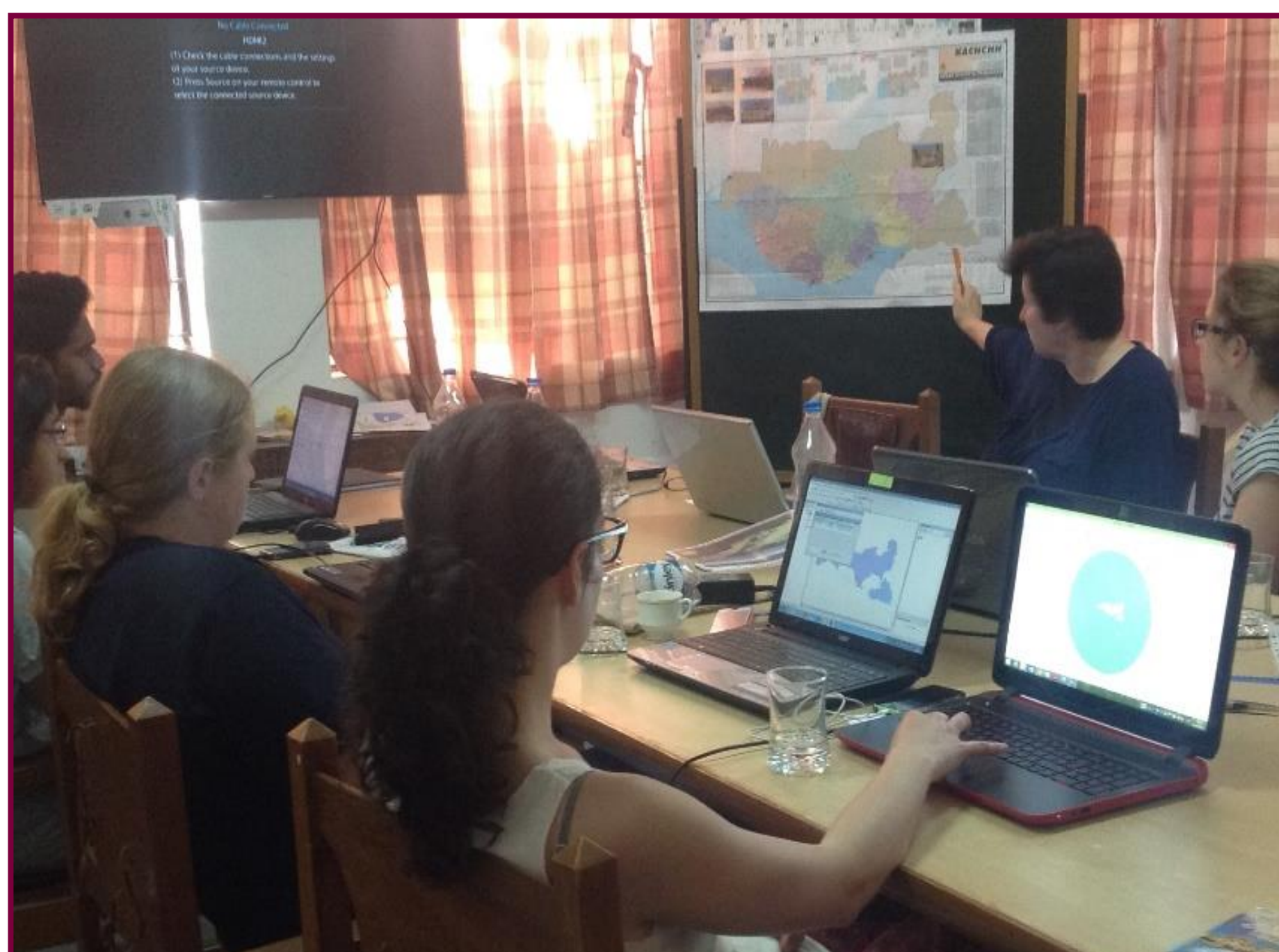
Other comments

Ability to accommodate change

Resilient Vulnerable

Phase 2 Formulation of the Natural Character Area profile

- This brought together the results of the landscape and ecosystem service assessment in the context of existing plans, policies and strategies for the region, with the objective of balancing the priorities of ensuring the livelihoods of local stakeholders while at the same time maintaining important habitats and native wildlife. Strategic objectives were identified and an action plan outlined as the basis for developing an implementation strategy.



Desk study



Landscape Character Assessment



Focus groups

Statements of Environmental Opportunities

- **SEO1:** Maximise the potential of *Prosopis juliflora* for fuel, charcoal and biochar and explore the potential for eradicating it in key areas such as the Naliya grassland.
- **SEO2:** Maintain and enhance the natural and cultural heritage, for example by promoting sustainable tourism that delivers direct benefit to local people.
- **SEO3:** Formulate a strategy to minimise the negative impact of industry on the environment and local communities, and increase the potential for delivering real benefits such as quality jobs for local people.
- **SEO4:** Enhance and maintain mangrove and creek ecosystems and ecosystem services such as flood prevention and fish production while considering the potential for industrial expansion in the area



Mangrove forest



Suf embroidery



Charcoal

This section contains the background information derived from the desk study:

1. Landscape and nature conservation designations
2. Landform, geology and soils
3. Water bodies and catchments
4. Population statistics
5. Location of settlements on the coastal plain
6. Historic sites and features
7. Cultural aspects
8. Landscape and natural habitats
9. Livelihood change
10. Ecosystem services
11. Coastal plain of Kachchh today
12. Key characteristics of the coastal plain

1. Landscape and nature conservation designations

1.1 Designated nature conservation sites

Any area can be designated by the State Government to constitute a wildlife sanctuary if it is of adequate ecological, faunal, floral, geomorphological, natural or zoological significance, for the purpose of protecting, enhancing or developing wildlife or its environment. Some restricted human activities are allowed inside the sanctuary area (Wildlife Protection Act 1972). The Coastal Plain includes the following non-statutory designated areas:

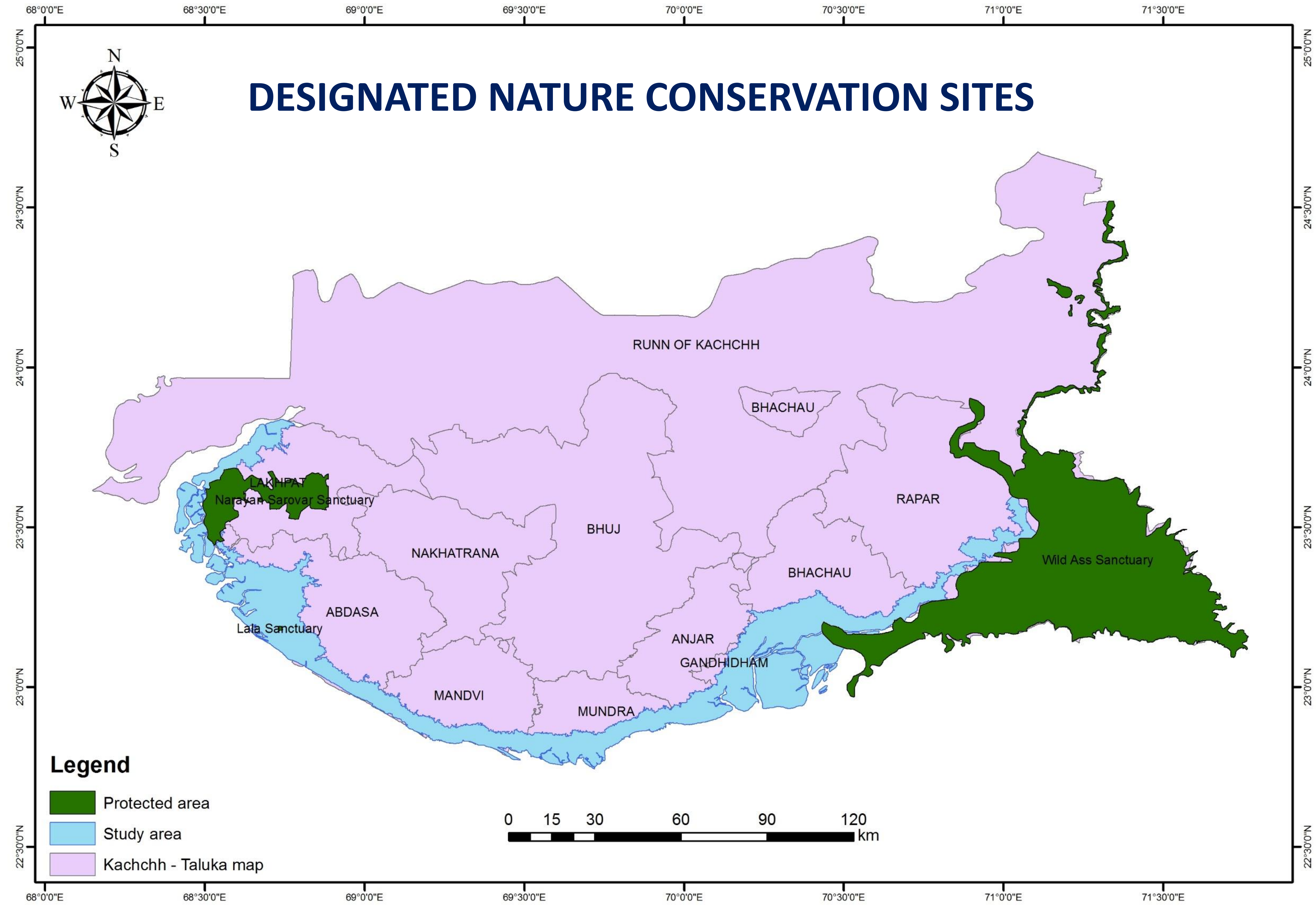
Tier	Designation	Name	Area (ha)
Regional	Wildlife sanctuary (WLS)	Lala Great Indian Bustard Sanctuary	203
Regional	Wildlife Sanctuary (WLS)	Narayan Sarovar (Chinkara) Sanctuary	44,423

1.2 Potential nature conservation sites

Community Reserve is a term denoting a protected areas of India which typically acts as a buffer zone, connection or migration corridor between established national parks, wildlife sanctuaries and reserved and protected forests of India.

Such areas are designated as conservation areas if they are uninhabited and completely owned by the Government of India but used for subsistence by communities and community areas if part of the lands are privately owned.

These protected area categories were first introduced in the Wildlife (Protection) Amendment Act of 2002 – the amendment to the Wildlife Protection Act of 1972.

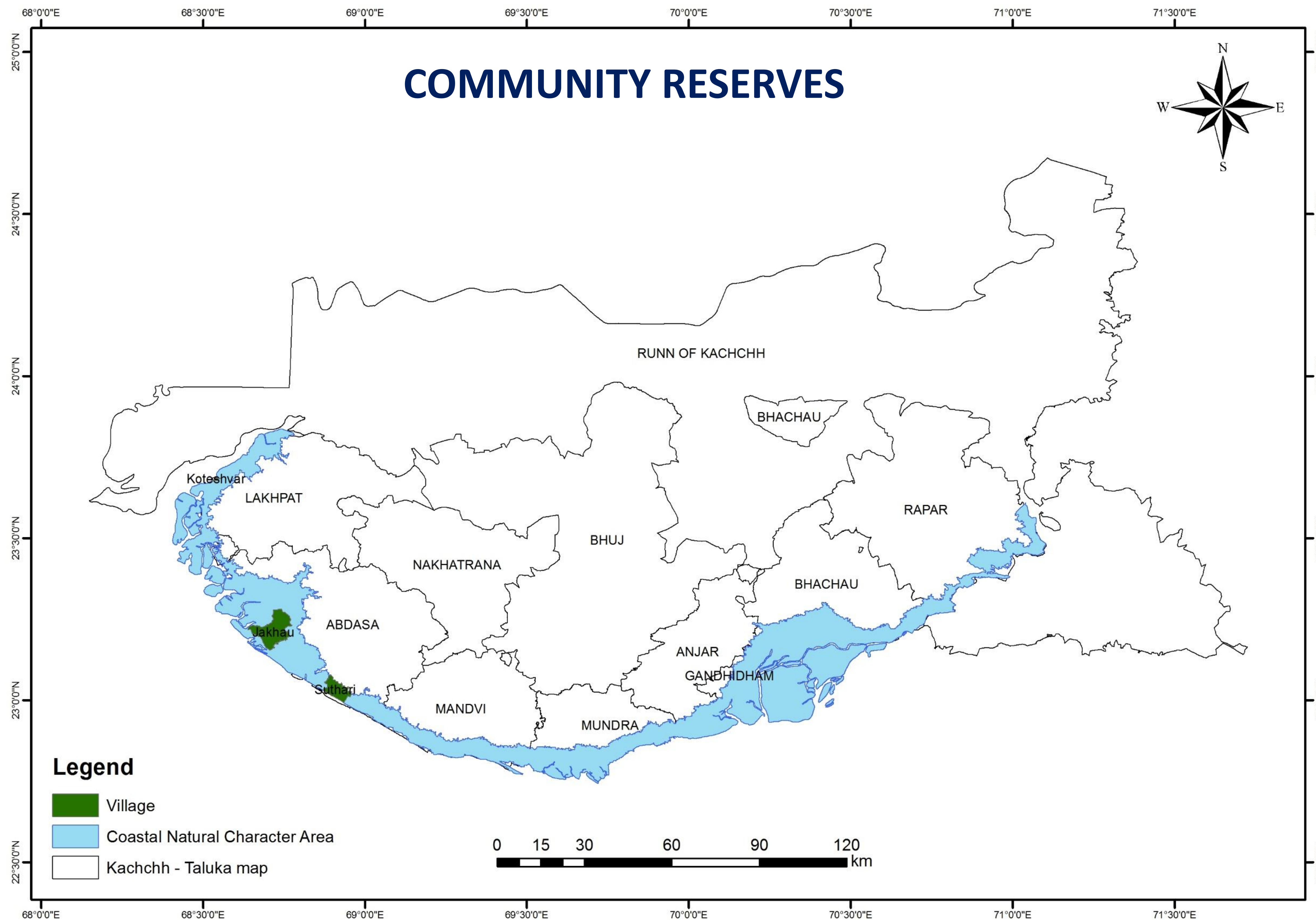


These categories were added because of reduced protection in and around existing or proposed protected areas due to private ownership of land, and land use.

The Coastal Plain includes the following Community Reserves:

Tier	Designation	Name	Area (ha)
Regional	Community Reserve	Koteshwar	14,600
Regional	Community Reserve	Jacau	403
Regional	Community Reserve	Suthri	19

- **Koteshwar:** The extensive mudflat with mangroves supports an enormous wealth of marine fauna and wetland birds, which are considered to be an important ecosystem asset for the region.
- **Jacau:** This extensive mudflat and mangrove habitat provides shelter for a number of wetland species such as Pelicans or Painted Storks.
- **Suthri:** It is composed by a narrow strip of beach bordered by minor dunes. The site has been used by sea turtles for nesting, and important avifauna consists of shore birds on the beach and grouses and passerine birds on the dry grassland.



2. Landform, geology and soils

2.1 Elevation

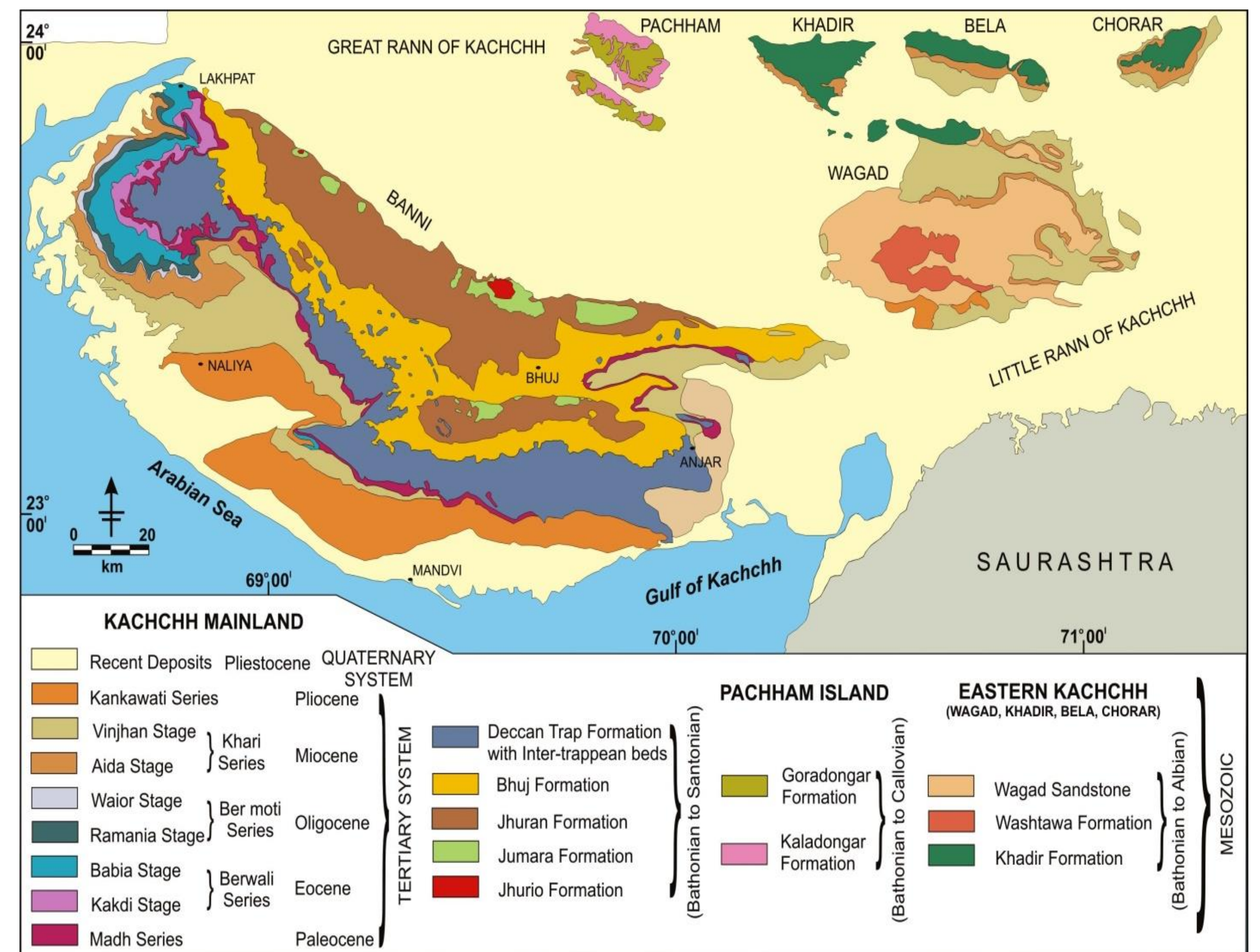
Elevation ranges from sea level along the coast to a maximum of 12 metres.

2.2 Landform and process

The Coastal Plain is made up of Quaternary sediments devoid of any significant topographic features. The western half, trending NW-SE and facing the Arabian Sea, is muddy and consists of extensive alluvial tidal flats. The segment lying within the Gulf of Kachchh is silty and sandy with narrow beaches and trends E-W; to the east it joins the Little Rann. The seasonal river mouths are filled with small muddy tidal lagoons. The shoreline is irregular and much dissected. The low level plain has a submerging aspect with marked indentations, deep inlets and a number of offshore islands and several estuarine river mouths.

2.3 Bedrock geology

The Quaternary sediments overly soft Tertiary sandstones and conglomerates. These are rich in mineral deposits of bauxite, limestone, lignite and bentonite.



2.5. Soils and Agricultural land Classification

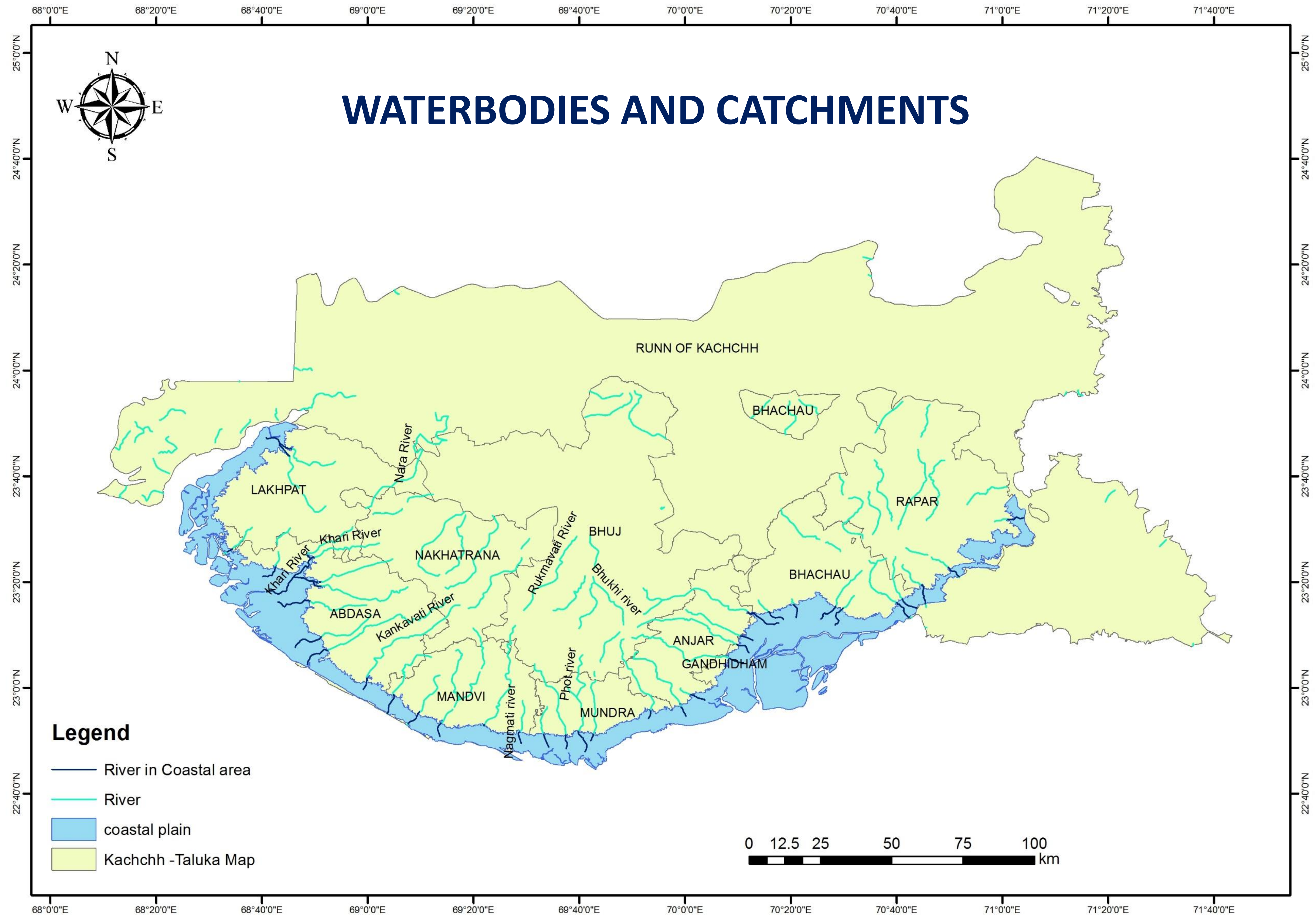
- A fertile strip of land runs along the southern coast
- Only 10% of cultivable land is irrigated
- Sheep rearing in a free grazing based animal husbandry system is dominant in a few coastal villages of Abdasa Taluka



3. Key water bodies and catchments

All water bodies in the area are seasonal. Are monsoon dependent. The following major rivers and streams have been identified in this NCA.

Name	Length in NCA (Km)
Bhuki	2.5582
Phot	7.78969
Nagavanti	4.27
Khari	25.0969
Rukmawati	0.318359
Kankawatiand	4.22695
Naira	0



4. Population statistics

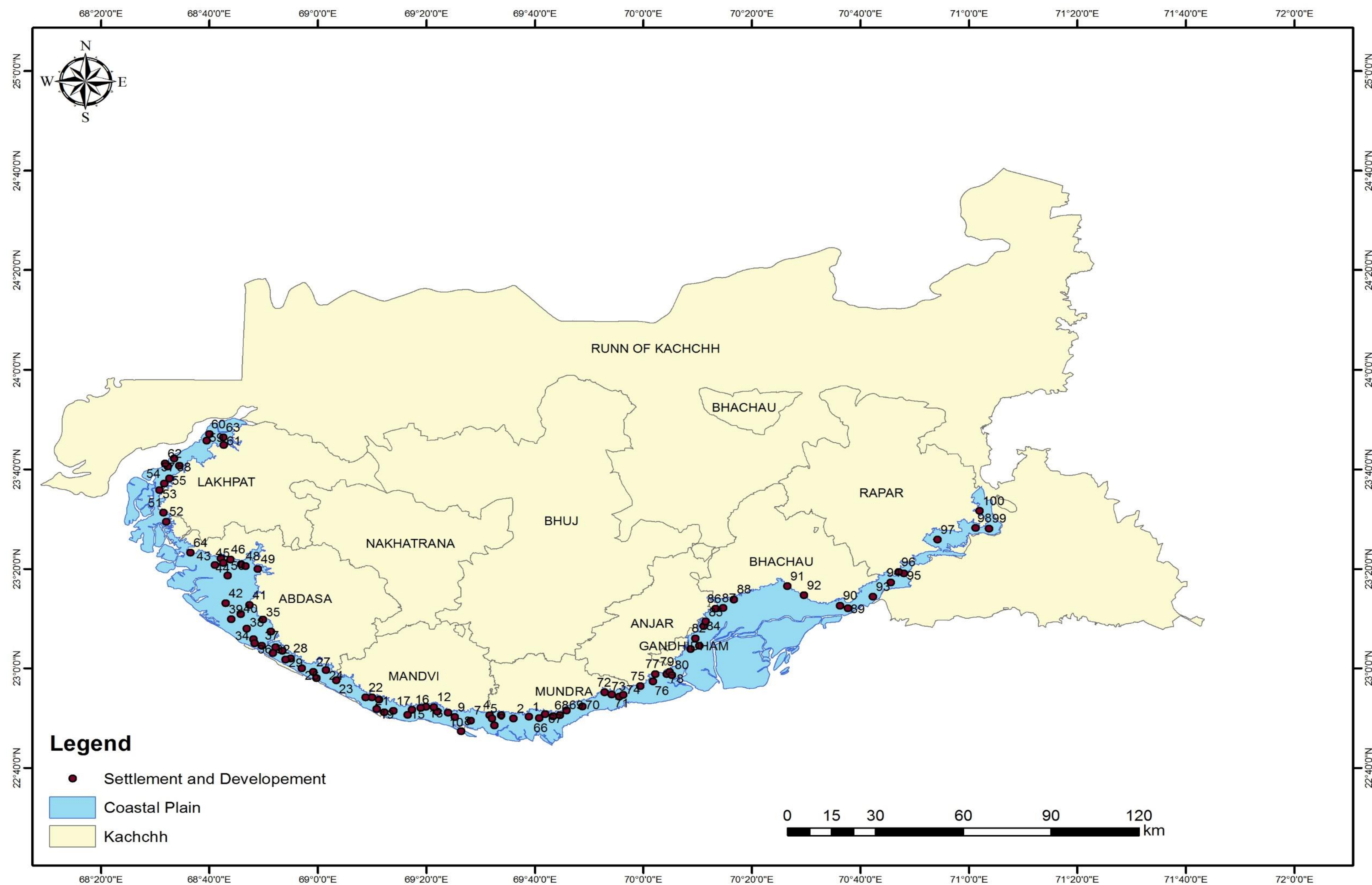
In 2011 the population of the district of Kachchh was 2,092,371, of which males 1,096,737 and females 995,634. This compares with the previous census in 2001 when the population was 1,583,225, of which males 815,153 and females 768,073. This represents an increase of 32.16 percent in a decade. Comparing the 2001 census with the 1991 census, the decadal increase was only 25.4 percent.

Due to the concentration of natural resources such as mangroves and fisheries, the coastal strip has a higher population density when compared to the 6749 square kilometre hinterland that it encompasses.

The Mandvi-Mundra stretch has the highest rural population density, with 101 persons/square kilometre. This contrasts with the district average of 35 persons/square kilometre in 2001, and 46 persons/square kilometre in 2011, which testifies to a significant population increase in a decade.

Industrial development has encouraged migration towards the coast which has resulted in the growth of coastal towns and the creation of new settlements, with the concomitant conversion of agricultural land for non-agricultural purposes. Most of the workforce in the coastal industries are skilled and semi-skilled migrants.

5. Location of settlements on the coastal plain



6. Historic sites and features

- **Aaina Mahal** – Bhuj: Museum, built in the 18th century as the palace of Maharao Lakhpatji.
- **Prag Mahal** – Bhuj: In 1865 construction was started by Rao pragmalji 2 (bija) and it was completed in 1879. The building is in Italianate style.
- **Vijaya Vilas Palace** – Mandvi: Summer palace of Jadeja Rajas of Kutch.
- **India house (Kranti Tirth)** – Mandvi: A memorial for Shyamji Krishnavarma, an Indian revolutionary fighter.



Indian epic sports-drama film

7. Cultural aspects

- The coastal plain of Kachchh was used as the location for nationally important Bollywood films such as 'Lagaan', and the internationally acclaimed and 'My name is Salt'.
- The area is also culturally important because of its traditional handicrafts.



Traditional handicraft



Vijaya Vilas Palace

8. Landscape and natural habitats

The Kachchh coast has diverse ecological habitats and ecosystems which enhance its landscape diversity and natural resources. Extensive mangrove formations and a continental shelf of 164,000 square km facilitate rich fishing grounds, and livestock tending is a major income generating activity in most coastal villages.

The mangrove ecosystem has an important protective function, particularly in times of increased threat of extreme events along the coast of Kachchh which is known to be highly vulnerable to cyclones and storm surges. These mangroves are themselves under increasing threat from anthropogenic activities.

There are five habitat types. The two most important are mangroves and mudflats which occupy about 940 and 2500 square km respectively.

Sandy beaches and dunes form about 456 square kilometres along the coast in Mandvi, Mundra and Naliya talukas. These habitats are characterised by sparse halophytic communities with low diversity. The remaining two habitats present in this area, but in lower proportions, are creeks and seasonal rivulets, and rocky outcrops.



Sandy beach and dunes at Nimdi Wandh, Abdasa taluka

The diversity of habitats generated by the unique topography is important from both an environmental and economic point of view.

Part of the Gulf of Kachchh is currently a Marine Protected Area (MPA). This is not the only conservation initiative in the area; for instance, the sandy coastal area between Mandvi and Pingleswar provides the perfect nesting and breeding sites for sea turtles such as the green sea turtle (*Chelonia mydas*), the olive Ridley turtle (*Lepidochelys olivacea*) and leatherback turtle (*Dermochelys coriacea*). Due to their importance for the ecosystem and tourism, conservation initiatives are being carried out by the Forest Department in Mandvi.

Faunal diversity includes economically important species such as shrimps, lobsters, crabs and fishes like the ribbon fish, the cat fish, the Bombay duck (*Harpadon nehereus*), leather jackets (*Oligoplites saurus*) and mullets (*Mugilidae*).

Mangroves are another key ecosystem in the area. Harsh environmental conditions, such as the arid hinterland, minimal rainfall and the very high evapotranspiration rate, have reduced the mangrove formations to a single dominant species, *Avicennia marina*, with *Rhizophora apiculata*, *Ceriops tagal* and *Aegiceros corniculatum* mangrove species also occurring.

The importance of mangroves is acknowledged and evident from the restoration programmes currently being carried out to recover mangroves damaged by industry in areas of Abdasa taluka.

Other plant species on the Coastal Plain include *Casuarina equisetifolia*, *Sporobolus* sp., *Suaeda fruticosa* and *Salicornia* sp. The isolated pockets of coastal grasslands have been invaded by the alien shrub *Prosopis juliflora*.

9. Livelihood change

Charcoal production is a minor livelihood in the area. However the spread of *Prosopis juliflora*, and the decline in other livelihoods as a result of industrial expansion, are increasing the interest of the coastal communities in this activity.

The characteristic flat topography of the coast and the strategic position of the area for commercial purposes has encouraged the settlement of industry. The National Highway crosses most of Kachchh district and connects it with its 2 major and 11 minor ports. Industries include chemical, fertiliser, cement and mining companies, among others. The vast amount of energy required by these industries has led to the establishment of power generation plants such as thermal power stations and wind farms which are especially present along the coast.

This industrial development has encouraged migration towards the coast, which has resulted in the growth of coastal towns and the creation of new settlements, with the conversion of agricultural land into new land uses. Industrial development has also favoured a shift from traditional housing (bungas) made of natural materials, to concrete houses.



Traditional circular house-form (bungas) in Kachchh

The rapid growth of industry in the coastal area has changed the surrounding environment and impacted traditional livelihoods and the cultural heritage.

The high demand for water, along with the removal of key ecosystems such as mangroves, is increasing water scarcity; water quality is decreasing due to industrial pollution and ingress of salt water into the groundwater. Climate change and the consequent rise in sea level exacerbate these problems, with salt water flooding becoming more frequent and the monsoon rainfall more variable.

This combination of factors has resulted in a decrease in drinking water quality and availability and an increase in soil salinity. Traditional livelihoods such as fishing, livestock rearing and agriculture are being severely affected.

Fish production is low due to pollution; the poor quality soils result in low crop and grassland productivity which affect livestock rearing; and limited drinking water makes it more expensive to develop these activities.

In addition, *Prosopis juliflora* is spreading across the coastal area as it grows better than native plants on saline soils. This shrub is useful for fuel and charcoal production but is generally considered detrimental to both livestock rearing and agriculture.

The rapid industrialisation of the Coastal Plain has brought some benefits to the villages, such as an increase in literacy and new job opportunities. But these have been limited and the overall impact has been negative.

10. Ecosystem services

The Coastal Plain of Kachchh District provides a wide range of benefits to society. Each is derived from the attributes and processes (both natural and cultural features) within the area. These benefits are known collectively as 'ecosystem services'. The predominant services are summarised below.

10.1 Provisioning services

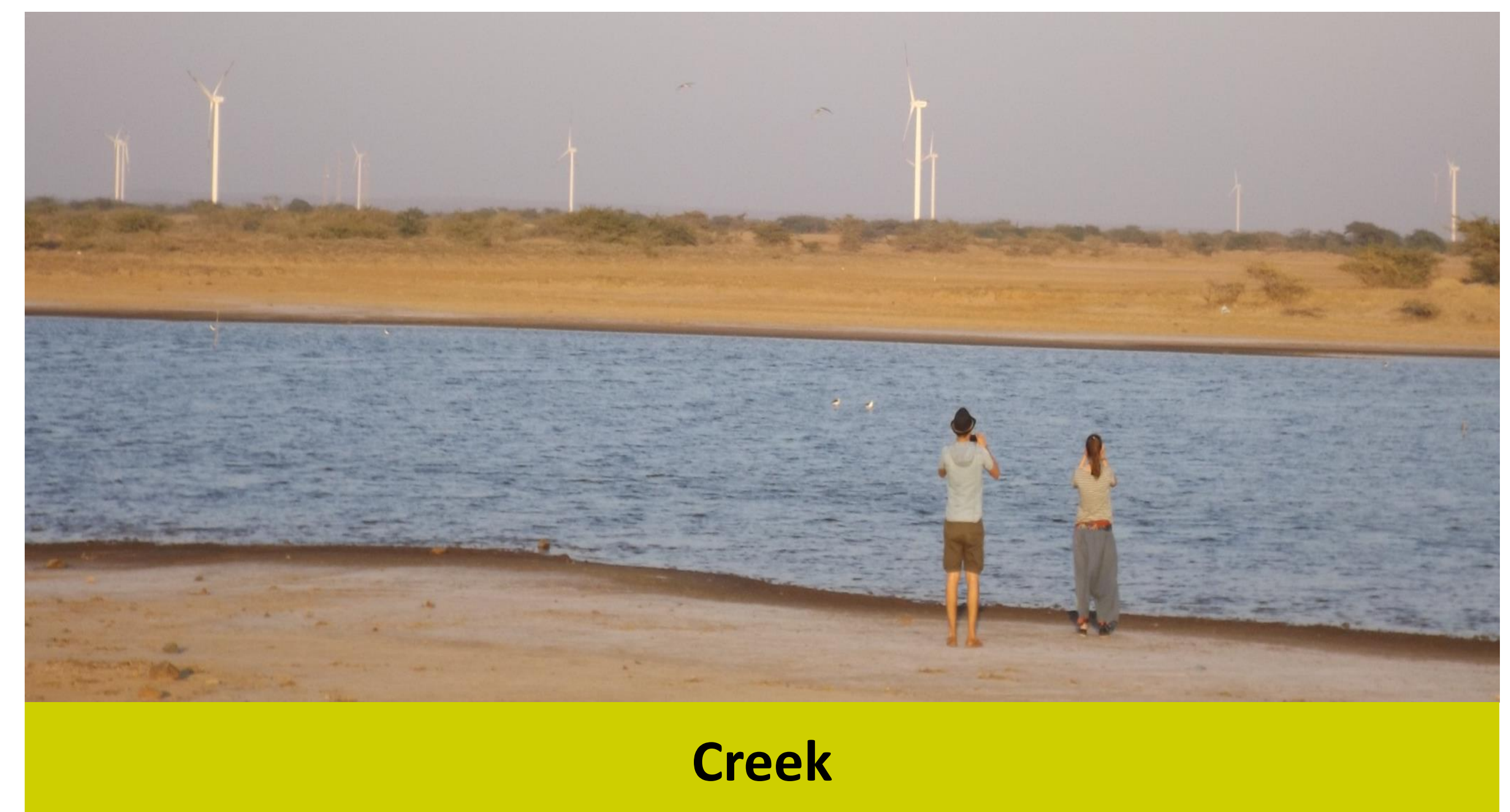
➤ **Food provision:** The NCA contains extensive areas of agricultural land with cultivation of different crops such as bajra, jowar, cotton, guar and castor. Wide areas of pasture land provide grazing for livestock. The fishing industry is also supported by the provision of crustaceans and fishes such as pomfrets, tuna and Bombay duck. Important ecosystems such as mangroves also provide fodder for livestock (leaves and fruit). Salt and edible seaweeds are also provided by marine ecosystems.

- **Medicine provision:** Native plants are of key importance for traditional practices and medicinal use, for example the gugal (*Commiphora wightii*).
- **Fibre and fuel:** *Prosopis juliflora* as well as other shrub species provide an important source of wood fuel. The charcoal produced from *P. juliflora* is known to have a high calorific index, thus producing high quality charcoal. Mangrove leaves are also used as fuel.
- **Minerals:** Bauxite, limestone and bentonite are the main minerals found in the area, leading many industries to settle on the coast.
- **Other:** Despite the negative impact of *P. juliflora* it provides a number of secondary products, such as honey and gum.

10.2 Regulating services

- **Climate regulation:** Significant carbon storage is provided by extensive areas of mudflats, mangroves and grasslands.
- **Regulating soil quality:** Ecosystems such as mangroves prevent sea water infiltration, thereby reducing the risk of salinisation of the soil. Mangroves and their associated habitats also filter and assimilate pollutants from the water, thus reducing the occurrence of these pollutants in the coastal soils. Habitats such as estuaries maintain a constant flux of sediments and nutrients, thereby maintaining the soil productivity of the area.
- **Regulating water quality:** Mangroves and their associated habitats preserve water quality and reduce pollution by filtering suspended material and assimilating dissolved nutrients.

- **Regulating coastal flooding and erosion:** The major risk of flooding in the area comes from the sea. The extensive coastal habitats such as mangroves, creeks, mudflats and sandy dunes, as well as marine ecosystems such as coral reefs, provide an important natural defence against flooding by reducing the impact of wave action on the coastline. In recent years this service has become highly important due to the rising sea level; coastal habitats provide erosion control as well as protection from cyclones and storms.



Creek

10.3 Supporting services

- **Species diversity:** Marine ecosystems of the Kachchh coast are very rich in species diversity and abundance. Mangroves, algae (108 species recorded) and seagrass species along with phytoplankton provide primary production which sustains rich faunal life: dolphins, crabs, fish, prawns and shrimps which are both ecologically and economically important.
- **Breeding sites:** Mandvi coast is a breeding site for the endangered green sea turtle, olive Ridley turtle and leatherback turtles. Mangroves provide breeding grounds for many marine animals, including commercially important fish, prawns, lobsters and crabs.
- **Shelter:** Mangroves provide shelter for many animals during harsh weather conditions and protection to coastal communities.
- **Habitat maintenance:** Mangroves supply nutrients and oxygen to animals and plants in the ecosystem.

10.4 Cultural services

- **Sense of peace/inspiration:** A sense of peace is provided by the coastal landscape.
- **Tranquillity:** Remote areas far from the hubbub of the city can be found on the coast.
- **Recreation:** there are many opportunities for quiet enjoyment of the beautiful beaches; there is horse and camel riding on Mandvi beach.
- **Spiritual value:** Many different cultures coexist in the area, with places of significance for different religions. The tranquil and relaxing atmosphere of the area provides an enhanced spiritual experience.
- **Education:** The unique landscape and biodiversity of the area offers opportunities for watching rare species in their natural area. This is especially true for sea turtles and a wide range of both migratory and endemic bird species.

11. Coastal Plain of Kachchh today

The Coastal Plain extends for about 406 km, bordering the Kachchh mainland to the north, the Gulf of Kachchh to the south and the Arabian Sea to the west. As one of the three major gulf systems of India, this coast has high biological richness and physical and chemical peculiarities. The coastal zone generally consists of unconsolidated coastal and fluvial Quaternary sediments overlying soft Tertiary rocks.

The western half, trending NW-SE and facing the Arabian Sea, is muddy and consists of extensive alluvial tidal flats. The segment lying within the Gulf of Kachchh is silty and sandy with narrow beaches and trends E-W; to the east it joins the Little Rann. The seasonal river mouths are filled with small muddy tidal lagoons. The shoreline is irregular and much dissected. The low level plain has a submerging aspect with marked indentations, deep inlets and a number of offshore islands and several estuarine river mouths.

The Coastal Plain of Kachchh is divided in five zones with distinctive topographic and geomorphological characteristics, which have resulted in the formation of diverse landscapes and ecological habitats.

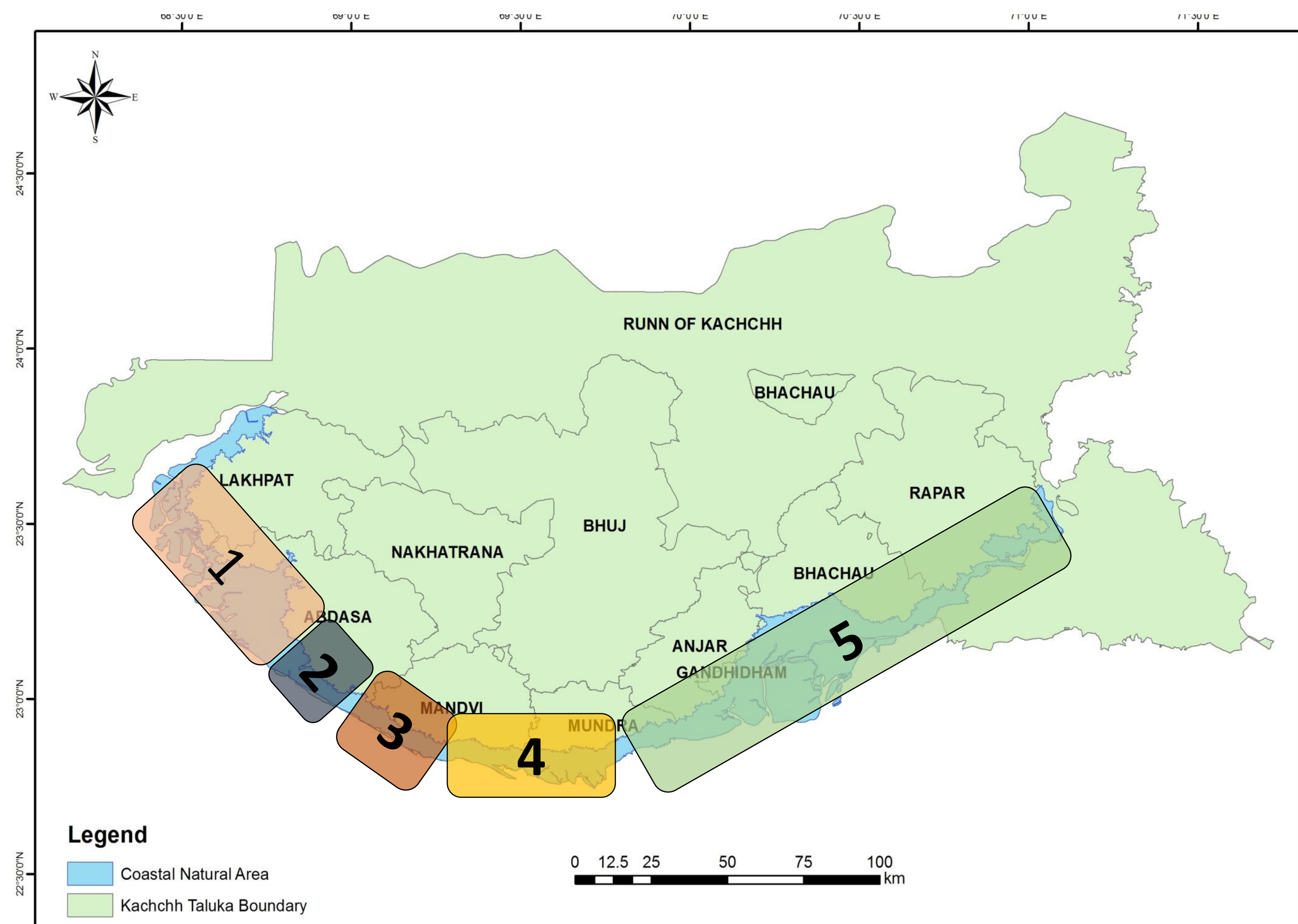
1. Narayan Sarovar to Jakhau includes several creeks and rivers. The intertidal zone is the widest and comprises a vast expanse of mudflats with several rocky islands. A prominent feature of this segment is the presence of 10-15m high rocky cliffs which mark the palaeo-shoreline.

2. Jakhau to Khuada is a narrow area of well-developed beach–dune–lagoon complexes with an approximately 500m wide intertidal zone, providing a rich microhabitat for intertidal fauna. The exposed and open nature of this stretch does not support mangrove formation.

3. Khuada to Bhada is similar to the Jakhau–Khuada segment but it differs because of the absence of a coastal alluvial plain and the occurrence of well-developed active beach–dune complexes.

4. Bhada to Mundra is characterised by a wavy coastline, a wide intertidal mudflat area with extensive mangroves, and a well-developed coastal alluvial plain. The coastline has a well-developed active beach–dune complex. A number of major rivers enter the sea here, forming estuaries.

5. Mundra to Surajbari is characterised by a significant narrowing of the intertidal zone, which varies between 0.5 and 1.5 km in width. The offshore region has several creeks which feature mangroves. A major feature of this coastal segment is the presence of a narrow zone of raised mudflats and alluvial plain along its extent.



The five Local Character Areas of the Coastal NCA

12. Key Characteristics of the Coastal Plain Summarised

- Predominantly flat, low lying coastal landscape with extensive open, sparsely vegetated areas.
- Formed of Tertiary rock outcrops, and sediments from the Banas and other minor streams draining into the Little Rann.
- Rich deposits of bauxite, limestone, lignite and bentonite enable intensive mining operations and allied industries such as cement plants.
- Extensive mangrove formations and a continental shelf of 164,000 square km facilitate rich fishing grounds.
- The sandy coastal area between Mandvi and Pingleswar is an important nesting and breeding site for sea turtles.
- Agricultural land and herds of livestock indicate significant farming activity.
- The 20 km coastal strip has higher population density compared to the 6749 square km hinterland.
- The presence of infrastructure such as highways, roads, ports and communication masts indicate the presence of increasing industrial activity.
- Industrial development has encouraged migration towards the coast resulting in the growth of coastal towns and the creation of new settlements, reducing the area of agricultural land.
- Power plants have been built to support the industrial development. There is significant wind farm development evident along the coast.

Statements of Environmental Opportunity

SEO1: Maximise the use of *Prosopis juliflora* for fuel and charcoal production, and explore the potential for using biochar (small sized charcoal fragments) to improve soil quality

For example,

- Promote *P. juliflora* as a source of fuel and limit the use of native plants for this purpose.
- Raise awareness of the properties of biochar and set up demonstration plots to show the benefits, which include increased soil fertility and water holding capacity, and reduced salinity.
- Explore the potential for eradicating *Prosopis* in specific target areas, for example the Naliya grassland. This would require funding and could be the basis of an environmental management training programme and employment scheme.

- Carry out research into the potential for using *Prosopis* for the creation of living fences.



Each sack of charcoal is sold for 220 rupees

SEO2: Maintain and enhance the natural and cultural heritage of the coastal plain

For example,

- Camel milk derivatives are sold via the internet on the basis of specific health promoting properties. Setting up processing to produce dry milk powder should be explored.
- Promote production of traditional handicrafts and embroidery to improve women's financial independence; there are some excellent examples and these could be supported to expand and increase capacity in other locations.
- Promote sustainable tourism to directly benefit local rural communities based on the unique natural and cultural heritage.



Traditional local handicrafts

Introduction & Summary

Description

Opportunities

Community participation

Action plan

References

Community ecosystem services assessment

SEO3: Formulate a strategy to minimise the negative impact of industry on the environment and local communities and take a participatory approach to developing effective, locally relevant, compensation programmes

For example,

- Develop a strategic plan that identifies zones where development is acceptable and where it should not be located. This should include consideration of infrastructure as well as the socio-economic and environmental conditions.
- Use planning conditions to ensure that a proportion of jobs are reserved for local people and that, where appropriate, specialist training is available in local colleges to ensure access to permanent rather than day labouring employment.

- Set up regular monitoring of socio-economic and environmental impact of companies. This should include detailed evaluation of air and water quality and, where limits are exceeded, treatment systems should be put in place.



Large herd of livestock

SEO4: Enhance and maintain mangrove and creek ecosystems, maintaining important ecosystem services such as flood prevention and fish production while considering the industrial expansion in the area

For example,

- Work with the local fishing community to inform them about the importance of mangrove and creek ecosystems.
- Inform local authorities about the economic importance of such ecosystems in order to promote appropriate land use planning and ensure that water supply to mangroves is maintained.
- Monitor water quality in order to regulate the pollution levels in mangroves and creeks and take action to ensure that it is maintained.
- Involve companies and local communities in mangrove restoration and conservation programmes.
- Implement a monitored programme of sanctions and compensation to encourage companies to promote good environmental and social practices.
- Ensure that a full Environmental Impact Assessment is carried out to ensure that future industrial development is located in areas of minimal impact; cumulative impacts should be included.

Community Participation Rationale

Community participation has been used to understand the perceptions of different social groups and to learn about their livelihoods, their relationship with the environment and social and cultural aspects such as education and the role of women in the community. In short, to identify the environmental, social and economic issues of the coastal plain.



Villagers from Nimdi Wandh

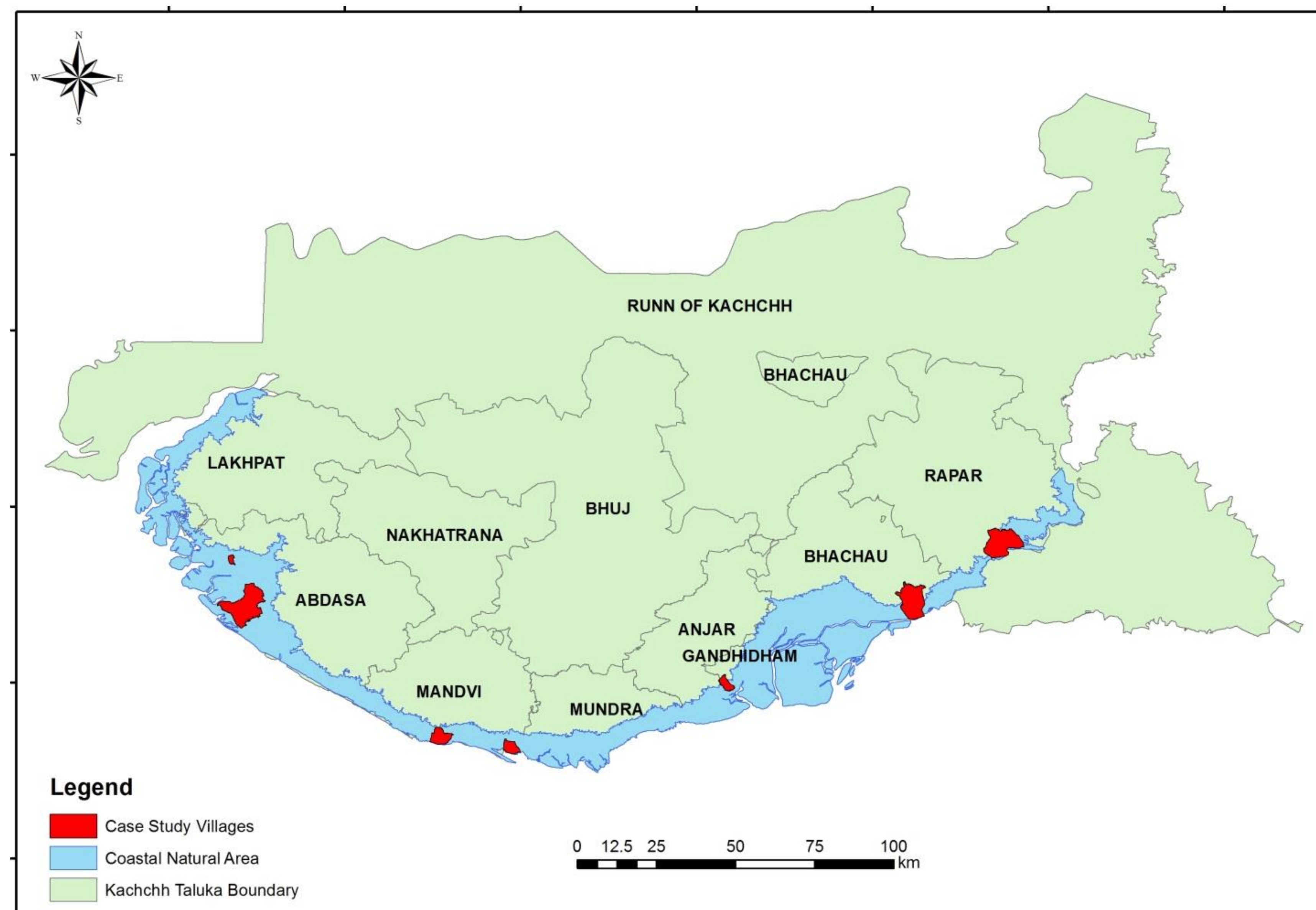


Villagers from Kanmer

Case Study Villages: participatory investigation

In order to extend the depth of information and to begin to consider ecosystem services in more detail, a number of villages in the coastal area were selected on the advice of GUIDE.

Basic information about these villages was gathered by carrying out a desk study; information about them can be found on the following pages



Location of the eight case study villages

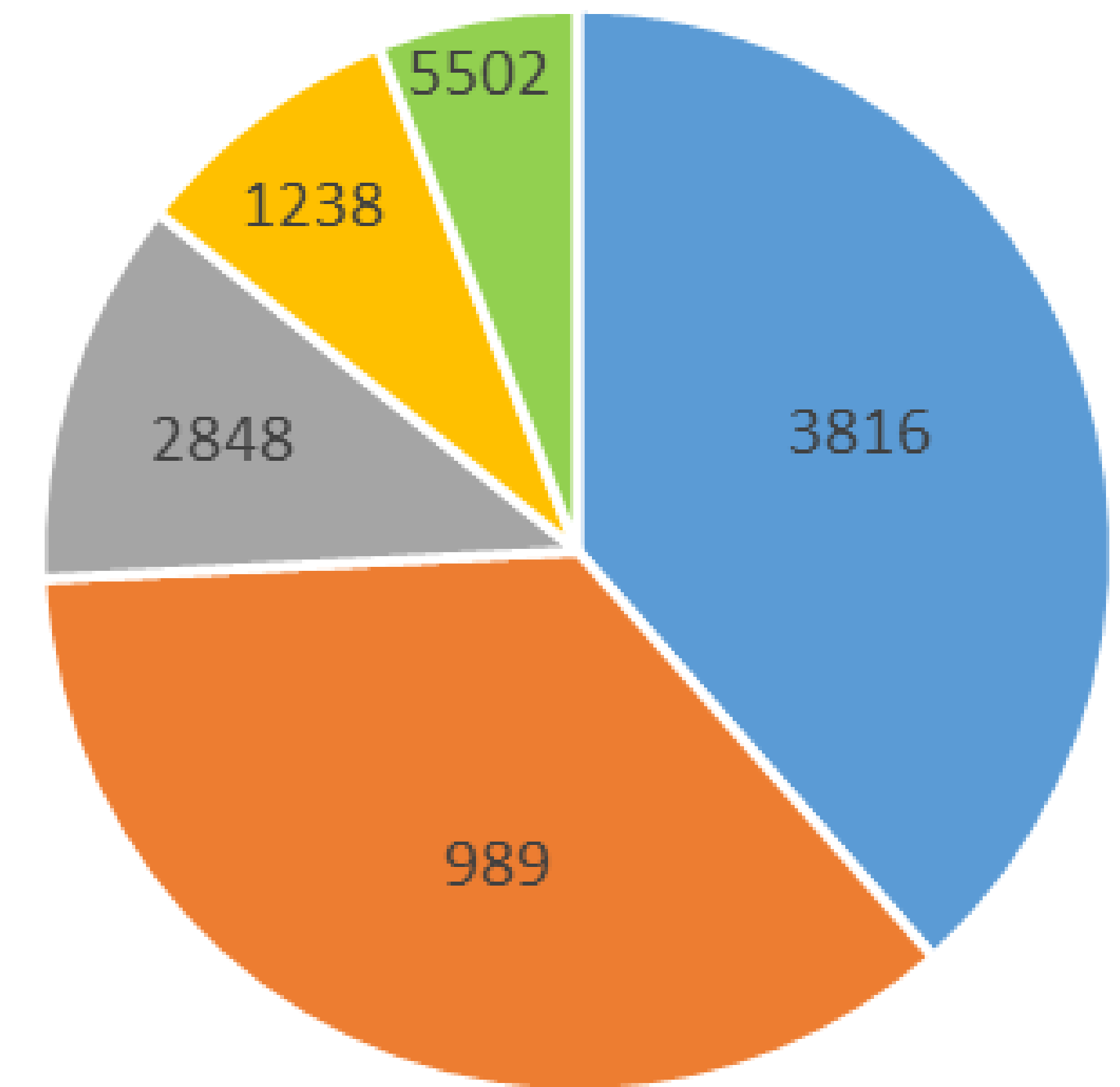
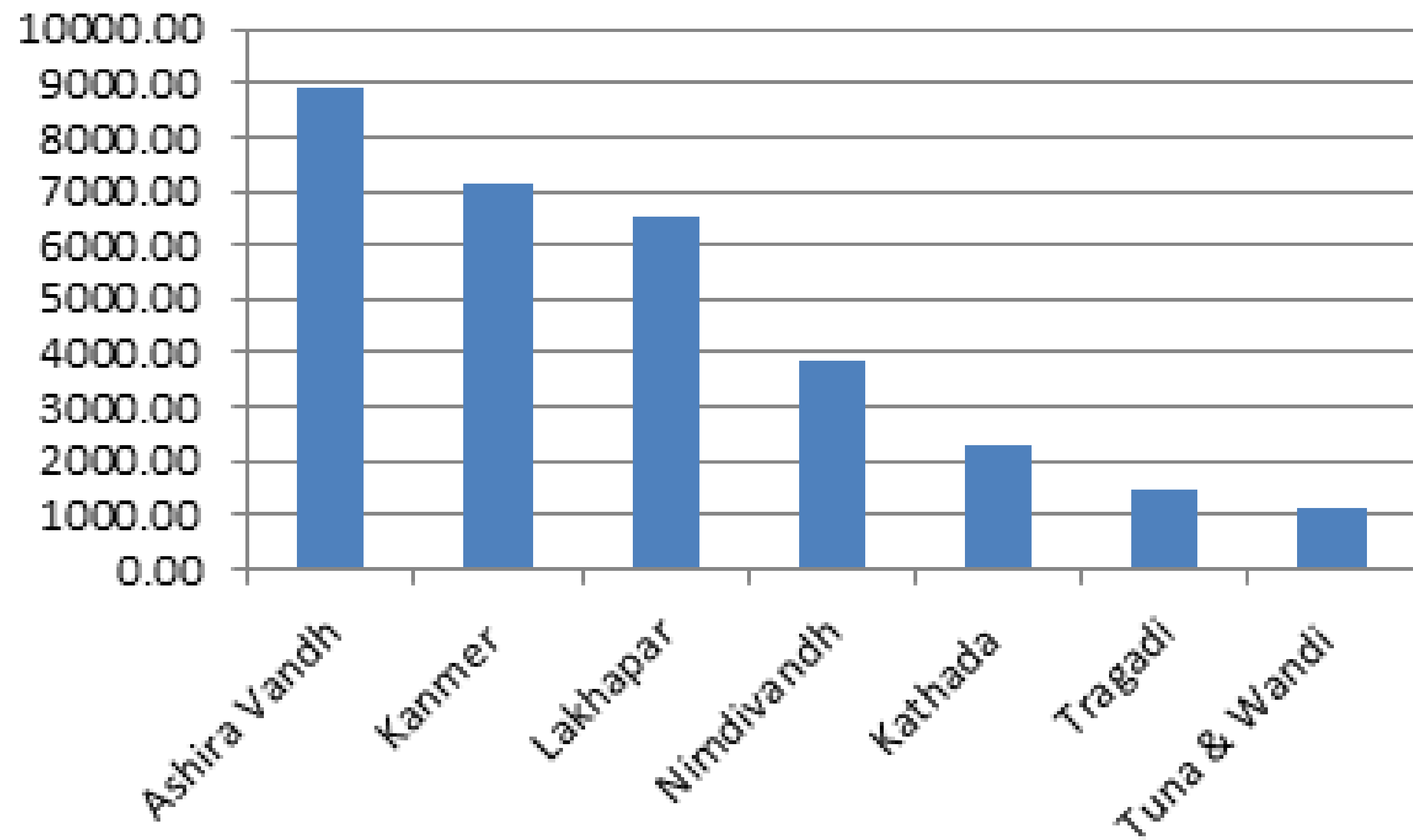
Specific features of each village:

- Ashira Vandh contains the Lala Indian Bustard sanctuary
- Kanmer is the only village with hilly land
- Kathada is the only village with forest
- Lakhapar is the only village with industry
- Lakhapar and Tragadi have salt pans
- Nimdivandh includes estuary and creek areas



There are significant differences between the villages, firstly in size with Ashira Vandh the largest and Tuna and Wandi combined the smallest.

hectares



■ Kanmer ■ Lakhpar ■ Kathda ■ Tragadi ■ Tuna & Wandi

The areas of the pie chart represents the relative areas of each village, and the number inside indicates the total population in that village (populations are not available for all)

Land Cover Change between 1999 and 2014

LANDCOVER	Ashira Vandh	Kanmer	Kathada	Lakhapar	Nimdivandh	Tragadi	Tuna & Wandi
Settlement	-14.43	0.00	0.00	0.00	+2.60	0.00	+42.42
Cultivated land	-142.24	+12.24	-232.85	-70.68	+4.51	-46.82	-83.12
Industry				+70.67			
Forest			+2.60				
Scrub	+782.27	-5.10	+289.00	-180.48	+20.82	-22.90	+39.59
Mud flat	-662.45	-7.16	+3.11		-28.18	+125.72	
Salt pan				+187.76		+21.19	+4.40
Estuary					-5.01		
Creek					+5.86		
Road	0.00	0.00	0.00	0.00	0.00	0.00	-3.29
River	+51.59	0.00	0.00	0.00	0.00	0.00	0.00
Water bodies	-14.75		-68.27	-7.86		-79.00	

The most significant changes are loss of cultivated land, particularly notable in Lakhapar with over 70 ha replaced by industry, increased settlement in Tuna & Wandi, and of salt pans, which appear to have replaced scrub, in Lakhapar and Tragadi. Where scrub has expanded this is apparently onto mudflats in Ashira Vandh but onto formerly cultivated land in Kathada.

Participatory appraisal – May- June 2015

Focus groups were held in the eight villages in May – June 2015 using a pre-pre-prepared schedule. This enabled information to be collected on the aspects in the bullet list below.

- LIVELIHOODS
- FUEL
- WOMEN
- CHANGE/THE FUTURE
- ALTERNATIVE LIVELIHOODS
- EDUCATION
- LANDSCAPE
- OTHER ISSUES RAISED
- IMPRESSIONS



Analysing the data collected

Using the results of the participation appraisal an ecosystem services evaluation was done and the key facts and issues for each village analysed. The results for each village were displayed on a poster, including photographs taken during the May visit, so the villagers could identify themselves, in both English and Gujarati.





Fact checking - December 2015

The second visit, in December, 2015 was conducted using these posters. The information on them was discussed to ensure our understanding had been correct..

Villagers corrected any misunderstandings and the amended posters, with maps of each village follow.



Ecosystem Assessment of the Habitats in the Kachchh District: Ashira Vandh, Abdasa taluka

<p>Village profile</p> <ul style="list-style-type: none"> Population: 250 Maldhari Near mangrove forest Industry: <ul style="list-style-type: none"> Cement Salt pan Wind turbines 		<p>ગામની રૂપરેખા</p> <ul style="list-style-type: none"> વસ્તી: ૨૫૦ માલધારી ચેરિયાનાં જંગલની નજીક ઉદ્યોગ <ul style="list-style-type: none"> સિમેન્ટ પ્લાન્ટ મીઠાનાં અગર પવન ચક્રીઓ 				
<table border="0"> <tr> <td data-bbox="569 856 934 1171"> <p>Main livelihoods</p> <ul style="list-style-type: none"> Livestock <ul style="list-style-type: none"> Buffalo Some people migrate for better grazing Activity increasing Fishery <ul style="list-style-type: none"> Don't dry fish Activity decreasing </td> <td data-bbox="934 856 1308 1171"> <p>Threats</p> <ul style="list-style-type: none"> ↓ Drinking water ↓ Water salinity ↓ Grassland quality ↑ Pollution ↓ Mangroves ↓ Fish population </td> </tr> </table>	<p>Main livelihoods</p> <ul style="list-style-type: none"> Livestock <ul style="list-style-type: none"> Buffalo Some people migrate for better grazing Activity increasing Fishery <ul style="list-style-type: none"> Don't dry fish Activity decreasing 	<p>Threats</p> <ul style="list-style-type: none"> ↓ Drinking water ↓ Water salinity ↓ Grassland quality ↑ Pollution ↓ Mangroves ↓ Fish population 		<table border="0"> <tr> <td data-bbox="1798 856 2181 1171"> <p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> પશુધન <ul style="list-style-type: none"> લેસ ચરાઈ માટે અમુક લોકોનું સ્થળાંતર સ્થળાંતર ની પ્રવૃત્તિ માં વધારો માછીમારી <ul style="list-style-type: none"> માછલીની સુકવણી કરતાં નથી પ્રવૃત્તિમાં ઘટાડો </td> <td data-bbox="2181 856 2531 1171"> <p>ભય</p> <ul style="list-style-type: none"> ↓ પીવાનું પાણી ↓ પાણીની ખારાશ ↓ ઘાસના મેદાનની ગુણવત્તા ↓ પ્રદુષણ ↓ ચેરિયા ↓ માછલી ની સંખ્યા </td> </tr> </table>	<p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> પશુધન <ul style="list-style-type: none"> લેસ ચરાઈ માટે અમુક લોકોનું સ્થળાંતર સ્થળાંતર ની પ્રવૃત્તિ માં વધારો માછીમારી <ul style="list-style-type: none"> માછલીની સુકવણી કરતાં નથી પ્રવૃત્તિમાં ઘટાડો 	<p>ભય</p> <ul style="list-style-type: none"> ↓ પીવાનું પાણી ↓ પાણીની ખારાશ ↓ ઘાસના મેદાનની ગુણવત્તા ↓ પ્રદુષણ ↓ ચેરિયા ↓ માછલી ની સંખ્યા
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<p>Challenges</p> <ul style="list-style-type: none"> Reduce water pollution Restore and enhance mangrove forest Increase fish population Improve drinking water quality Increase soil quality 	<p>Opportunities</p> <ul style="list-style-type: none"> Effective anti-pollution legislation Create a mangrove restoration program Employ women for seed collection in mangroves Promote charcoal production 		<p>પડકારો</p> <ul style="list-style-type: none"> પાણીનું પ્રદુષણ ઘટાડવું ચેરિયાનાં જંગલનું પુનઃસ્થાપન અને વધારો કરવો માછલીની સંખ્યા વધારવી પીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો માછીની ગુણવત્તામાં વધારો કરવો 	<p>તકો</p> <ul style="list-style-type: none"> અસરકારક પ્રદુષણ-વિરોધી કાયદો ચેરિયાનાં પુનઃસ્થાપનાં કાર્યક્રમો બનાવવાં સ્ત્રીઓને ચેરિયાનાં બીજ ભેગાં કરવાં માટે રોજગાર આપવો કોલસાનાં ઉત્પાદનને પ્રોત્સાહન કરવો 		

Introduction & Summary

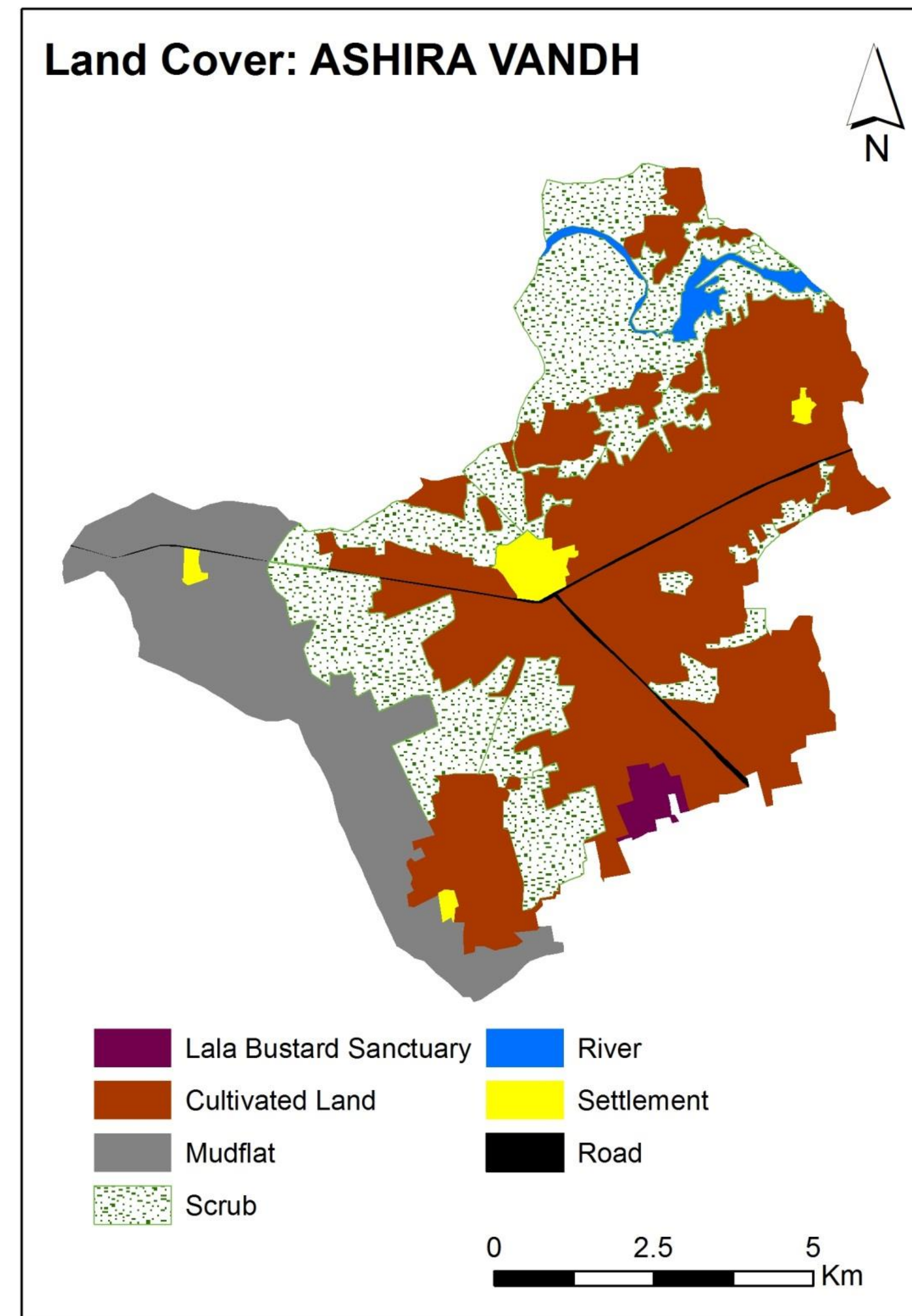
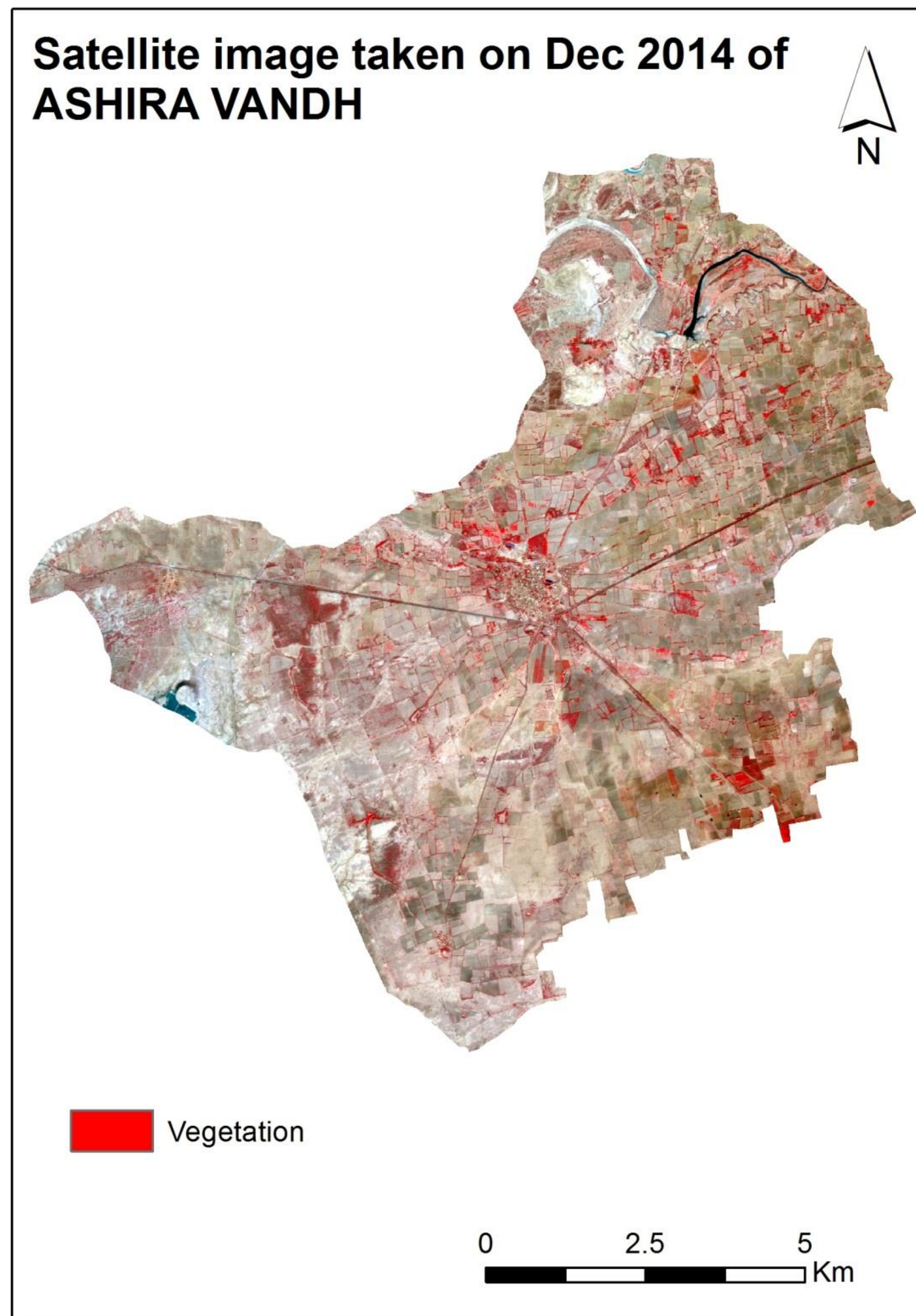
Description

Opportunities

Community participation

Action plan

References



Ecosystem Assessment of the habitats in the Kachchh District: Kanmer Village, Rapar taluka

Village profile

- Population: 3816
- Rabari community
- Archaeological site from the Indus Valley Civilization



ગામની રૂપરેખા

- વસ્તી: ૩૮૧૬
- રબારી સમુદાય
- સિંધુ ખીણની સંસ્કૃતિની પુરાતત્ત્વીય જગ્યા

Main livelihoods

- Livestock
 - Goats and Sheep
 - Cows
 - Buffalo
- Agriculture
 - Depends on monsoon
 - Decreasing yield

Threats

- Rainfall
- Soil quality
- Fodder quality
- Prosopis juliflora
- Soil quality
- Wild ass
- Prosopis juliflora



મુખ્ય આજીવિકા

- પશુધન
 - બકરા અને ઘેટાં
 - ભેંસ
 - ગાય
- ખેતી
 - વરસાદ આધારીત
 - ઉપજમાં ઘટાડો

ભય

- વરસાદ
- માટીની ગુણવત્તા
- ધાસચારાની ગુણવત્તા
- પરદેશી બાવડ
- માટીની ગુણવત્તા
- જંગલી ગધેડાં
- પરદેશી બાવડ

Sources of fuel

- Prosopis wood
- LPG gas
- Animal dung
- No charcoal production



બળતણનાં સ્રોત

- પરદેશી બાવડનાં લાકડા
- એલ.પી.ગેઝ
- ઢોરનું છાશ
- કોલસાનું ઉત્પાદન નહિવત

Challenges

- Control the spread of Prosopis juliflora
- Improve soil quality
- Improve water quality
- Manage Wild Ass population

Opportunities

- Prosopis charcoal production
- Promote sustainable tourism
- Promote the use of traditional crops
- Promote the use of organic fertilizers



પડકારો

- પરદેશી બાવડનાં ફેલાવામાં નિયંત્રણ લાવવું
- માટીની ગુણવત્તામાં સુધારો કરવો
- ખીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો
- જંગલી ગધેડાંની સંખ્યાનું નિયંત્રણ લાવવું

તકો

- પરદેશી બાવડનાં કોલસાનાં ઉત્પાદનને પ્રોત્સાહન
- ટકાઉ પ્રવાસનને પ્રોત્સાહન આપવું
- પરંપરાગત પાકોનાં વાવેતરને પ્રોત્સાહન આપવું
- સૈનિક ખાતરનાં ઉપયોગને પ્રોત્સાહન આપવું

Introduction & Summary

Description

Opportunities

Community participation

Action plan

References

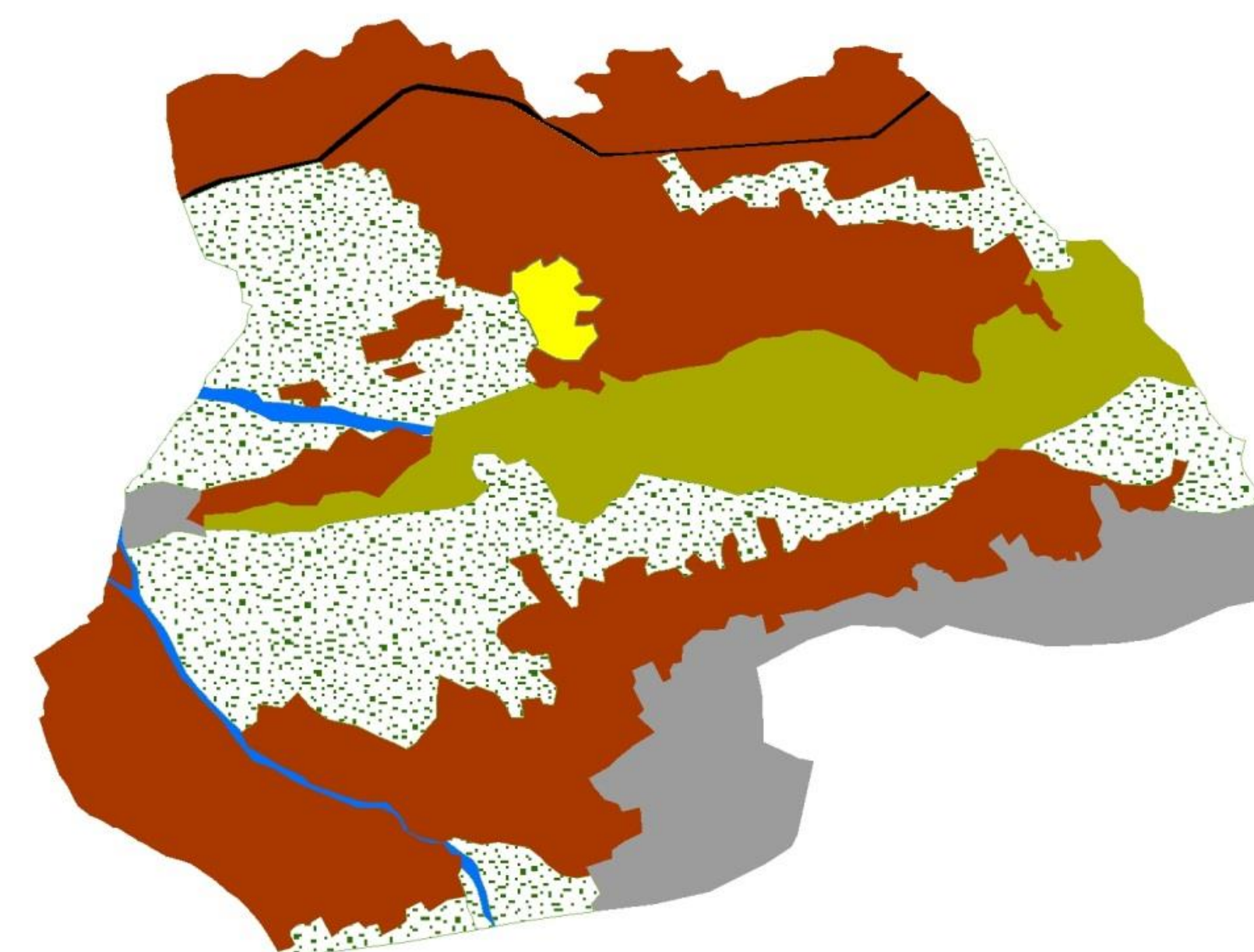
Satellite image taken on Oct 2014 of
KANMER



Vegetation



Land Cover: KANMER



- Cultivated Land
- Scrub
- Hilly Area with Scrub
- Mudflat
- River
- Settlement
- Road



Ecosystem Assessment of the Habitats in the Kachchh District: Kathda, Mandvi taluka

Village profile

- Population: 2848
- Majority of the villagers are involved in agriculture
- 1000 acres of pastureland have been protected by the government



ગામની રૂપરેખા

- વસ્તી: ૨૮૧૮
- અધિકાંશ લોકો ખેતીમાં સામેલ છે
- ૧૦૦૦ એકર ગોચરની જગ્યા સરકાર દ્વારા સુરક્ષિત કરવામાં આવી છે

Main livelihoods

- Agriculture
 - BT cotton, main crop
 - Depends on monsoon
 - Fodder
- Livestock rearing
 - Buffalo
 - Cattle
 - Goats and Sheep

Threats

- ↓ Rainfall
- ↑ Water salinity
- ↑ Use of chemical fertilizers
- ↓ Number of people involved
- ↓ Drinking water
- ↑ Soil salinity
- ↓ People moving to the city



મુખ્ય આજીવિકા

- ખેતી
 - મુખ્ય પાક બી.ટી. કપાસ
 - વરસાદ આધારીત
 - પાસચારો
- પશુધન
 - ભેંસ
 - ગાય
 - બકરા અને ઘેટાં

લય

- ↓ વરસાદ
- ↑ ખાણીની ખારાંશ
- ↑ રસાયણિક ખાતરનો ઉપયોગ
- ↓ ખેતીમાં લોકોની સંખ્યા
- ↓ પીવાનું પાણી
- ↑ ખાણીની ખારાંશ
- ↓ લોકોનું શહેર તરફ સ્થળાંતર

Sources of fuel

- Prosopis wood
- LPG gas
- People from outside hired by the government to produce charcoal



બળતણનાં સ્રોત

- પરદેશી બાવડનાં લાકડા
- એલ.પી.ગેઝ ગેસ
- સરકાર દ્વારા લોકોને લાકડે રાખીને કોલસાનું ઉત્પાદન કરવામાં આવે છે

Challenges

- Create employment
- Improve water quality
- Balance agriculture with wildlife

Opportunities

- Promote charcoal production
- Promote the use of organic fertilizers
- Ecotourism
- Promote the use of traditional crops



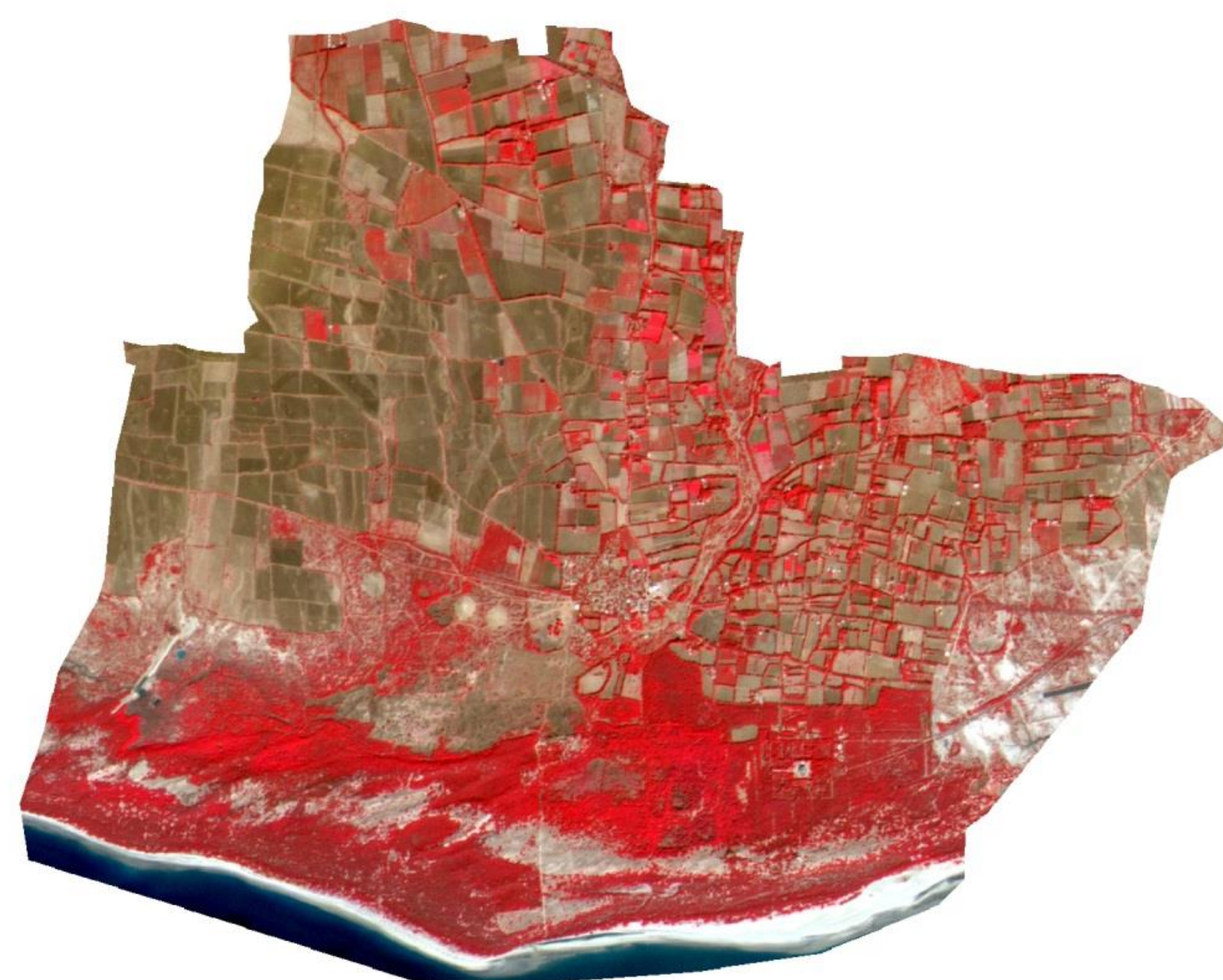
પડકારો

- રોજગાર ઉભા કરવા
- પીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો
- ખેતી અને વન્યજીવન વચ્ચે સમતોલપણું લાવવું

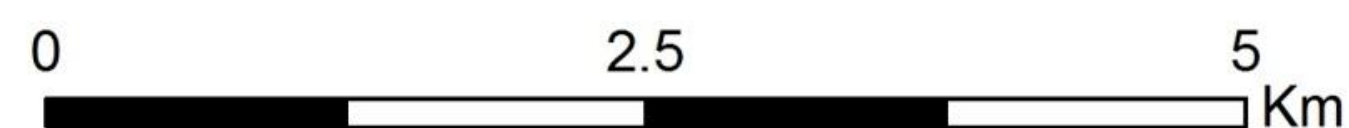
તકો

- કોલસાનાં ઉત્પાદનને પ્રોત્સાહન
- સેનિટર ખાતરનાં ઉપયોગને પ્રોત્સાહન આપવું
- પરંપરાગત પાકોનાં વાવેતરને પ્રોત્સાહન આપવું
- પર્યાવરણને સાંકળ આપતાં પ્રવાસનને પ્રોત્સાહન આપવું

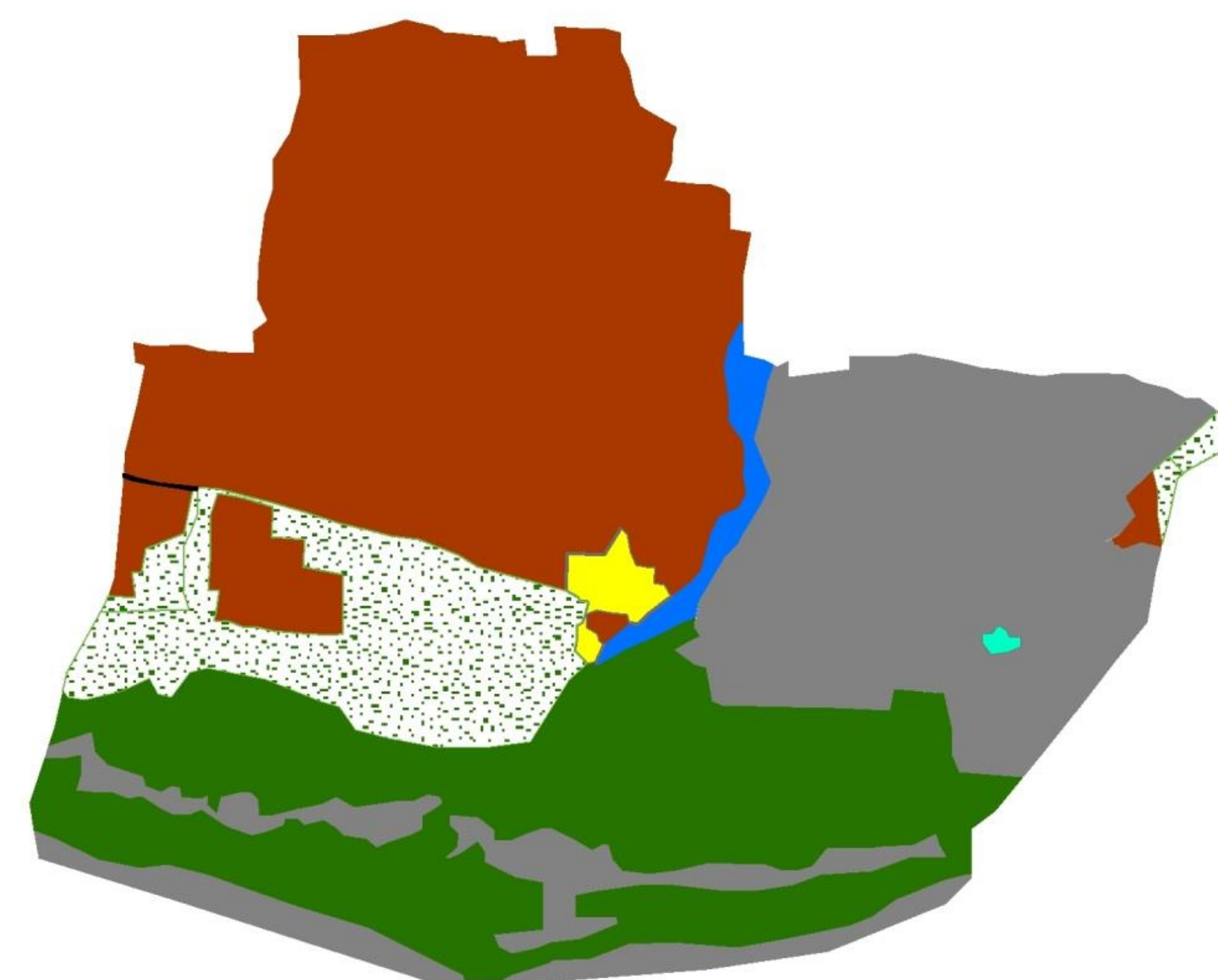
Satellite image taken on Dec 2014 of KATHDA



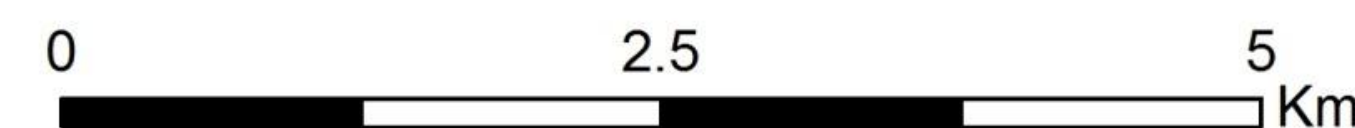
Vegetation







Land Cover: KATHDA



- Cultivated Land
- Forest
- Scrub
- Mudflat
- River
- Standing Water
- Settlement
- Road



Ecosystem Assessment of the Habitats in the Kachchh District: Lakhapar, Bachau taluka

<p>Village profile</p> <ul style="list-style-type: none"> Proximity to Little Rann Population: 989 Industry <ul style="list-style-type: none"> Wind farms Salt pans 		<p>ગામની રૂપરેખા</p> <ul style="list-style-type: none"> નાના રણની નજીક વસ્તી: ૯૮૯ ઉદ્યોગ <ul style="list-style-type: none"> મીઠાનાં અગર પવન ચક્કીઓ 				
<table border="0"> <tr> <td data-bbox="528 821 934 1171"> <p>Main livelihoods</p> <ul style="list-style-type: none"> Salt pans <ul style="list-style-type: none"> 80% people involved 10-12 companies Water from sea and bore well Farming <ul style="list-style-type: none"> Cattle, Buffalo, Goats and Sheep Agriculture depends on monsoon </td> <td data-bbox="934 821 1314 1171"> <p>Threats</p> <ul style="list-style-type: none"> Ground water Jobs during monsoon Industry buying up land Pollution Drinking water Soil salinity Wind farms Agricultural land sold </td> </tr> </table>	<p>Main livelihoods</p> <ul style="list-style-type: none"> Salt pans <ul style="list-style-type: none"> 80% people involved 10-12 companies Water from sea and bore well Farming <ul style="list-style-type: none"> Cattle, Buffalo, Goats and Sheep Agriculture depends on monsoon 	<p>Threats</p> <ul style="list-style-type: none"> Ground water Jobs during monsoon Industry buying up land Pollution Drinking water Soil salinity Wind farms Agricultural land sold 		<table border="0"> <tr> <td data-bbox="1813 821 2196 1171"> <p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> મીઠાનાં અગર <ul style="list-style-type: none"> ૮૦% લોકો સામેલ છે ૧૦-૧૨ કંપનીઓ પાણી બોર વેલ અને સમુદ્ર માંથી લેવામાં આવે છે ખેતી અને પશુધન <ul style="list-style-type: none"> લેસગાય બકરા અને ઘેટાં વરસાદ આધારીત </td> <td data-bbox="2196 821 2597 1171"> <ul style="list-style-type: none"> જુગલ જળ ચોમાસા દરમિયાન રોજગર કંપની દ્વારા જમીનની ખરીદી પ્રદેશ પીવાનું પાણી માટીની ગુણવત્તા પવન ચક્કીઓ ખેતીલાયક જમીનનું વિચાર </td> </tr> </table>	<p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> મીઠાનાં અગર <ul style="list-style-type: none"> ૮૦% લોકો સામેલ છે ૧૦-૧૨ કંપનીઓ પાણી બોર વેલ અને સમુદ્ર માંથી લેવામાં આવે છે ખેતી અને પશુધન <ul style="list-style-type: none"> લેસગાય બકરા અને ઘેટાં વરસાદ આધારીત 	<ul style="list-style-type: none"> જુગલ જળ ચોમાસા દરમિયાન રોજગર કંપની દ્વારા જમીનની ખરીદી પ્રદેશ પીવાનું પાણી માટીની ગુણવત્તા પવન ચક્કીઓ ખેતીલાયક જમીનનું વિચાર
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<table border="0"> <tr> <td data-bbox="528 1192 934 1402"> <p>Sources of fuel</p> <ul style="list-style-type: none"> Prosopis wood collected directly from forest No charcoal production </td> <td data-bbox="934 1192 1314 1402"> <p>Drinking water</p> <ul style="list-style-type: none"> Water from Narmada Ground water is depleting </td> </tr> </table>	<p>Sources of fuel</p> <ul style="list-style-type: none"> Prosopis wood collected directly from forest No charcoal production 	<p>Drinking water</p> <ul style="list-style-type: none"> Water from Narmada Ground water is depleting 		<table border="0"> <tr> <td data-bbox="1813 1192 2196 1402"> <p>બળતણનાં સ્રોત</p> <ul style="list-style-type: none"> પરદેશી બાવડનાં લાકડા સીધા જંગલમાંથી લેવાં કરે છે કોલસાનું ઉત્પાદન નહિવત </td> <td data-bbox="2196 1192 2597 1402"> <p>પીવાનું પાણી</p> <ul style="list-style-type: none"> નર્મદાની પાઈપલાઇન દ્વારા જુગલ જળમાં દિવસે દિવસે ઘટાડો જોવાં મળે છે </td> </tr> </table>	<p>બળતણનાં સ્રોત</p> <ul style="list-style-type: none"> પરદેશી બાવડનાં લાકડા સીધા જંગલમાંથી લેવાં કરે છે કોલસાનું ઉત્પાદન નહિવત 	<p>પીવાનું પાણી</p> <ul style="list-style-type: none"> નર્મદાની પાઈપલાઇન દ્વારા જુગલ જળમાં દિવસે દિવસે ઘટાડો જોવાં મળે છે
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<p>Challenges</p> <ul style="list-style-type: none"> Create seasonal employment Create effective legislation for wind farm companies Improve quality of drinking water 	<p>Opportunities</p> <ul style="list-style-type: none"> Promote the use of marine water by salt companies Create alternative livelihoods promoting charcoal production 		<p>પડકારો</p> <ul style="list-style-type: none"> મોસમી રોજગર ઉત્પાદન ઘટતું છે પવન ચક્કી ચલાવતી કંપનીઓ માટે અસરકારક કાયદો પડવો પીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો 	<p>તકો</p> <ul style="list-style-type: none"> મીઠાનાં અગરો માટે સમુદ્રનાં પાણીનો ઉપયોગ માટે પ્રોત્સાહન આપવું આજીવિકાનાં વિકલ્પિકરણે કોલસાનાં ઉત્પાદનને પ્રોત્સાહન આપવું 		

Introduction & Summary

Description

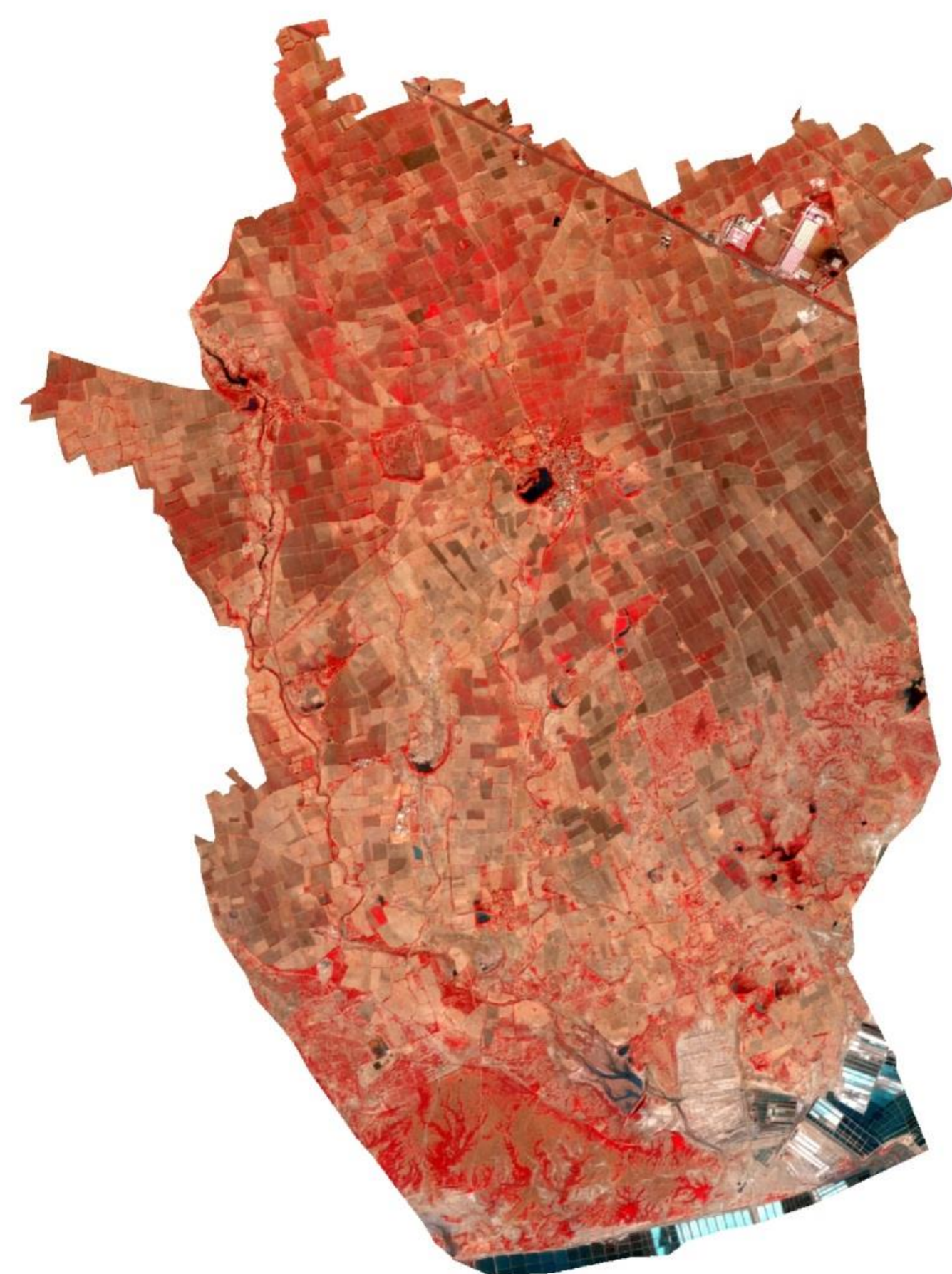
Opportunities

Community participation

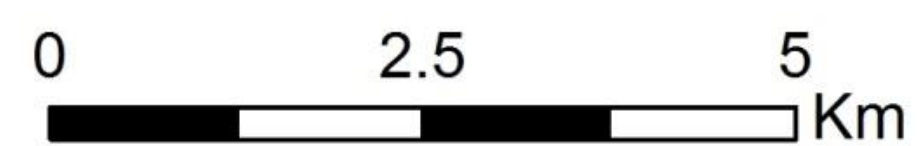
Action plan

References

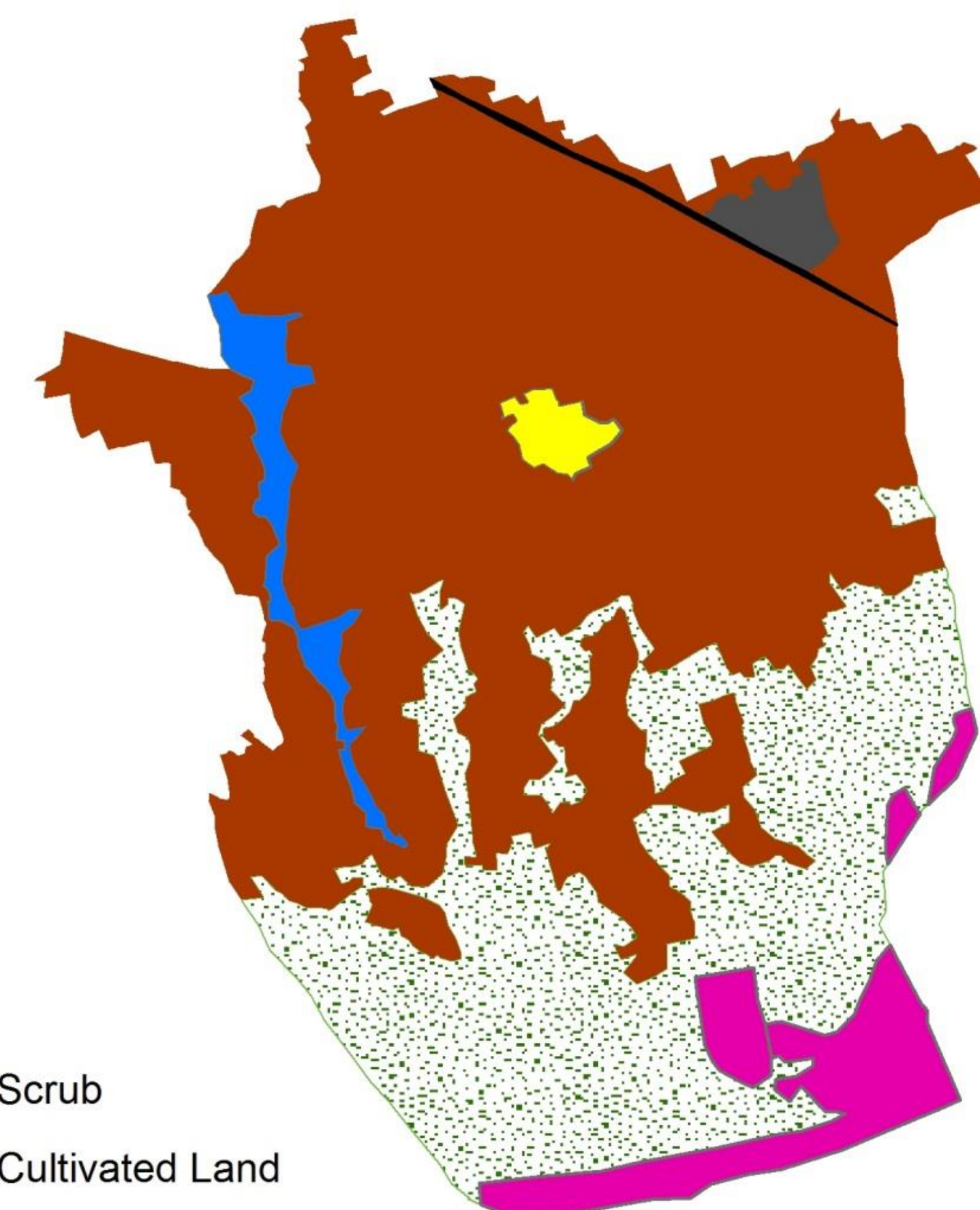
Satellite Image taken on Oct 2014 of LAKHAPAR



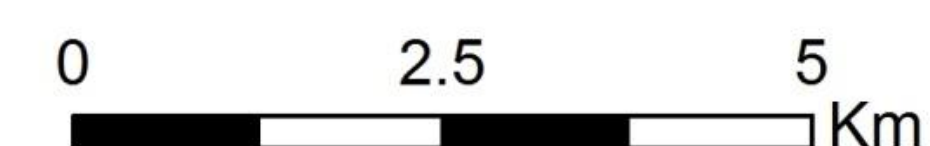
Vegetation







Land Cover: LAKHAPAR



- Scrub
- Cultivated Land
- River
- Salt pan
- Settlement
- Industries
- Road



Ecosystem Assessment of the Habitats in the Kachchh District: Nimdi Wandh, Abdasa taluka

<p>Village profile</p> <ul style="list-style-type: none"> Mudflats and mangrove forest nearby Population: 225 Industry: <ul style="list-style-type: none"> Wind farms Cement 		<p>ગામની રૂપરેખા</p> <ul style="list-style-type: none"> કાદવવાડી જમીન અને ચેરિયાના જંગલ ની નજીક વસ્તી: ૨૨૫ ઉદ્યોગ <ul style="list-style-type: none"> પવન ચક્કીઓ સીમેન્ટ કંપની 				
<table border="0"> <tr> <td data-bbox="549 842 934 1165"> <p>Main livelihoods</p> <ul style="list-style-type: none"> Fishing <ul style="list-style-type: none"> Nets and small boats Travel 3-7km Livestock <ul style="list-style-type: none"> Buffalo Cattle Camels </td> <td data-bbox="934 842 1308 1165"> <p>Threats</p> <ul style="list-style-type: none"> ↑ Pollution ↓ Water quality ↓ Mangroves ↓ Fish population ↓ Availability of drinking water ↑ Water salinity ↓ Mangrove leaves (fodder) </td> </tr> </table>	<p>Main livelihoods</p> <ul style="list-style-type: none"> Fishing <ul style="list-style-type: none"> Nets and small boats Travel 3-7km Livestock <ul style="list-style-type: none"> Buffalo Cattle Camels 	<p>Threats</p> <ul style="list-style-type: none"> ↑ Pollution ↓ Water quality ↓ Mangroves ↓ Fish population ↓ Availability of drinking water ↑ Water salinity ↓ Mangrove leaves (fodder) 		<table border="0"> <tr> <td data-bbox="1804 842 2181 1165"> <p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> માછીમારી <ul style="list-style-type: none"> જાળો અને નાની બોટો ૫-૭ કીમીનો પ્રવાસ બેડલો પશુધન <ul style="list-style-type: none"> બકરા અને ઘેટાં લેસ અને ગાય ઊંટો </td> <td data-bbox="2181 842 2561 1165"> <p>ભય</p> <ul style="list-style-type: none"> ↑ પ્રદૂષણ ↑ પાણીની ગુણવત્તાની ચેરિયા ↓ માછલીની સંખ્યા ↓ પીવાનું પાણી ↑ પાણીની ખારાશ ↓ ચેરિયાના પાંદડા (પાસચરા) </td> </tr> </table>	<p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> માછીમારી <ul style="list-style-type: none"> જાળો અને નાની બોટો ૫-૭ કીમીનો પ્રવાસ બેડલો પશુધન <ul style="list-style-type: none"> બકરા અને ઘેટાં લેસ અને ગાય ઊંટો 	<p>ભય</p> <ul style="list-style-type: none"> ↑ પ્રદૂષણ ↑ પાણીની ગુણવત્તાની ચેરિયા ↓ માછલીની સંખ્યા ↓ પીવાનું પાણી ↑ પાણીની ખારાશ ↓ ચેરિયાના પાંદડા (પાસચરા)
<p>Main livelihoods</p> <ul style="list-style-type: none"> Fishing <ul style="list-style-type: none"> Nets and small boats Travel 3-7km Livestock <ul style="list-style-type: none"> Buffalo Cattle Camels 	<p>Threats</p> <ul style="list-style-type: none"> ↑ Pollution ↓ Water quality ↓ Mangroves ↓ Fish population ↓ Availability of drinking water ↑ Water salinity ↓ Mangrove leaves (fodder) 					
<p>મુખ્ય આજીવિકા</p> <ul style="list-style-type: none"> માછીમારી <ul style="list-style-type: none"> જાળો અને નાની બોટો ૫-૭ કીમીનો પ્રવાસ બેડલો પશુધન <ul style="list-style-type: none"> બકરા અને ઘેટાં લેસ અને ગાય ઊંટો 	<p>ભય</p> <ul style="list-style-type: none"> ↑ પ્રદૂષણ ↑ પાણીની ગુણવત્તાની ચેરિયા ↓ માછલીની સંખ્યા ↓ પીવાનું પાણી ↑ પાણીની ખારાશ ↓ ચેરિયાના પાંદડા (પાસચરા) 					
<table border="0"> <tr> <td data-bbox="549 1186 934 1396"> <p>Sources of fuel</p> <ul style="list-style-type: none"> Mangrove wood Prosopis wood No charcoal production </td> <td data-bbox="934 1186 1308 1396"> <p>Drinking water</p> <ul style="list-style-type: none"> Main problem of the village No government aid Saline water caused by cement industry </td> </tr> </table>	<p>Sources of fuel</p> <ul style="list-style-type: none"> Mangrove wood Prosopis wood No charcoal production 	<p>Drinking water</p> <ul style="list-style-type: none"> Main problem of the village No government aid Saline water caused by cement industry 		<table border="0"> <tr> <td data-bbox="1804 1186 2181 1396"> <p>બળતણનાં સ્રોત</p> <ul style="list-style-type: none"> પરદેશી બાવડ અને ચેરિયાના લાકડાં ઢોલસાનું ઉત્પાદન નફિવત </td> <td data-bbox="2181 1186 2561 1396"> <p>પીવાનું પાણી</p> <ul style="list-style-type: none"> ગામની મુખ્ય સમસ્યા કોઈ સરકારી સહાય નથી સિમેન્ટ ઉદ્યોગને કારણે પાણીમાં ખારાશનું પ્રમાણ વધવું </td> </tr> </table>	<p>બળતણનાં સ્રોત</p> <ul style="list-style-type: none"> પરદેશી બાવડ અને ચેરિયાના લાકડાં ઢોલસાનું ઉત્પાદન નફિવત 	<p>પીવાનું પાણી</p> <ul style="list-style-type: none"> ગામની મુખ્ય સમસ્યા કોઈ સરકારી સહાય નથી સિમેન્ટ ઉદ્યોગને કારણે પાણીમાં ખારાશનું પ્રમાણ વધવું
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<p>Challenges</p> <ul style="list-style-type: none"> Reduce water pollution Improve drinking water Restore and enhance mangrove forest Increase fish population 	<p>Opportunities</p> <ul style="list-style-type: none"> Effective anti-pollution legislation Improve the mangrove restoration program Force the company to provide more drinking water Promote the use of Prosopis wood as fuel 		<p>પડકારો</p> <ul style="list-style-type: none"> પાણીનું પ્રદૂષણ ઘટાડવું પીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો ચેરિયાનાં જંગલનું પુનઃસ્થાપન અને વધારો કરવો માછલીની સંખ્યા વધારવી 	<p>તકો</p> <ul style="list-style-type: none"> અસરકારક પ્રદૂષણ-વિરોધી કાયદો ચેરિયાનાં પુનઃસ્થાપનાં કાર્યક્રમો બનાવવાં પરદેશી બાવડનાં ઢોલસાનાં ઉત્પાદનને પ્રોત્સાહન વધુ પીવાનું પાણી પુરું પાડવા માટે કંપનીના દબાણ કરવું 		



Introduction & Summary

Description

Opportunities

Community participation

Action plan

References

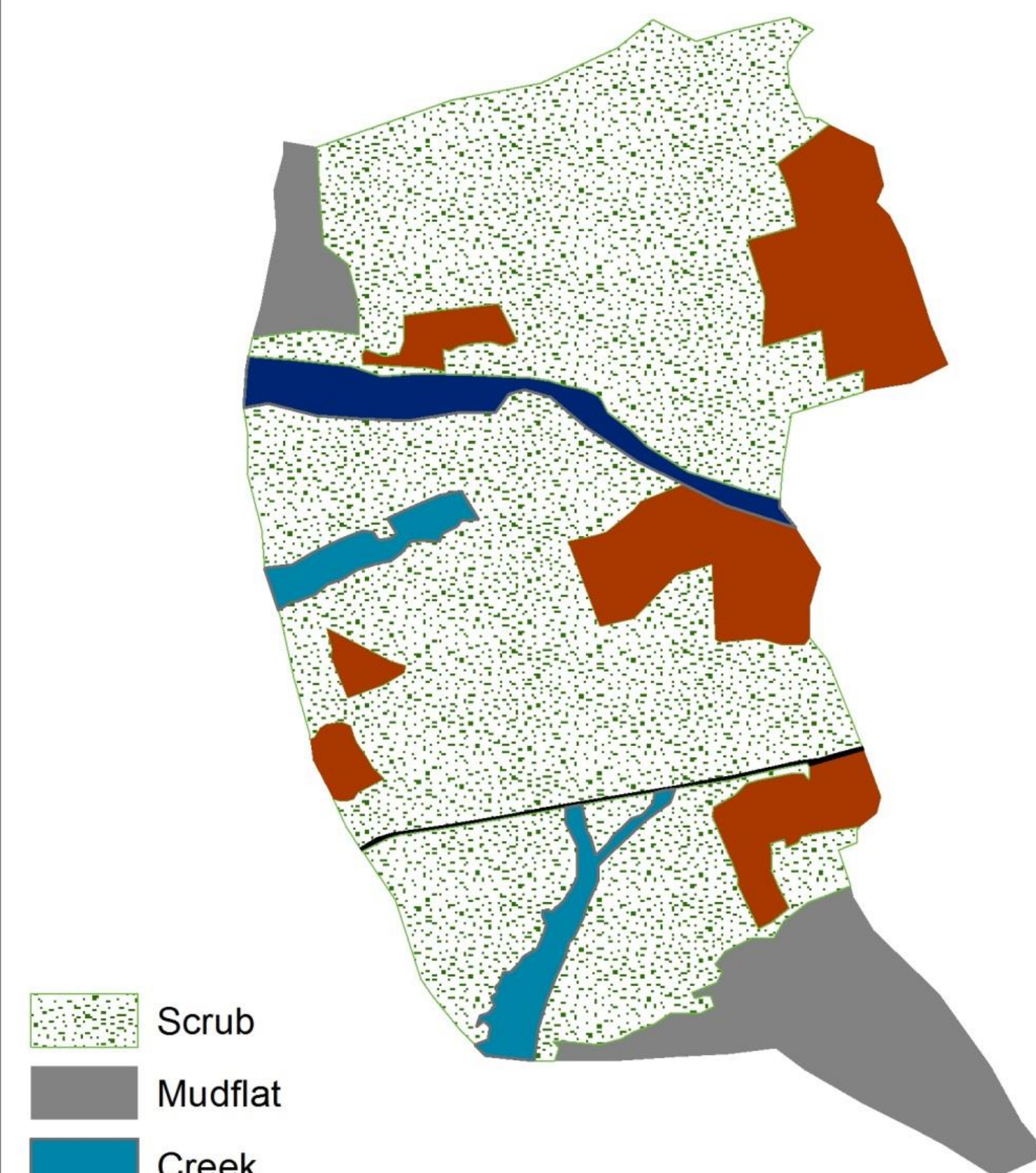
Satellite Image taken on Dec 2014 of NIMDI VANDH within Mohadi



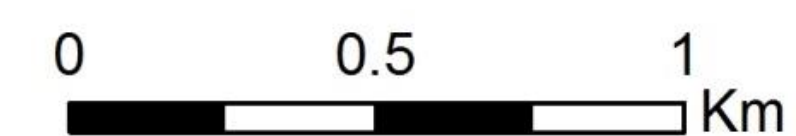
Vegetation



Land Cover: NIMDI VANDH within Mohadi



- Scrub
- Mudflat
- Creek
- Estuary
- Cultivated Land
- Road



Ecosystem Assessment of the Habitats in the Kachchh District: Tragadi, Mandvi taluka

Village profile

- Maldhari community
- Population: 1238
- Industry
 - TATA power plant
 - Two salt companies



ગામની રૂપરેખા

- વસ્તી: ૧૨૩૮
- માલધારી સમુદાય
- ઉદ્યોગ
 - ટાટા વીજ કંપની
 - ૨ ખીંકાંની કંપનીઓ

Main livelihoods

- Fishing
 - By foot
 - By boat
 - Travel 20-25 km
- Livestock rearing
 - Buffalo
 - Cattle
 - Goats and Sheep

Threats

- ↓ Fish population
- ↓ People involved
- ↓ Industry
- ↓ Pollution
- ↓ Drinking water
- ↓ Soil salinity
- ↓ Rainfall



મુખ્ય આજીવિકા

- માછીમારી
 - પગે ચાલીને
 - નાની બોટોથી
 - ૨૦-૨૫ કીમીનો પ્રવાસ ખેડવો
- પશુધન
 - ભેંસ
 - ગાય
 - બકરા અને ઘેટાં

ભય

- ↓ માછલીની સંખ્યા
- ↓ સામેલ લોકો
- ↓ ઉદ્યોગ
- ↓ પ્રદૂષણ
- ↓ ખીવાનું પાણી
- ↓ પાણીની ખારાંશ
- ↓ વરસાદ

Sources of fuel

- Prosopis wood
- Gas
- Biogas made with cow and buffalo dung
- Charcoal production: 5-10 people involved



બજાતણાંનો સ્રોત

- પરદેશી બાવડનાં લાકડા
- એલ.પી.જી. ગેસ
- ગાય અને ભેંસનાં છાણમાંથી બનાવેલ બાયોગેસ
- ઢોલસાનું ઉત્પાદન ૫-૧૦ લોકો સામેલ છે

Challenges

- Reduce water pollution
- Increase fish population
- Improve drinking water
- Fishery control
- Wildlife protection

Opportunities

- Charcoal production
- Promote the use of biogas
- Promote the sale of embroidery
- Effective anti-pollution legislation



પડકારો

- પાણીનું પ્રદૂષણ ઘટાડવું
- માછલીની સંખ્યા વધારવી
- ખીવાનાં પાણીનું ગુણવત્તામાં સુધારો કરવો
- માછીમારી નિયંત્રણ
- વન્યજીવનનું રક્ષણ

તકો

- ઢોલસાનાં ઉત્પાદનને પ્રોત્સાહન
- બાયોગેસના ઉપયોગને પ્રોત્સાહન આપવું
- ભરતકામ વેચાણને પ્રોત્સાહન આપવું
- અસરકારક પ્રદૂષણ-વિરોધી કાયદો

Coastal Plain of Kachchh District

Introduction & Summary

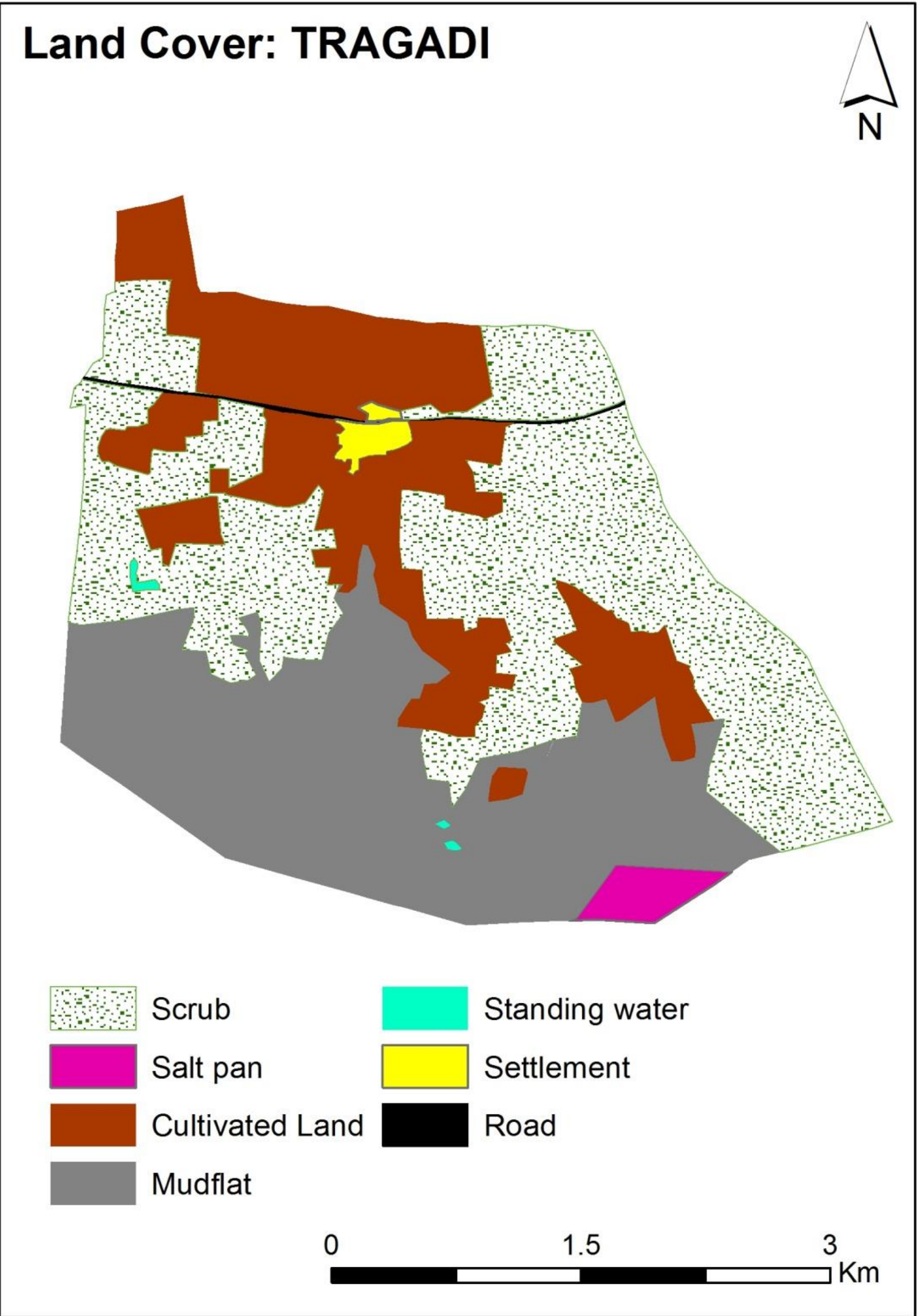
Description

Opportunities

Community participation

Action plan

References



Ecosystem Assessment of the habitats in the Kachchh District: Tuna, Anjar taluka

Village profile

- Population: 5114
- Very industrialized: steel, cement, salt
- Well connected with other parts of Kachchh
- Close to Kandla Port



ગામની રૂપરેખા

- વસ્તી: ૫૧૧૪
- ખૂબ જ ઔદ્યોગિક : સીમેન્ટ, સ્ટીલ, મીઠાં
- કચ્છ અંતર ભાગો સાથે સારી રીતે જોડાયેલ છે
- કંડલા બંદરની નજીક આવેલું છે

Main livelihoods

- Salt pans
 - Ground and sea water
 - Help from government
 - 2-3 families own salt pan
- Farming
 - Cattle, Buffalo, Goats and Sheep
 - Irrigation system
 - Chemical fertilizers

Threats

- ↓ Rainfall
- ↓ Soil quality
- ↓ Fodder quality
- ↓ Prosopis juliflora
- ↓ Soil quality
- ↓ Industry
- ↓ Water quality
- ↓ Prosopis juliflora
- ↓ Grassland



મુખ્ય આજીવિકા

- મીઠાનાં અગર
 - પાણી બોર વેલ અને સમુદ્ર માંથી લેવામાં આવે છે
 - સરકારી સહાય મળે છે
 - 2-3 કુટુંબના મીઠાનાં અગરના માલિક છે
- ખેતી અને પશુધન
 - લેસ, ગાય, બકરા અને ઘેટાં
 - સિંચાઈ વ્યવસ્થા
 - રસાયણિક ખાતર

ભય

- ↓ વરસાદ
- ↓ માટીની ગુણવત્તા
- ↓ ધાસચારાની ગુણવત્તા
- ↑ પરદેશી બાવડ
- ↓ માટીની ગુણવત્તા ઉદ્યોગ
- ↑ પાણી ની ગુણવત્તા
- ↑ પરદેશી બાવડ
- ↓ ધાસના મેદાન

Sources of fuel

- LPG Gas
- Kerosene
- Prosopis wood
- Cow dung
- No charcoal production



બળતણનાં સ્રોત

- ઓલ પી.જી. ગેસ
- કેરોસિન
- ગાયરનું છાશ
- પરદેશી બાવડનાં લાકડાં
- કોલસાનું ઉત્પાદન નહિવત

Challenges

- Increase soil quality
- Reduce Prosopis juliflora
- Increase drinking water quality

Opportunities

- Charcoal production
- Promote the use of organic fertilizers
- Promote the traditional clay pottery industry







પડકારો

- માટીની ગુણવત્તામાં સુધારો કરવો
- પરદેશી બાવડના ફેલાવામાં ધટારો લાવવો
- ખીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો

તકી

- પરદેશી બાવડનાં ફેલાવામાં ઉત્પાદનને પ્રોત્સાહન
- સેન્દ્રિય ખાતરનાં ઉપયોગને પ્રોત્સાહન આપવું
- પરંપરાગત માટીકામ ઉદ્યોગને પ્રોત્સાહન આપવું

Ecosystem Assessment of the Habitats in the Kachchh District: Wandi, Gandhidham taluka

<p>Village profile</p> <ul style="list-style-type: none"> Population: 388 Traditionally a fishing village with increased industry: <ul style="list-style-type: none"> - Steel - Cement - Salt 		<p>ગામની રૂપરેખા</p> <ul style="list-style-type: none"> વસ્તી: 388 પરંપરાગત માછીમારી ગામ સાથે ઉદ્યોગોમાં વધારો: ઉદ્યોગ <ul style="list-style-type: none"> - સ્ટીલ - સીમેન્ટ - મીઠાં કંપની 				
<table border="0"> <tr> <td data-bbox="513 814 920 1150"> <p>Main livelihoods</p> <ul style="list-style-type: none"> Fishing <ul style="list-style-type: none"> • By foot, by motorised boat • They dry the fish • Fish is sold to a company Livestock <ul style="list-style-type: none"> • Cattle • Goats and sheep • They buy fodder </td> <td data-bbox="920 814 1314 1150"> <p>Threats</p> <ul style="list-style-type: none"> ↑ Pollution ↓ Traditional fishing ↓ Fish population ↓ Drinking water ↓ Grassland quality ↓ Price of fodder </td> </tr> </table>	<p>Main livelihoods</p> <ul style="list-style-type: none"> Fishing <ul style="list-style-type: none"> • By foot, by motorised boat • They dry the fish • Fish is sold to a company Livestock <ul style="list-style-type: none"> • Cattle • Goats and sheep • They buy fodder 	<p>Threats</p> <ul style="list-style-type: none"> ↑ Pollution ↓ Traditional fishing ↓ Fish population ↓ Drinking water ↓ Grassland quality ↓ Price of fodder 		<table border="0"> <tr> <td data-bbox="1825 814 2196 1150"> <p>મુખ્ય આજીવિકા</p> <p>માછીમારી</p> <ul style="list-style-type: none"> • પગે ચાલીને, મોટર બોટોથી • માછલીની સુકવણી કરે છે • માછલી કંપનીને વેચે છે <p>પશુધન</p> <ul style="list-style-type: none"> • લેસ, ગરુ • બકરા અને ઘેટાં • તેઓ વેચાતો ધાસચારો લે છે </td> <td data-bbox="2196 814 2608 1150"> <p>ભય</p> <ul style="list-style-type: none"> ↑ પ્રદુષણ ↓ પરંપરાગત માછીમારી ↓ માછલીની સંખ્યા ↓ પીવાનું પાણી ↓ ધાસના મેદાનની ગુણવત્તા ↓ ધાસચારાની કિંમત </td> </tr> </table>	<p>મુખ્ય આજીવિકા</p> <p>માછીમારી</p> <ul style="list-style-type: none"> • પગે ચાલીને, મોટર બોટોથી • માછલીની સુકવણી કરે છે • માછલી કંપનીને વેચે છે <p>પશુધન</p> <ul style="list-style-type: none"> • લેસ, ગરુ • બકરા અને ઘેટાં • તેઓ વેચાતો ધાસચારો લે છે 	<p>ભય</p> <ul style="list-style-type: none"> ↑ પ્રદુષણ ↓ પરંપરાગત માછીમારી ↓ માછલીની સંખ્યા ↓ પીવાનું પાણી ↓ ધાસના મેદાનની ગુણવત્તા ↓ ધાસચારાની કિંમત
<p>Main livelihoods</p> <ul style="list-style-type: none"> Fishing <ul style="list-style-type: none"> • By foot, by motorised boat • They dry the fish • Fish is sold to a company Livestock <ul style="list-style-type: none"> • Cattle • Goats and sheep • They buy fodder 	<p>Threats</p> <ul style="list-style-type: none"> ↑ Pollution ↓ Traditional fishing ↓ Fish population ↓ Drinking water ↓ Grassland quality ↓ Price of fodder 					
<p>મુખ્ય આજીવિકા</p> <p>માછીમારી</p> <ul style="list-style-type: none"> • પગે ચાલીને, મોટર બોટોથી • માછલીની સુકવણી કરે છે • માછલી કંપનીને વેચે છે <p>પશુધન</p> <ul style="list-style-type: none"> • લેસ, ગરુ • બકરા અને ઘેટાં • તેઓ વેચાતો ધાસચારો લે છે 	<p>ભય</p> <ul style="list-style-type: none"> ↑ પ્રદુષણ ↓ પરંપરાગત માછીમારી ↓ માછલીની સંખ્યા ↓ પીવાનું પાણી ↓ ધાસના મેદાનની ગુણવત્તા ↓ ધાસચારાની કિંમત 					
<table border="0"> <tr> <td data-bbox="513 1171 920 1392"> <p>Sources of fuel</p> <ul style="list-style-type: none"> Kerosene <u>Prosopis</u> wood No charcoal production </td> <td data-bbox="920 1171 1314 1392"> <p>Drinking water</p> <ul style="list-style-type: none"> Ground water is saline The government is providing drinking water </td> </tr> </table>	<p>Sources of fuel</p> <ul style="list-style-type: none"> Kerosene <u>Prosopis</u> wood No charcoal production 	<p>Drinking water</p> <ul style="list-style-type: none"> Ground water is saline The government is providing drinking water 		<table border="0"> <tr> <td data-bbox="1825 1171 2196 1392"> <p>બળતણનાં સ્રોત</p> <ul style="list-style-type: none"> કેરોસિન પરદેશી બાવડનાં લાકડાં ઢોલસાનું ઉત્પાદન નહિવત </td> <td data-bbox="2196 1171 2608 1392"> <p>પીવાનું પાણી</p> <ul style="list-style-type: none"> ભૂગર્ભ જળ ખારા છે સરકાર પીવાનું પાણી પુરુ પાડે છે </td> </tr> </table>	<p>બળતણનાં સ્રોત</p> <ul style="list-style-type: none"> કેરોસિન પરદેશી બાવડનાં લાકડાં ઢોલસાનું ઉત્પાદન નહિવત 	<p>પીવાનું પાણી</p> <ul style="list-style-type: none"> ભૂગર્ભ જળ ખારા છે સરકાર પીવાનું પાણી પુરુ પાડે છે
<p>Sources of fuel</p> <ul style="list-style-type: none"> Kerosene <u>Prosopis</u> wood No charcoal production 	<p>Drinking water</p> <ul style="list-style-type: none"> Ground water is saline The government is providing drinking water 					
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<p>Challenges</p> <ul style="list-style-type: none"> Reduce water pollution Increase fish population Improve drinking water Create employment Improve soil quality 	<p>Opportunities</p> <ul style="list-style-type: none"> Effective anti-pollution legislation Promote the use of <u>Prosopis</u> wood as fuel Charcoal production 		<p>પડકારો</p> <ul style="list-style-type: none"> પાણીનું પ્રદુષણ ઘટાડવું માછલીની સંખ્યા વધારવી પીવાનાં પાણીની ગુણવત્તામાં સુધારો કરવો રોજગાર ઉભા કરવા માટીની ગુણવત્તામાં સુધારો કરવો 	<p>તકો</p> <ul style="list-style-type: none"> અસરકારક પ્રદુષણ-વિરોધી કાયદો બળતણ તરીકે પરદેશી બાવડનાં ઉપયોગને પ્રોત્સાહન આપવું પરદેશી બાવડનાં ઢોલસાનાં ઉત્પાદનને પ્રોત્સાહન 		

Introduction & Summary

Description

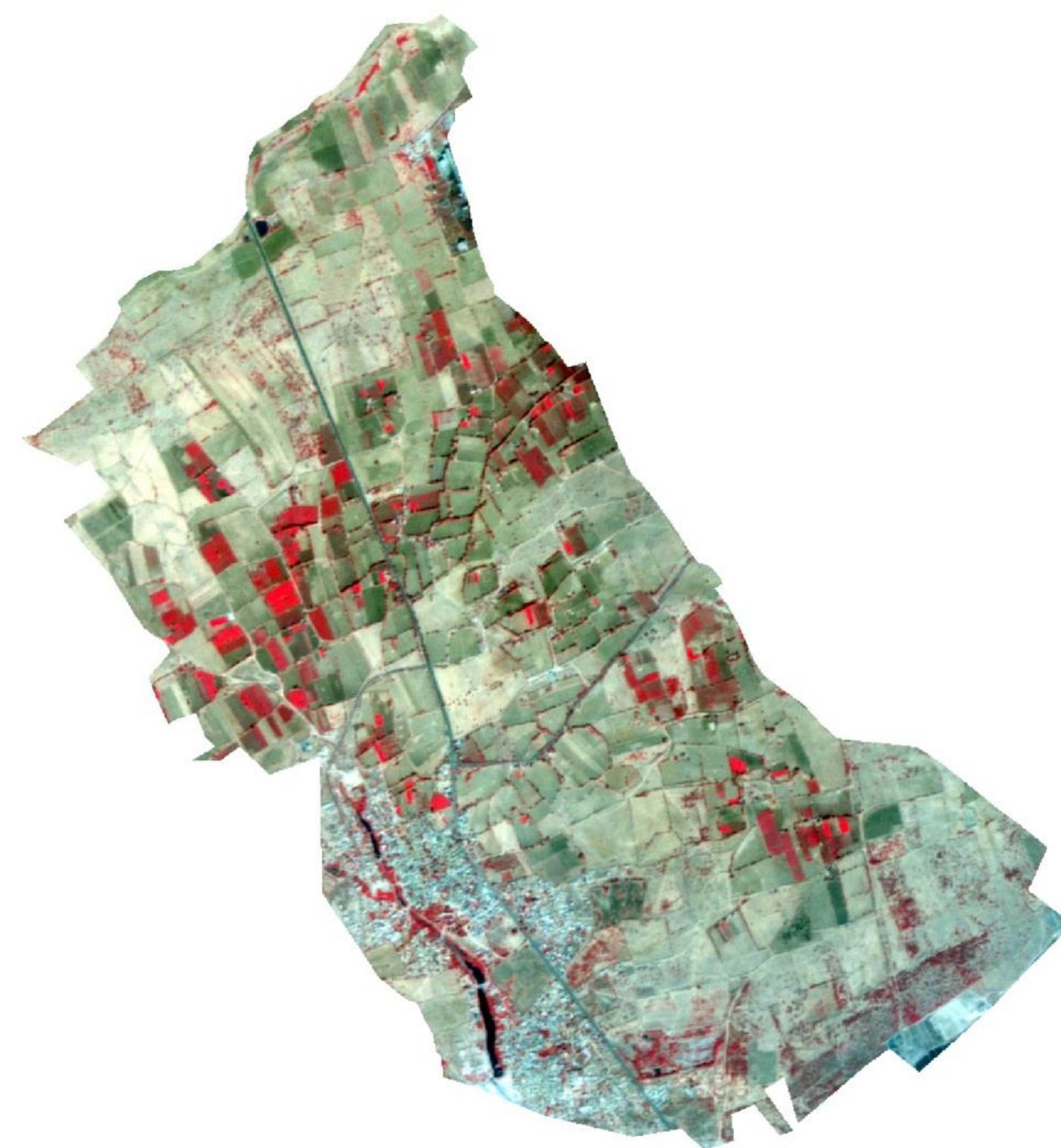
Opportunities

Community participation

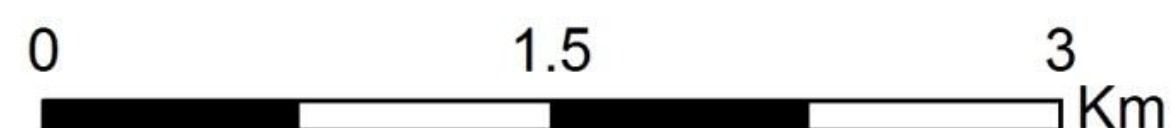
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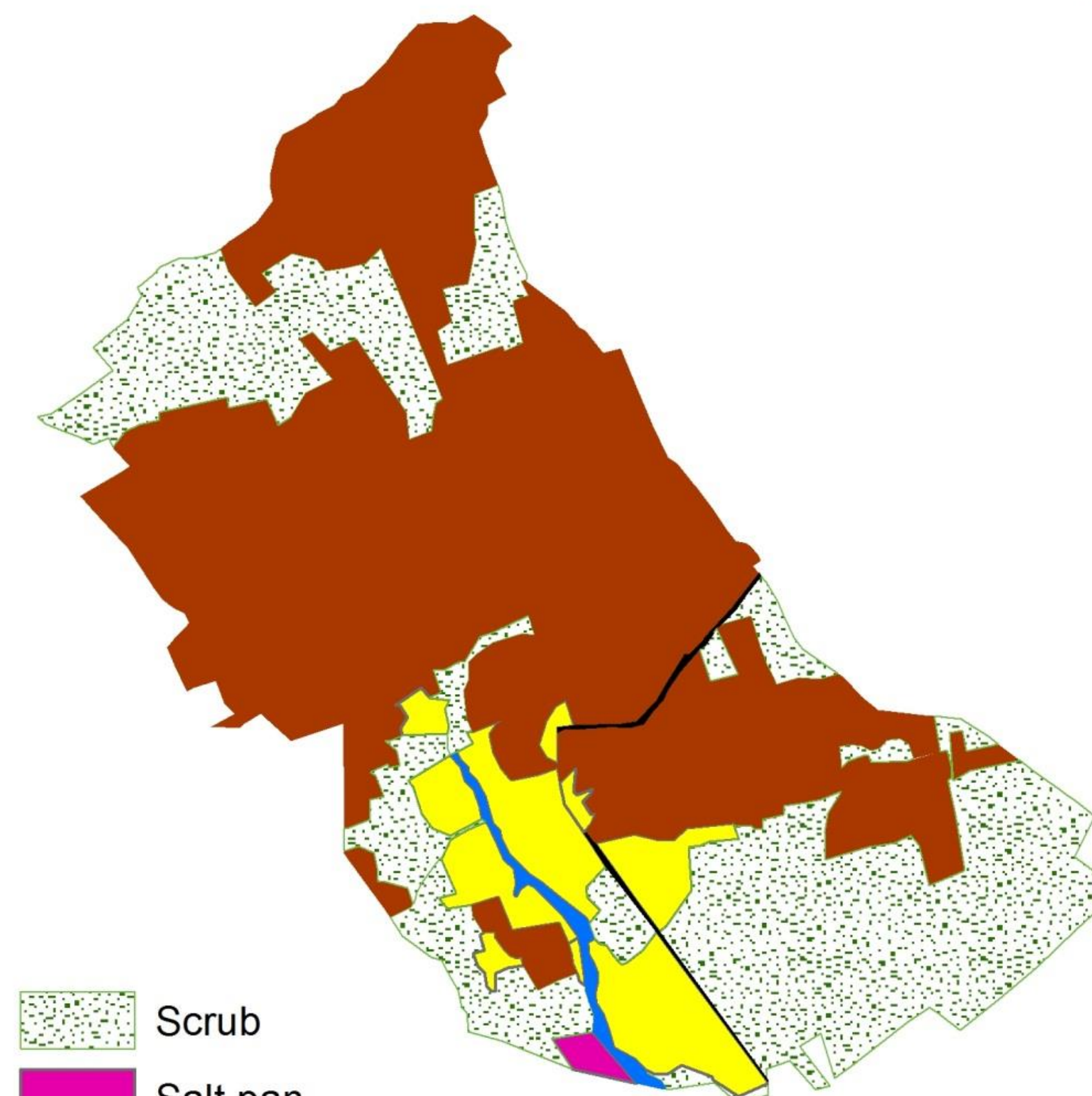
Satellite image taken on Dec 2014 of
TUNA and WANDI



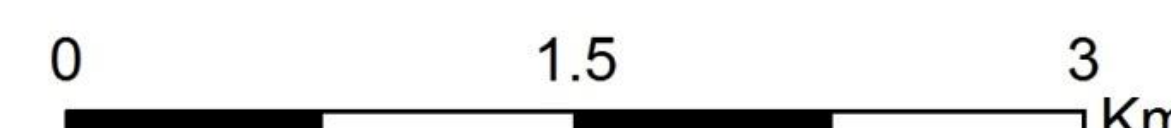
Vegetation



Land Cover: TUNA and WANDI



- Scrub
- Salt pan
- Cultivated Land
- River
- Settlement
- Road



Bringing the results together

Two common issues were identified in the case study villages during this project:

- The need for fences to prevent nilgai, wild ass, boar and wandering domestic livestock from entering fields and damaging crops
- Problems with soil fertility and increasing salinity

None of the villagers were concerned about *Prosopis juliflora*, other than as shelter for the nilgai antelopes, a pest on crops.

Communication Workshop

A workshop was held on 29th December 2015 at the Vivekanand Research and Training Institute (VRTI), NH 8 - A Extension, Nagalpur Road, Mandvi .

Dr Debbie Bartlett and Dayesh Parmar introduced the project and described how the Natural Character Area profile had been produced with the involvement of villagers in the coastal area. It was explained that this is a standard approach in England with a Natural Character Area (NCA) profile available on the internet for the whole of England. NCA profiles describe the situation for the specific area and identify threats and opportunities to enable planning for the future. Every proposal – for development, funding initiatives or land use change – is considered within this framework .

The workshop was well attended with constructive discussion followed by a good lunch.



Photos of the Stakeholder Communication Workshop 29th December 2015



LIVING FENCES

In Europe 'living fences' are made using a technique called hedgelaying. Diagrams and a short video were used at the workshop to show how thorny shrubs are partially cut through and bent over so that they form a stock proof barrier.



In the early stages stakes are used to reinforce while new growth develops. It was suggested that the properties of *Prosopis juliflora*, a non-native but widespread shrub throughout the coastal area, may well be suitable for making 'living fences' using this technique.

Representation was made to the British Council to enable an extension of the project so that research could be carried out on the potential for creating living fences out of *Prosopis juliflora*.

This was granted on the basis of the success of the project to date and the team will return to Kachchh to carry this out. It is hoped that this will result in simple guides produced in English and Gujarati to enable farmers to create these for themselves.

SOIL QUALITY

Biochar is a kind of charcoal which has been demonstrated to improve soil quality and crop growth when used alongside appropriate sources of nutrients, like green manures, animal manures, or composts.



Research has shown that the incorporation of biochar in the soil raises the pH, increases its water holding capacity, counteracts the effects of salinity, helps retain nutrients, and provides good conditions or beneficial soil microbes, resulting in greater crop yields.

Biochar has the potential to provide benefits for soil quality both on the short and long term. The long-term benefits of biochar are unique to this form of soil amendment, since other organic amendments decompose rapidly in the years after they are applied.

Researchers at Tamil Nadu Agricultural University are investigating the use of *Prosopis juliflora* as a suitable source of biochar.

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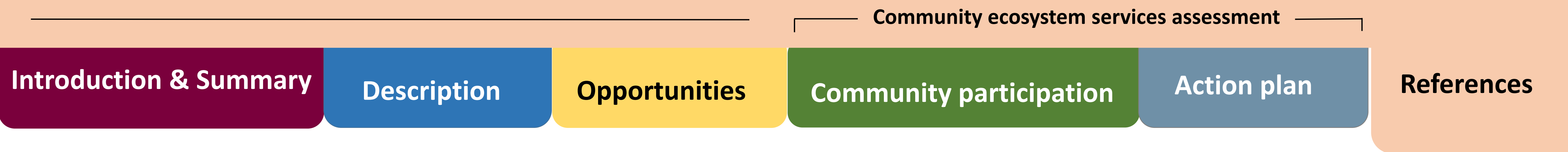
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Acknowledgements

Thanks are due to the following without whom this project would not have been possible

University of Greenwich Team:

Dr Debbie Bartlett, Dr Sarah Milliken, Eulalia Gomez Martin, Vincenzo Iannuzziello and Laura Villar Aylagas

GUIDE Team:

Dayesh Parmar, Jayesh Bhatt and Chetan Sanariya.

The villagers, wider stakeholders who commented on the draft and the British Council UKIERI fund.

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