

ABSTRACT

Landscape Character Assessment has provided the context for land use planning decisions and for identifying priorities for environmental restoration and enhancement in England since the 1990s. Increasing awareness of the importance of ecosystem services has led to the method being refined in order to enable informed management of change, with the inclusion of socioeconomic data and the identification of strategic management objectives providing an integrated approach to sustainable development in a changing This research, funded by the British Council UK-India Education and Research Initiative (UKIERI), was prompted by concerns expressed by ecologists about the increase in the extent of an invasive plant species, *Prosopis juliflora*, in the district of Kachchh, Gujarat. A combination of Landscape Character Assessment and participatory appraisal were used in order to produce a Natural Character Area profile for the coastal plain. The process revealed that concerns regarding the spread of *Prosopis* were outweighed by its socio-economic importance as a source of fuel, charcoal, honey and gum. Their most pressing concern was the impact of recent industrial development on the environment, in particular water abstraction and pollution, crop predation by livestock and increasing soil salinity.

1. INTRODUCTION

Rapid population growth and the consequent strain on limited resources increase the importance of appropriate land use and urban planning measures. In recent years most societies and governments have understood the relationship between healthy ecosystems and economic growth and have set objectives and measures to maximise sustainable development via their land use planning system.

The importance of ecosystem services for human health and well-being and economic systems has been extensively researched in Europe (e.g. Millennium Ecosystem Assessment, 2005; European Environment Agency, 2013; UK National Ecosystem Assessment, 2011).

The UK has integrated this approach into land use decision making, taking into account the value of ecosystem services and the 'cost' of inappropriate decisions (Rydin, 1995; Owens and Cowell, 2011). Using Landscape Character Assessment as a tool to better understand the relationship between people and place can help make informed judgements, planning decisions and management of environmental change, and enhance the quality of environmental assessments (Potschin and Haines-Young, 2013).

Incorporating landscape assessment in this way was first implemented as the Environmental Capital Approach, piloted in the 1990s. This involved experts conducting a desk study, followed by Landscape Character Assessment, in order to identify and describe the specific features of a particular landscape. This was followed by a participatory exercise to determine which landscape attributes were valued and why these were felt to be important. The results of these exercises were then brought together, combining the professional/expert perspective with that of stakeholders. This provided insight into the interaction between the physical and socio-economic attributes that makes places distinct from each other, identifying important features, and enabling an assessment of the scale of importance of the associated ecosystem services and whether these could be replaced or substituted by others.

Ecosystem services and landscape character are different, but related, concepts. The former aims to assess the value of the natural environment, while the latter focuses on perception and preference. Combining the two techniques is a powerful tool for decision-making and sustainable development (Landscape Institute, 2016; Tudor, 2014). The fundamental difference between these and other policy support tools lies in the division of the study area into natural - rather than administrative - units. The boundaries are drawn after carrying out a Natural Character Area (hereafter NCA) profiling exercise and defined by a combination of environmental, cultural and economic features. The NCA profile describes how the landscape has changed over time and identifies the drivers behind these changes, enabling an analysis of

the ecosystem services. This has been done for the whole of England and the NCA profiles are available on the internet as guidance documents for decision makers, enabling access to natural and cultural heritage as well as pertinent socio-economic information (Natural England, 2014).

Developing countries offer an opportunity to incorporate these approaches before the industrialisation process adversely affects the environment. Many biodiversity hot spots are located in tropical countries where, until recently, human activities have had little impact. While preservation of natural ecosystems should neither prevent development nor disadvantage the well-being of local communities, an integrated approach to land use planning, balancing environmental conservation and economic growth, is desirable. The Natural Character Area approach is proposed as a way to achieve this.

India has seen a dramatic increase in both population and industrial activity in recent years. Positive consequences have included improved communications and literacy (Ministry of Finance, 2014); however, in places poorly planned growth has exacerbated social inequalities, damaged the environment and compromised the delivery of ecosystem services. Environmental Impact Assessment (EIA) was introduced in 1994 and has since become an integral part of the decision-making process. However, while the legislative provisions and guidelines are quite comprehensive, weak enforcement, including the inability to impose fines, is resulting in many developments taking place without undergoing an EIA, despite their potential to cause environmental and socio-economic impacts. A recent assessment of the EIA system in India revealed a lack of coordination between the various authorities involved, inadequate screening and scoping, lack of expertise among EIA professionals, and inadequate implementation of mitigation measures and monitoring. In contrast to many countries, where public involvement is mandatory at various stages of the EIA process (i.e. screening, scoping, report preparation and decision making), in India consultation occurs only

once, just before decision making, and the points raised by the public are rarely taken into account (Panigrahi and Amirapu, 2012).

The state of Gujarat is the second most industrialised state in India and its rapid development has had a marked impact on the environment, local communities and their livelihoods (Awasthi, 2000). This study focused on the coastal plain of Kachchh district, located in the north-western part of Gujarat. The national census of 2011 recorded Kachchh as having experienced a population increase of 32.16% in the preceding decade; the 2001 census showed an increase of 25.4% since 1991 (Kachchh District census 2011 data). The coastal plain is composed of a mosaic of different ecosystems, such as coral reefs, mangroves, mudflats, creeks and estuaries, with many villagers dependent on these for their livelihoods. Those involved in salt production and fishing are dependent on the sea, while land based occupations include agriculture, horticulture and animal husbandry (Ministry of Environment, Forests and Climate Change and GIZ, 2014). The area is undergoing significant change, with industrial development, combined with climate and sea level rise, affecting traditional livelihoods. Fish production is reported to have decreased dramatically, with pollution combined with displacement resulting from the building of industrial plants being the likely cause (Fishmarc and Kutch Nav Nirman Abhiyan, 2010). Mangroves, the breeding grounds for many local species of fish, have been destroyed to make way for industry (Dixit *et al.*, 2010). Industrial plants also consume large quantities of freshwater and this, combined with a change in rainfall patterns, has contributed to a fall in the water table, followed by the incursion of sea water into freshwater reservoirs. This reduces crop productivity and affects grassland quality for grazing livestock (Geevan *et al.*, 2003). The cumulative impact is pressure on small landowners and young people to leave the area (Fishmarc & Kutch Nav Nirman Abhiyan, 2010).

The non-native invasive species *Prosopis juliflora* was first introduced to Kachchh in the 1960s to prevent the Rann desert from encroaching onto the Banni grassland, an important area for grazing and biodiversity. *Prosopis juliflora* has a high tolerance of drought and soil salinity, and has spread rapidly competing with native species such as *Prosopis cineraria* and gugal (*Commiphora wightii*), which were important sources of medicine for local people (Dixit and Subba Rao, 2000). The invasion of pastureland by *P. juliflora* threatens local livestock based economies: the thorny shrubs restrict access to water and can cause injury. While the pods can be used as a high protein feed for goats, sheep and camels, the high sugar content makes them indigestible for buffalo and cattle (Shukla *et al.*, 1984). The plant has become an important part of the local economy, with different parts providing fodder, gum, honey, a cotton-like substance, and wood for fuel and charcoal production (Varshney, 1996). Charcoal production is a significant livelihood in some villages, and is practiced particularly by the Koli tribe (Bartlett, 2015). Charcoal made from *P. juliflora* has a higher calorific content than that made from native species (Vimal and Tyagi, 1986) and so is considered to be of high quality.

When approached by partners to collaborate on the *Prosopis juliflora* ‘problem’, it became apparent that the decision-making process for locating development is more ad hoc than in England. Further, environmental and social issues are not always fully considered in the EIA process, which has resulted in negative impacts along the coast (Fishmarc and Kutch Nav Nirman Abhiyan, 2010). While all planning systems can be criticised, the Natural Character Area approach (Natural England, 2014) has proved effective in England and been adopted by the Government as part of the ‘access to evidence’ initiative to inform planning decisions. This research applied the NCA approach to the coastal plain of Kachchh in order to assess the suitability of this approach to inform land use planning and, in particular, to identify issues

and opportunities. The results form a working document which could be used as a model for extending this approach to other natural areas in Kachchh and, indeed, further afield.

2. METHODS

This research was carried out in Kachchh district, Gujarat, north-western India (figure 1).

The district has an area of 45,652 km², comprises a quarter of Gujarat State, and is composed of ten administrative units or talukas (shown in figure 1 section C). The frontier with Pakistan lies to the north-west while the south-western border is formed by the Arabian Sea. An initial desk study identified several distinct Natural Character Areas, of which the coastal plain was selected as the study area.

A comprehensive desk study of the coastal plain brought together information about the environmental, biological and socio-economic aspects of the area derived from books, papers, reports and research projects previously conducted by the Gujarat Institute of Desert Ecology (GUIDE). This included information about the climate, geology, soils, hydrology, culture, economy, history, flora and fauna. The objective was to provide background information and inform the fieldwork phase.

Field survey sheets were created to enable the Landscape Character Assessment to be carried out. These were used to record information that was not revealed by the desk study and required substantial modification and pilot testing as the features and characteristics of the Gujarati landscape are very different from those found in England. The field sheets, shown in Figure 2, listed options, using local terminology for features are were composed of two parts, the first recording landscape features such as topography, land cover or land use (Figure 2a). The second part of the sheet aimed to record how the landscape was perceived by the surveyor (Figure 2b). The surveyor's name, the date, weather, location, and direction of view were recorded at the top of the first sheet, and surveyors worked independently while at the same location. Additional information was also recorded while traveling around the area. The

results for each location were compiled and a consensus descriptor was selected for each one, based on the options most frequently selected by the surveyors.

In order to identify the environmental, social and economic issues of the coastal plain, focus groups were carried out in eight villages in different parts of the coastal plain for participatory investigation (Figure 3). These villages were selected because of the differences in their economic and ecological features, established during the desk study and fieldwork phases of this research, so they provided as cross section of communities in the different areas of the coastal plain (see Table 1 for brief profiles) Visits were arranged in May and June 2015 in order to carry out focus group discussions, an established technique for gathering information (e.g. Kamberelis and Dimitriadis, 2013). GUIDE staff made initial contact with each village sarpanch (headman), and an invitation, in both English and Gujarati, invited everyone to attend, irrespective of age, status, or occupation. The groups were facilitated by an interpreter, with the researcher following leads in the discussion in order to maintain a dynamic debate, and to avoid influencing the answers of the interviewees. A pre-prepared semi-structured interview schedule, addressing the topics of livelihoods, culture, and landscape and wildlife, was used to standardise (as far as possible) the information collected see Table 2. The intention was to understand the relationships among and between these topics, and to identify any changes and/or problems that were being experienced. The discussions tended to be free-ranging, jumping from topic to topic. The number of attendees was recorded and categorised by gender and apparent age, with 'A' for those under 15 years; 'B', between 15 and 34 years; 'C' 35 to 60 years and 'D' over 60 years. Transcription of notes was done as quickly as possible after each meeting, recording information under the headings in the pre-prepared schedule. The information in each village profile, based on the 2011 census was checked in order to record any change in population, sex ratio, overall literacy rate and literacy rate by gender. The proportion of villagers

classified as being of Scheduled Caste (SC) or Scheduled Tribe (ST), was considered as this is used as a measure of disadvantage in India. SC and ST are officially designated groups of indigenous people that have historically suffered discrimination in India (Chanana, 1993).

The percentage of people belonging to these groups can influence availability of resources in a village, with additional funding available for communities which include members of these groups; this was the explanation given for the computing equipment in some village schools whereas this was absent in others.

The results from the participation exercise, combined with the earlier desk study and the Landscape Character Assessment, were used to inform an evaluation of the ecosystem services, and to analyse the key issues for each village. These were displayed on a bilingual English/Gujarati poster, including photographs taken during the first visit to enable the villagers to identify themselves (see figure 4). Return visits were made to each village in December 2015 so that the villages could verify the information and make any necessary changes. A further analysis was then carried out to identify common strands and these, together with the full NCA profile, were presented and discussed in the final stakeholder workshop.

3. RESULTS

Landscape Character Assessment and the initial desk study were carried out across Kachchh as a whole and the coastal plain was identified as a distinct unit defined by natural, rather than political, boundaries. A Natural Character Area profile was created describing it as a flat, low lying coastal landscape with extensive open, sparsely vegetated areas. There are rock outcrops containing rich deposits of bauxite, limestone, lignite and bentonite, and consequent intensive mining and associated industry. Population density is relatively high, with infrastructure such as highways, roads, ports, communication masts, wind turbines and power plants providing evidence of increasing industrial activity. This has encouraged

inward migration, the growth of coastal towns and the establishment of new settlements while at the same time reducing the area of agricultural and grazing land.

The coastal plain provides a wide range of ecosystem services and those determined as most important as a result of this research are summarised below.

3.1. Provisioning services

- **Food:** despite the increase in development there are still extensive areas of agricultural land producing crops such as bajra, jowar, cotton, guar and castor. Wide areas of pasture land provide grazing for dairy livestock while the mangroves provide additional fodder. The fishing industry harvests crustaceans as well as fish and the marine ecosystem also provides edible seaweed as well as supporting the significant salt industry. Honey is a secondary product from *Prosopis juliflora*.
- **Medicine:** native plants, such as gugal (*Commiphora wightii*), are important in traditional medicine. *P. juliflora* is a source of a gum that is used medicinally.
- **Fibre and fuel:** *P. juliflora* as well as other shrub species are used for fuel. Charcoal made from *P. juliflora* has a high calorific value and so is considered to be of high quality. Mangrove leaves are also used as fuel.
- **Minerals:** salt production is practiced at both a domestic and an industrial scale, the latter being of high economic significance. Bauxite, limestone and bentonite are all mined here.

3.2. Regulating services

- **Climate regulation:** the extensive areas of mudflats, mangroves and grasslands contribute to significant carbon storage.
- **Soil quality:** mangroves reduce sea water infiltration, thereby reducing the risk of salinisation of the soil. They also filter and assimilate pollutants, reducing the impact

of these on coastal soils. Estuaries maintain a constant flux of sediment and nutrients, and, during flood events, can increase soil productivity.

- **Water quality:** mangroves and associated habitats contribute to water quality by filtering suspended material and assimilating dissolved nutrients.
- **Flooding and erosion:** habitats such as mangroves, creeks, mudflats and sand dunes, as well as marine ecosystems such as coral reefs, provide an important natural defence against flooding by reducing the impact of waves. This service has become increasingly important due to rising sea levels and increased frequency of storms, providing erosion control as well as protection from cyclones and storms.

3. 3. Supporting services

- **Species diversity:** species diversity and abundance is high in the coastal waters.
- **Breeding sites:** Mandvi beach is a breeding site for the endangered green sea turtle, olive ridley sea turtle and leatherback sea turtle. 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 for coastal communities.
- **Habitat maintenance:** mangroves supply nutrients and oxygen to animals and plants.

3. 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 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. There are many temples and religious sites on the coast.
- **Education:** the unique landscape and biodiversity offers opportunities for watching rare species in their natural habitat. This is especially true for sea turtles and a wide range of migratory and endemic bird species.

Community participation was necessary in order to determine the importance of these ecosystem services to local people. The villages were very different in terms of size, population, land use and principal livelihoods (see Table 3). Analysis of land use change revealed significant loss of cultivated land, particularly in Lakhpar, where industry has replaced agriculture over more than 70 hectares. The settlements of Tuna and Wandi had grown and salt pans had been developed on areas previously recorded as scrub in both Lakhpar and Tragadi. *Prosopis juliflora* has expanded onto mudflats in Ashira Vandh, and onto formerly cultivated land in Kathada.

The perceived decreases or increases in ecosystem services for each village are shown in Table 4.

Some common issues were identified. For example, all the villages that identified fishing as the main livelihood were concerned about the decrease in fish populations. This has led many to shift from fishing to farming and livestock rearing, further encouraged by a rise in the milk price. However, soil salinization has reduced the quality of the grazing, while industrial development, particularly of wind turbines, has reduced the area of grassland and mangroves previously used for fodder. Fodder now has to be brought into the area, thereby affecting the profitability of livestock rearing and dairying. These factors have encouraged many small farmers, such as those in Lakhpar, to sell their land to development companies who erect wind turbines, providing energy to local industries.

A further issue affecting agriculture is the increase in protected animals such as the nilgai (blue bull) and wild ass which feed on their crops. On the other hand, most villagers felt that industrialisation was having an adverse effect on wildlife, particularly birds. While the increase in the extent of *Prosopis juliflora* was widely acknowledged, it is an important source of fuel in most villages.

Salt production was a significant livelihood in the recent past, with families owning and working salt pans; this is increasingly controlled by larger companies who, in some cases employ local people as day labourers. Salt production in the Little Rann, in the eastern part of the coastal plain, was the subject of a prize-winning documentary film (My Name is Salt see <http://mynameissalt.com/> directed by Pacha, 2015). Villagers reported problems with quality as 'black dust', air pollutants that mix with salt, reducing its value; the pollution derives from industry that has more recently moved into the area.

The completed Natural Character Area profile, modelled on the Natural England format, brought all of the information about the coastal area, from the desk study to the participatory analysis, together in a single 71page document which included the strategic opportunities identified by the research (Bartlett et al 2016). The front cover is shown in figure 5. This was presented to the villagers who had been involved in the study and to other stakeholders, including local government officials and decision makers, at a workshop held in December 2015.

4. DISCUSSION

The results of the desk study and Landscape Character Assessment process provided a context within which to consider the issues that emerged during the participatory phase. The topography is ideal for agriculture and livestock rearing, and these were formerly the principle land use. However, the flat topography and proximity to the coast has encouraged the settlement of industry, in particular cement, salt and chemical companies. Development

was further encouraged by policies after the earthquake in 2001 which introduced tax breaks to encourage investment in the area and the setting up of Special Economic Zones (Ministry of Micro, Small and Medium Enterprises, 2015). The rapid industrialisation of the coastal area has resulted in a proliferation of features such as roads, communication masts and wind turbines (Sharma *et al.*, 2012) and it was this contrast to the rural communities, still largely undeveloped and reliant on traditional livelihoods that led to this natural area being selected as a case study.

The Indian land use planning system, while requiring Environmental Impact Assessment for some large-scale projects, does not take into account the socio-economic impact of development this is left to Corporate Social Responsibility schemes set up and administered by individual companies. The focus groups revealed dissatisfaction with these, reporting that the impacts of industrial water use, which has lowered the water table and increased soil salinity, was not adequately compensated by the weekly delivery of bowsers of water for villagers to use. In addition, some of the water provided was so brackish as to be unfit for drinking.

The use of Natural Character Area profiles was introduced in England as part of Natural England's Access to Evidence initiative, which aims to provide decision makers with a context within which to make informed land use planning decisions by bringing together environmental, social and economic information in a balanced way (Natural England, 2014). The method used here was based on this approach and so some broad strategic objectives were identified and presented to the final workshop that brought together the villagers who had been involved in the focus groups as well as wider stakeholders, including decision makers, to discuss the approach and consider whether it would work for them. While the research team was keen to adhere to the format used in England, identifying important ecosystem services and strategic opportunities for the natural area, it was important not to be

detailed or prescriptive as it is for the local people to determine what is appropriate for them. A workshop was held on 29th December 2015 at the Vivekanand Research and Training Institute (VRTI) in Mandvi, to which the villagers and other stakeholders were invited. This was well attended and provided an opportunity to present the draft Natural Character Area profile, to describe the method used, and invite comments. The broad Strategic Environmental Objectives identified and presented to the workshop were as follows:

SEO1: Maximise the potential of *Prosopis juliflora* for fuel, charcoal and biochar and explore the potential for eradicating it in areas such as the Naliya grassland. This is designated as a Wildlife Sanctuary and is the location of the Lala Great Indian Bustard Sanctuary.

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

The project and the SEOs were well received and there were lively discussions on the topics raised. In addition to the prevalent concerns about the impact of industry on fish stocks and water quality, and the lack of jobs for local people, common issues were the predation of crops by nilgai, wild ass, boar and wandering domestic livestock, and declining soil fertility. Although the origin of this project had been concern about the spread of *Prosopis juliflora*, a key issue for the ecologists, as they were concerned about the loss of grassland habitat with

the spread of this shrub, this was not echoed by the villagers. These did however consider it provided shelter for the nilgai antelopes (*Boselaphus tragocamelus*), a serious predator of crops.

Ideas for maximising the potential of *Prosopis juliflora* for fuel, charcoal and biochar (SEO1) were discussed at the workshop. Currently charcoal is made using traditional ‘earthburn’ techniques which, although effective, are not efficient in terms of converting wood to charcoal. The stakeholder workshop provided the opportunity to discuss different methods that deliver higher yields for less effort, and to introduce the topic of biochar. The potential for biochar to improve soil quality by reducing the effects of salinity and increasing water retention (e.g. Akhtar et al 2015; Barrow 2012; Gokila and Baskar, 2015) is of particular relevance in areas such as the Kachchh coastal plain. The possibility of using the shrubs to create ‘living fences’, by laying them was also introduced.

5. CONCLUSION

This exercise, working in collaboration with Indians to introduce natural character-based, rather than administrative boundary-based, land use planning was both challenging and, ultimately, satisfying. The method of producing a Natural Character Area profile required some modification, particularly in developing appropriate field survey sheets, and the final document was lengthy as full working details were required. The reception from stakeholders – from villagers to local government officials – demonstrate that this integrated approach, based on balancing environmental, social and economic aspects within the framework of the ecosystem services approach, could be widely adopted.

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Table 3. Differences between villages in terms of size, population, land use and principal livelihoods.

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Focus groups	Villag	Date	Rationale for selection
<i>Table 1. Focus group profiles</i>			
1	Ashira Vandh	30/05 /2015	Village located near mangrove forest. Charcoal burning is known to take place in the area
2	Nimdi Wandh	06/06 /2015	Proximity to mudflats and mangrove swamps
3	Wandi	07/06 /2015	Traditionally a fishing village with increased industrial development
4	Tuna	07/06 /2015	Traditionally a fishing village with increased industrial development
5	Tragadi	09/06 /2015	Selected on the basis of previous contact between GUIDE and the sarpanch (headman) as the village has been involved in the ongoing PBR (People's Biodiversity Register) in recent years
6	Kathda	09/06 /2015	The majority of the population is involved in agriculture
7	Kanmer	10/06 /2015	Small rural village near the Little Rann. Rabari community
8	Lakhar	10/06 /2015	Salt pan works in the area. Proximity to the Little Rann

Table 2. Semi-structured Interview Schedule used in Focus groups

<u>Focus group no:</u>		<u>Site:</u>		<u>Date:</u>		
<u>Facilitator:</u>		<u>Translator:</u>				
<u>LIVELIHOODS</u>						
FISHING		FARMING		OTHER		
LIVESTOCK.		CATTLE:		BUFFALO:		
CAMEL:		GOATS or SHEEP		GRAZE OUT/KEEP IN		
IN VILLAGE		BEYOND				
TRANSHUMANCE		TIME AWAY		AVAILABLE FODDER?		
CROPS:		FOR SALE		SUBSISTANCE		
				FODDER		
IRRIGATION:		CHANNEL		DRIP		
				NONE		
POWER		DRAFT ANIMALS		TRACTORS		
FUEL:		SOURCE		AVAILABILITY		
WOMEN:		DECISION MAKING		ECONOMIC ROLE		
CHANGE/THE FUTURE:						
<u>ALTERNATIVE LIVELIHOODS</u>						
<u>EDUCATION</u>						
LOCAL PROVISION:		CHANGE		ASPIRATION		
<u>LANDSCAPE</u>						
CHANGE:		WILDLIFE:				
<u>OTHER ISSUES RAISED:</u>						
<u>OBSERVATIONS:</u>						
<u>VILLAGE PROFILE</u>						
Households:		Population:		Male:	Female:	
% SC	%ST	Other:				
Literacy %		Population:		Male:	Female:	
Average Gujarat:						
<u>ATTENDEES:</u> age category by visual observation A <15: B 15-34 C 35-60 D >60						
Number:		Male			Female	
Aprox age		A B C D			A B C D	

Table 3. Differences between villages in terms of size, population, land use and principal livelihoods.

Villages (Focus groups)	Village size (Ha)	Population		Predominant land cover	Principal livelihood
		Males	Females		
Ashira Vandh	9000	-	-	Cultivated land	Fishing and Livestock rearing
Nimdi Wandh	3900	-	-	Scrub	Fishing and Livestock rearing
Wandi	1000	186	202	Cultivated land	Fishing and Livestock rearing
Tuna		2573	2541	Cultivated land	Salt pans and Farming
Tragadi	1500	636	602	Scrub and Mudflat	Fishing and Livestock rearing
Kathada	2100	1387	1461	Cultivated land	Livestock rearing and agriculture
Kanmer	7000	1941	1875	Cultivated land	Livestock rearing and agriculture
Lakhapar	6500	547	442	Cultivated land	Salt pans and Farming

Table 4. Perceived decreases or increases in ecosystem services for each village. For species diversity, only two protected species have been taken into account: Wild Ass (*Equus hemionus khur*) and Nilgai (*Boselaphus tragocamelus*)

Provisioning services	AV	NW	W	Tu	Tra	Kath	Kan	Lak
Agriculture	↓	↓	↓	↓	↓	↓	↓	↓
Fishing	↓	↓	↓	↓	↓	↓	↓	↓
Fodder	↓	↓	↓	↓	↓	↓	↓	↓
Medicine	↓	-	-	-	-	-	-	-
Fuel and fibre	↑	↑	↑	↑	↑	↑	↑	↑
Regulating services								
Soil quality	↓	↓	↓	↓	↓	↓	↓	↓
Climate regulation	-	-	-	-	-	-	↓	-
Water quality	↓	↓	↓	↓	↓	↓	↓	↓
Flooding and erosion	↓	-	-	-	-	-	-	-
Supporting services								
Species diversity	↑	-	-	-	-	-	↑	↓
Breeding sites	↓	↓	-	-	-	-	-	-
Shelter	↓	↓	-	-	-	-	-	-
Habitat maintenance	↓	↓	-	-	-	-	-	-
KEY to village names: Ashira Vandh (AV), Nimdi Wandh (NW), Wandi (W), Tuna (Tu), Tragedy (Tra), Kathada (Kath), Kanmer (Kan), Lakhapar (Lak)								

List of figures.

Figure 2.1. Map showing the location of Gujarat state in India (A); map showing the location of Kachchh district in Gujarat (B); map showing the talukas of Kachchh (C).

Figure. 2.2a Field Survey Sheet page 1

Figure. 2.2b Field Survey Sheet page 2.

Figure. 2.3. Map showing the boundaries of the villages studied.

Figure 2.4. Bilingual English/Gujarati poster used in one of the participatory exercises.

Figure 3.1. Front cover of the completed Natural Character Area Profile of the coastal plain of Kachchh.