

DETAILED PROJECT REPORT



CLIMATE CHANGE ADAPTATION FOR NATURAL RESOURCE DEPENDENT COMMUNITIES IN KACHCHH, GUJARAT: STRENGTHENING RESILIENCE THROUGH WATER & LIVELIHOOD SECURITY AND ECOSYSTEM RESTORATION

*National Adaptation Fund on Climate Change (NAFCC) under
MoEF&CC, GoI*



Submitted by
Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar, Gujarat

*Technical support:
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*

February, 2017

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Abbreviations

Abbreviation	Expansion
AIA	Agricultural Intervention Activity
BCM	Billion Cubic Meters
BWFG	Bhungroo Women Farmers' Group
CbA	Community Based Adaptation
CIA	Coastal Intervention Activity
C&I	Criteria and Indicators
CO₂	Carbon-Di-Oxide
CPT	Cattle Proof Trenches
CRIDA	Central Research Institute For Dryland Agriculture
CSR	Corporate Social Responsibility
DoA	Dept. of Agriculture & Co-Operation
DoCC	Department Of Climate Change
DoFE	Dept. of Forests & Environment
DPR	Detailed Project Report
EbA	Ecosystem Based Adaptation
EE	Executing Entity
FGD	Focused Group Discussion
FSI	Forest Survey of India
GEC	Gujarat Ecology Commission
GEDA	Gujarat Energy Development Agency
GEER	Gujarat Ecological Education And Research Foundation
GGRC	Gujarat Green Revolution Company Ltd
GIS	Geographic Information System
GoG	Government of Gujarat
GoI	Government of India
GRK	Great Rann of Kachchh
GUIDE	Gujarat Institute of Desert Ecology
HDPE	High-Density Polyethylene
IARI	Indian Agricultural Research Institute
ICAR	Indian Council Of Agricultural Research
IEC	Information, Education, And Communication
INR	Indian Rupees
IPCC	Intergovernmental Panel On Climate Change
ISFR	India State Forest Report
IUCN	International Union For Conservation Of Nature
MoEF&CC	Ministry of Environment, Forest And Climate Change
MSL	Mean Sea Level
N₂O	Nitrous Oxide

NABARD	National Bank For Agriculture And Rural Development
NAFCC	National Adaptation Fund On Climate Change
NDVI	Normalized Difference Vegetation Index
NPMSHF	Mission For Integrated Development of Horticulture, National Project On Management of Soil Health And Fertility (NPMSHF)
NSP	Naireeta Services Pvt. Ltd.
PIA	Pastoral Intervention Activity
PKVY	Paramparagat Krishi Vikas Yojana
PRA	Participatory Rural Appraisal
RKVY	Rashtriya Krishi Vikas Yojana
RRA	Rapid Rural Appraisal
SAPCC	State Action Plan On Climate Change
SHG	Self Help Group
SNC	Second National Communication
SOC	Soil Organic Carbon
tCO₂e	tons of carbon dioxide equivalent
ToB	Training of Beneficiaries
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific And Cultural Organization
UNFCCC	United Nations Framework Convention. On Climate Change

Project Brief:

Title of Project/Programme:	Climate Change Adaptation for Natural Resource Dependent Communities in Kachchh, Gujarat: Strengthening Resilience through Water & Livelihood Security and Ecosystem Restoration
Project/Programme Objective/s:	The proposed project activities aim to enhance the adaptive capacity of natural resource dependent communities (Agriculture, Coastal Fishing and Pastoral communities) to climate change in targeted villages of Kachchh district, Gujarat.
Project/ Programme Sector:	Water, Agriculture, Forest and Coastal Area Management
Name of Executing Entity/ies/Department:	Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar
Beneficiaries:	Agriculture, Coastal Fishing and Pastoral Communities of Kachchh District, Gujarat. (1230 households from agricultural zone, 700 households from coastal zone and 240 households from pastoral zone totalling 2170 direct beneficiaries; covering at least 35% of women as beneficiaries).
Project Duration:	4 Years 00 months
Start Date:	July 2017
End Date:	June 2021
Amount of Financing Requested (Rs.):	INR 21,35,87,653.00 (Rupees Twenty One Crore Thirty Five Lakh Eighty Seven Thousand Six Hundred and Fifty Three Only)
Project Location:	The project location is within 3 talukas of Kachchh District: 1. 10 villages in Khadir bet in Bachua Taluka for agricultural communities. 2. 10 villages in Abdasa taluka for coastal fishing communities 3. 12 wands (hamlets) in Banni Grassland Reserve in Bhuj Taluka for pastoral communities
State:	Gujarat
District:	Kachchh District
Contact Details of Nodal Officer of the Executing Entity/ies/:	Sh. R. D. Kamboj, IFS Additional Principal Chief Conservator of Forests and Director, GEER Foundation Indroda Nature Park P. O. Sector-7, Gandhinagar
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1. PROJECT BACKGROUND

1.1 Project / Programme Background and Context

a. Provide brief information on the problem the proposed project/programme is aiming to solve

Climate Change and natural ecosystems are closely related. The changing climate poses risk to ecosystem productivity impacting communities' livelihood, sustenance, health and environmental security. As per the India's Second National Communication (SNC)¹, extremes of heat cold, droughts floods, and various forms of extreme weather have caused havoc on the natural resources such as agriculture, water, forestry etc. systems. Moreover, there is another risk arising from just residing in certain vulnerable areas which are directly prone to climate related hazards like rising sea levels, cyclones etc. About 55 million coastal dwellers along India's 7500 km long coastline, are particularly affected by the rise in sea levels, storms, and salinization of groundwater (Source: Climate Central, 2015). At the current trajectory of climate change, the global temperature is likely to rise by 4 degrees Celsius from pre-industrialization levels by the end of this century. This spike in temperature will lead to a sea-level rise enough to submerge the land inhabited by 55 million coastal population.

Gujarat is a state in Western India with an area of 196,024 km² and a population of approximately 6.03 crores (4.99% of the total population of India). The state is bordered by Rajasthan to the north, Maharashtra to the south, Madhya Pradesh to the east and Pakistan to the west. The Union Territories of Daman and Diu and Dadra and Nagar Haveli also lie in the vicinity of the state. It has a total coastline of 1600 km, the largest among all Indian states. The state came into being on May 1, 1960 from the carving out of 17 northern states of the former state of Bombay. Presently, Gujarat has 33 districts with Kachchh as the largest district in area, while Dang being the smallest. **Figure 1** shows the district map of the State.

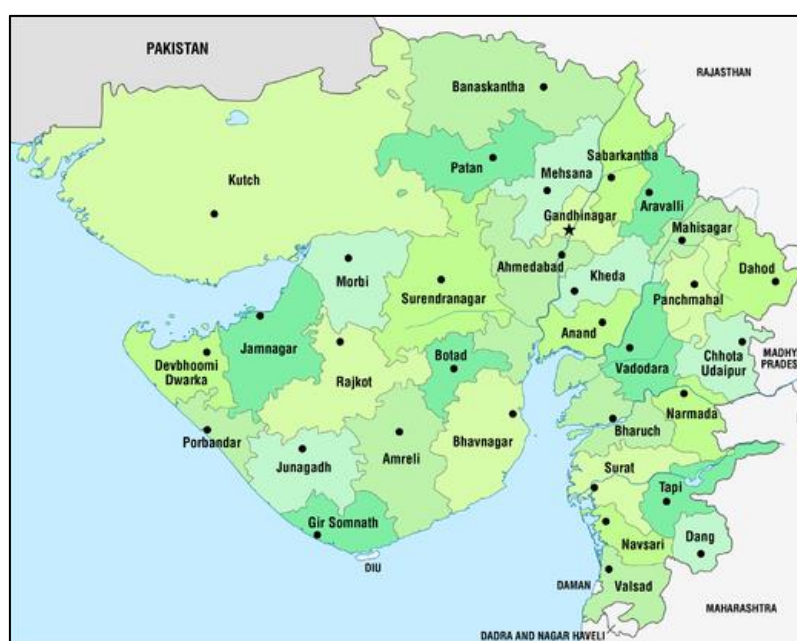


Figure 1: District map of the State of Gujarat

¹India's Second National Communication (Report) to UNFCCC (2012). Ministry of Environment and Forests, GOI.

The state gets its name from the Gujjar community, who ruled the area during the 700s and 800s. Excavations around Lothal (also believed to be one of the world's oldest seaports²), Rampur, Amri, Dholavira and other places around the Sabarmati and Mahi rivers also indicate the prevalence of the Indus Valley Civilization. Gujarat comprises of 3 distinct geographical regions³:

- I. The Peninsula, traditionally known as Saurashtra: Hilly tracts sprinkled with low mountains.
- II. Barren and rocky Kachchh, with the Rann of Kachchh: Great Rann in the north and the little Rann in the east.
- III. The alluvial plains in the mainland, extending from the Rann of Kachchh and the Aravalli Hills to the River Damanganga.

Gujarat is one of the most diverse ecosystems found in any state in India. Deserts, scrublands, grasslands, deciduous forests, wetlands, mangroves, coral reefs, gulfs and estuaries are present in the state boundaries. This makes the state of Gujarat a site of incredible ecological importance⁴.

Kachchh is an arid district in the north-west of Gujarat which has a total of 10 Talukas (Sub-Districts) and 877 inhabited villages(out of total 924).The economy of the district reincarnated after the unfateful earthquake of 2001 and many new industries like minerals, cement, steel, fisheries, salt, fertilizers and plastic which started grooming up. Kandla is a major port for import and export and Jhakhau is a major fishing harbour in the District. It has 52 landing sites for fishermen and a major Special Economic Zone at Mundra. The intertidal zone ranges from 100 m in Mandvi-Jakhau zone to 5 km in Anjar Mundra Zone to 10 km in Jakhau to Lakhpat zone to 20 km in Bhachau-Gandhidham Zone. The stage of ground water development / extraction in the district is at 79.34%, which falls under semi-critical category (Source: Central Ground Water Board, 2013).

With a total area of 45.6 thousand sq. km., Kachchh is the largest district of India. The Rann of Kachchh/salt desert(composed of salt marshes and marshy grasslands) occupies nearly 2/3rd of the area. The district has the lowest population density of 46 persons per sq. km. and a longest coastline of 406 km in the state of Gujarat. The climate in Kachchh is characterized by its aridity, low rainfall and extreme temperatures. Daily mean maximum and minimum temperature in the District is 39.5°C, and 9°C respectively, whereas mean annual rainfall is a scanty 378 mm (Source: Central Ground Water Board, 2013). Sea level rise along the Gulf of Kachchh is reported to be 0.4–2 mm/year (SNC, 2012) resulting to salinity intrusion and saline coastal groundwater, endangering wetlands, inundating valuable land & settlement of coastal communities. The Rann is a shallow wetland which is submerged in water for a significant part of the year. It is comprised of the Little and the Great Rann of Kachchh, along with the ecologically important Banni grasslands. The seasonally flooded salt marshes represent the only flooded grasslands in the Indo-Malayan realm⁵. Kachchh is a rare ecological zone represented by scrub forest, grasslands, *wetlands, the Ranns and the large coastal and marine belt*. It supports rich and unique biodiversity of marine species like mangroves, corals, algae, commercial fishes (including Kachchhi Prawns called *Metapenaeus Kachchhensis*), important migratory birds (including Grater

²en.wikipedia.org/wiki/Gujarat

³nrhm.gov.in/nrhm-in-state/state-wise-information/gujarat.html

⁴gujaratindia.com/about-gujarat/fact-file.htm

⁵ WWF – Rann of Kachchh Flooded Grasslands

(http://wwf.panda.org/about_our_earth/ecoregions/rannofkachchh_flooded_grasslands.cfm)

Flamingo, Montagu's Harrier, MacQueen's Bustard), wild fauna (Wild Ass, Desert Fox, Jackal, Indian Grey Wolf, Spiny Tailed Lizard etc.), important and rare grassland birds (Great Indian Bustard, Lesser Floricorn, Grey and Black Francolin) and a variety of domestic animals etc. The geological history of the Little Rann of Kachchh is similar to Great Rann of Kachchh i.e. at macro level both show homogeneity in terms of geology, geomorphology, ecology, climatic conditions etc., however at micro-level they show considerable diversities.

About 35.6% of the gross district domestic product with 49.3% of population employed is accounted by the primary sector i.e. livestock rearing, fishing (pagadiya and motor boats), salt-making and agriculture & horticulture in Kachchh (as against 18.4% for Gujarat) [Source: Gujarat Infrastructure Development Board, 2005].

Agriculture is mostly rain-fed and heavily dependent on groundwater. Irrigation in Kachchh is largely groundwater dependent and 87% of the total irrigated area depends on ground water sources and out of which 85% have traditional wells. Agricultural production is dominated by traditional crops like oil-seeds (groundnut, castor, rape and mustard), cereals (wheat, jowar & bajra), pulses, fodder and vegetables. New crops like medicinal crops (like isabgul), spices (jeera and chillis) and fruits (dates, pomegranate, mango etc.) are also cultivated and area under cultivation is increasing under these crops.

Between near shore and lagoon or estuarine environments, mangrove ecosystem acts as a buffer with regard to the influence of freshwater discharge and salinity regime (Ramanathan, 1997). The study of mangrove regions is necessary as they are highly productive and play an important role as breeding and nursery grounds for many commercially important fishes, especially shrimps (Kathiresan and Bingham, 2001). Distribution of nutrients determines the fertility potential of a water mass (Panda et al., 1989; Bragadeeswaran et al., 2007). The regular and periodic changes in the climate synchronized with season are ultimately reflected in the environmental parameters also, which in turn have a direct or indirect influence over the planktonic population. The seasonal distribution, abiotic and biotic processes affect the nutrient cycle of different coastal environments (Choudhury and Panigrahy, 1991). The magnitude and periodicity of forces such as tides, nutrients, hydro-period and stresses such as cyclones, drought, salt accumulation and frost may largely determine the 'energy signature' in mangrove realm and the floral and faunal composition.

The analysis of the last 100 years (1891 to 1996) data on annual mean maximum and minimum temperature showed that the mean maximum temperature increased by 0.5°C, while the mean minimum temperature has declined by 0.5°C. The decadal fluctuation of mean maximum and mean minimum temperature showed a significant raise in mean maximum temperature from the decade 1931-40. However, the mean minimum temperature did not show any major change over the same decades. This reflects a rise in the day temperatures.

The statistical analysis of the rainfall in Kachchh for the years 1932-2010 concludes that there were 11 years severe drought conditions and 12 years of excess rains. The incidence of severe drought during the period 2001 – 2010 has occurred only once and the number of good rainy years is more, with 2 years of excessive rain.

The agricultural policy of the State aims to bring in more area under irrigation resulted in promotion of agriculture in Kachchh. Various irrigation schemes like damming of rivers

and canal irrigation are promoted. Apart from this, the use of groundwater for irrigation is increased. In Nakhatrana almost 85% of the gross cropped area is irrigated, while in Rapar the figure is as low as 13%. Irrigation in Kachchh is largely groundwater dependent and 87% of the total irrigated area depends on groundwater sources, out of which 85% have traditional wells. Area under canal irrigation is the highest in Nakhatrana (more than 6000 ha), followed by Bhuj (5600 ha) and Lakhpat (4500 ha). In case of Rapar taluka, the situation is very different, there are high percentages of cultivators (as per 2001 census) but the area under irrigation is low.

During the 1971-72 period the net area and gross area remained almost similar, but after 1984-85 the area under net irrigation has increased. This implies that the number of crops taken from the agricultural field is more than one. Thus, it shows an increase in utilization of land resources for production of crops⁶.

The proposed project aims to make an effort in understanding climate induced risks to the marginal natural resource dependent communities in Kachchh, viz. coastal-fishing communities, agriculture communities and pastoral communities; identify measures and strategies to overcome them and undertake locally appropriate, cost-effective and community/sector specific adaptation measures.

b. Outline the economic, social, development and climate change in line with the State Action plan on Climate Change and relevant Missions under National Action Plan on Climate Change

Project activities are in line with the Gujarat State Action Plan on Climate Change (SAPCC) as well as the priority thematic areas identified in the National Mission for Sustainable Agriculture, National Water Mission and National Mission for Strategic Knowledge on Climate Change under National Adaptation Fund on Climate Change (NAPCC). Key aspects covered under the project are as follows:

- Economic– The project ensures sustained livelihoods and income of the communities directly dependent on natural resources in the selected Talukas of Kachchh District that are most vulnerable to climate change
- Social–Project activities ensure social capacity building towards climate change resilience
- Sustainable Development–Project ensures natural resource conservation and sustained ecosystem productivity

⁶Ramanathan, A.L.: Sediment characteristics of the Pichavaram mangrove environment, southeast coast of India. Ind. J. Mar. Sci., 26, 319-322 (1997).

Kathiresan, K. and B.L. Bingham: Biology of mangroves and mangrove ecosystems. Adv. Marine Biol., 40, 81-251 (2001).

Panda, D., K. Tripathy, D.K. Patnaik, S.B. Choudhury, R. Gouda and R.C. Panigrahy: Distribution of nutrients in Chilka lake, east coast of India. Ind. J. Mar. Sci., 18, 288 (1989).

Bragadeeswaran, S., M. Rajasegar, M. Srinivasan and U. Kanaga Rajan: Sediment texture and nutrients of Arasalar estuary, Karaikkal, southeast coast of India. J. Environ. Biol., 28, 237-240 (2007).

Choudhury, S.B. and R.C. Panigrahy: Seasonal distribution and behaviour of nutrients in the creek and coastal waters of Gopalpur, east coast of India. Mahasagar-Bull. Nat. Inst. Oceanogr., 24, 81-88 (1991).

<https://www.ncbi.nlm.nih.gov/pubmed/19295072>

- Climate change– Project proposes to prepare baseline climate scenario, assess climate vulnerability and impacts, local traditional knowledge repository of the selected villages vulnerable to climate change.

c. Include climate analysis and vulnerability analysis

The district faces harsh climate (extreme high & low temperatures and low rainfall) drought due to fresh water unavailability. Salinity ingress and saline winds from sea are often cited by farmers as a problem to agriculture. The district also falls in high seismic zone. **Annexure-3 gives out major trends in climatic variables like temperature, rainfall and droughts in the District over the years and also the trend in natural resource based livelihood in agriculture, fisheries and livestock sector in the district.**

Analysis of 100 years shows a 0.5°C increase in mean maximum temperature and 0.5°C decrease in mean minimum temperature in Kachchh District. The average annual rainfall of the District is 373mm and it has witnessed 11 years of severe droughts and 12 years of excessive rains between 1932 and 2010. A total of 10 cyclones associated with heavy rainfall were reported during the span of 20 years between 1990 and 2010, whereas prior to 1990s, only 5 cyclones occurred 1990s within a span of two decades (Gavali, Lakhmapurkar, Vasava, & Deshkar, 2011).

Climate models predict global temperature changes in the range of 0.3°C to 4.8°C and rise in sea levels in the range of 0.26m to 0.81m towards the end of 21st century (2081-2100). These models emphasize the particularly severe impacts of these changes on developing countries including India.

To attribute the temperature and rainfall changes over the last 60 years in India, the IMD undertook an analysis of its observational records from 1951-2010 from 282 surface meteorological stations and 1451 rainfall stations. Out of these, 18 surface meteorological stations and 27 rainfall stations fall in Gujarat. The results reveal the spatial and temporal variations in warming and rainfall changes. This poses a concern for the rain-fed agriculture and water resources of the country⁷. Trends seen in Gujarat (1951-2010) at annual and seasonal levels are given below:

Table 1: Changes in climatic patterns in Gujarat state

	Mean Temperature (°C/year)	Mean Maximum Temperature (°C/year)	Mean Minimum Temperature (°C/year)	Rainfall (mm/year)
Annual	+0.01	+0.01	+0.02	+1.41
Winter	+0.02	+0.01	+0.033	No trend
Summer	+0.01	+0.01	+0.02	-0.03
Monsoon	+0.01	+0.01	+0.01	+1.27

In addition, tropical thorn forest are predominant in Gujarat and especially in Kachchh district, more than 80% of forested grids are expected to undergo changes under the A2 climate change scenario and 50% under the B2 scenario⁸.

⁷ State-Level Climate Change Trends in India; India Meteorological Department, 2013.

⁸ Chaturvedi et al. (2010); Impact of climate change on Indian forests: A dynamic vegetation modelling approach; Mitigation and Adaptation Strategies for Global Change.

Kachchh District

In total, 74 districts of the country have been identified as drought prone⁹. The Kachchh district is one of them, consisting of 9 taluks with a total area of 19476.5 sq. kms¹⁰. From 1932 to 2010 (78 years), 11 years of severe drought conditions and 12 years of excess rains have been observed.

The water resources in the district is dominated by the West-flowing rivers of Kachchh and Saurashtra, which have a catchment area of 321,851 sq kms with an average water resources potential of 15.1 BCM and utilizable potential of 15 BCM¹¹.

In recent times, there has been no significant temperature changes observed in Kachchh. On the other hand, changes in rainfall patterns have been observed. The number of years with excess rainfall have increased in the decade 2001-10; overall rainfall is also above average in the same time-period. These patterns are consistent with regional-level analyses of heavy rainfall and decreasing incidents of drought, thus indicating changes in the overall rainfall patterns in western India¹².

GEER Foundation, in the initial results of the baseline study of coastal ecosystem in Gulf of Kachchh (as part of the baseline data generation for the ICZM project), has interestingly found a slow and steady increase in the average sea surface temperature between 2011 and 2014 at three coastal sites of Kachchh district (Surajbari, Mandvi and Mundra). This very much correlated to loss of livelihood to fishermen, especially those who collect fish by foot (pagadiyas) in the coastal area.

The ecologically important areas identified in the district are the Banni grasslands, the Great and Little Rann, the Narayan Sarovar Wild Life Sanctuary and the coastal and marine ecosystem. Specifically, the increase in average rainfall observed over the past 60 years has benefited the grass diversity in Banni. The productivity of grass like *Dichanthium annulatum* (local name *Jinjvo*) was traditionally observed to be low due to continuing drought conditions. The increase in rainfall has helped increase the productivity of the grass, with corresponding benefits in livestock fodder availability and milk production. Livestock rearing is an important occupation in the district: livestock population increased from 94,097 in 1962 to 1,707,279 in 2007, an 18-fold increase in a span of 45 years.

Agriculture in the district is rain-dependent and it has been that the area under cultivation is directly correlated with rainfall trends in the district. Changes in temperature and rainfall are projected to have significant impacts on the production of fruits, vegetables, medicinal plants as well agricultural crops in Kachchh. Land use data of Kachchh have shown an increase in net sown area from 1975 to 2008. The area under traditional cereal crops reduced to 13% of the total area under cultivation, with a corresponding increase in oilseeds, fodder, vegetables and spices, signifying a shift from traditional crops to cash crops. Socio-economic surveys conducted in the landscape have indicated the increase in insect and pest attacks in horticulture crops. Such changes have been attributed to changes in the climate and other related changes¹³.

⁹ nihroorkee.gov.in/rbis/India_Information/draught.htm

¹⁰ iasri.res.in/agridata/02data%5Cchapter%201%5Cdb2002tb1_8.htm

¹¹ Water and Related Statistics (2015), Central Water Commission.

¹² Trends of Changing Climate and Effects on Eco-Environment of Kachchh District, Gujarat; Gujarat Ecology Commission, 2011.

¹³ Ibid.

The project will therefore make an effort to measure and map climate variables (1990-2015) like temperature, precipitation, humidity, surface and ground water, climate related anomalies (heat strokes, sea level changes, sea storms, extreme weather events etc.) in the selected talukas/villages from reliable secondary sources and undertake monitoring during the project period (2017-2021). These climate variables will be analysed to indicate certain spatial/ temporal trends, correlation with economic productivity of agriculture, fishing and livestock rearing; gradient of climate change effect and vulnerable area in terms of exposure and intensity of climate stress. Sector-wise vulnerability assessment shall also be conducted for the given project locations/clusters based on *the sensitivity and exposure to climate related risks*.

Studies carried out by the Central Research Institute for Dryland Agriculture (CRIDA-ICAR) infer that the inhabitants of Kachchh regions are increasingly vulnerable. In arid regions in western Rajasthan and Gujarat and south-central India in arid districts of Bellary and Anantapur, vegetation cover remained sparse as agriculture is restricted to short window during southwest monsoon period. However the large livestock population contributes to increased vulnerability as fodder availability could be critical in the event of drought.

Study of trend in Max NDVI during 1982-2006 indicates a positive trend in vegetation index in this critical zone. In semi-arid and sub-humid zones which account for large area under rained agriculture, the natural resource base supporting agricultural enterprise is poor owing to shallow soil cover and falling groundwater table, in addition to presence of large number of marginal and small farm holdings that depend on southwest monsoon rainfall for carrying out agricultural operations. Agricultural vulnerability in this zone increases owing to impact of climate variability. (Kaushalya et al, 2014)

Black soil is the most prevalent soil type in the region covering over 10,54,000 ha area which constitutes 53.8% of the total area. Sandy soils and hydromorphic soils are other major soil types in the region covering 41.6% and 4.5% of the total area, respectively. Most of the area is rainfed, due to which only one crop is taken in more than 90% of the total agricultural land (**Table 2** below).

Table 2: Net sown area in Kachchh District (for 2013)

Agricultural land-use	Area ('000 ha)	Cropping intensity %
Net sown area	680	107
Area sown more than once	48	
Gross cropped area	728	

Source: CGWB, 2013

Further corroborating this is the fact that with a net irrigated area of only 178,000 ha, the agriculture in the district is largely rain-fed (502,000ha).

Table 3: Source of irrigation in Kachchh District

Sources of irrigation	Number	Area ('000 ha)	% of total irrigated area
Canals		132.1	38.7
Tanks	2608		

Open wells	28664	194.3	56.9
Bore wells	219	14.8	4.4
Lift irrigation schemes	-	-	-
Micro-irrigation	-	-	-
Total irrigated area		341.2	
Pump sets	33273		

The fact that agriculture in Kachchh is vulnerable can be seen in the thematic maps given below.

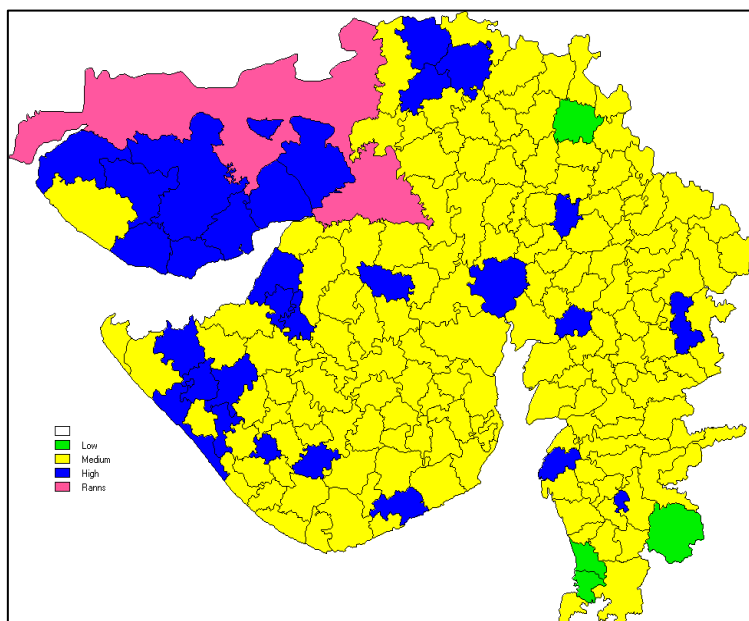


Figure 2: Drought Value Index of districts of Gujarat

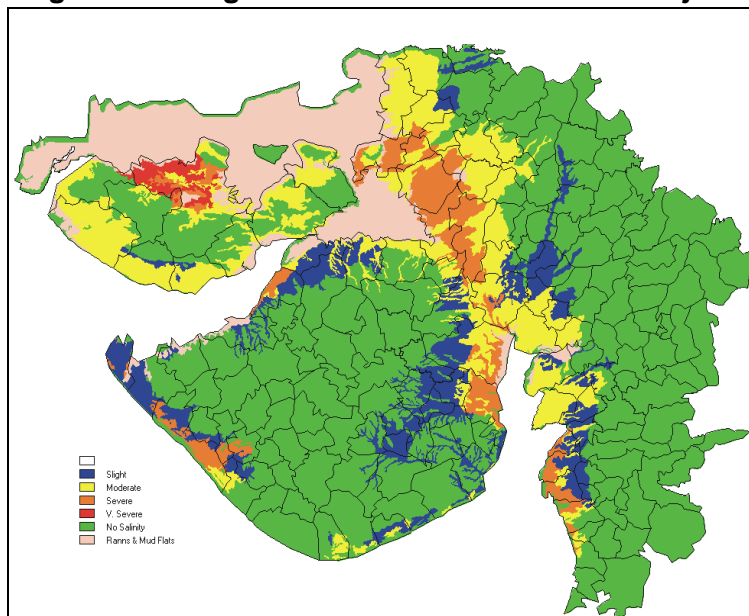


Figure 3: Soil salinity index of talukas of Gujarat

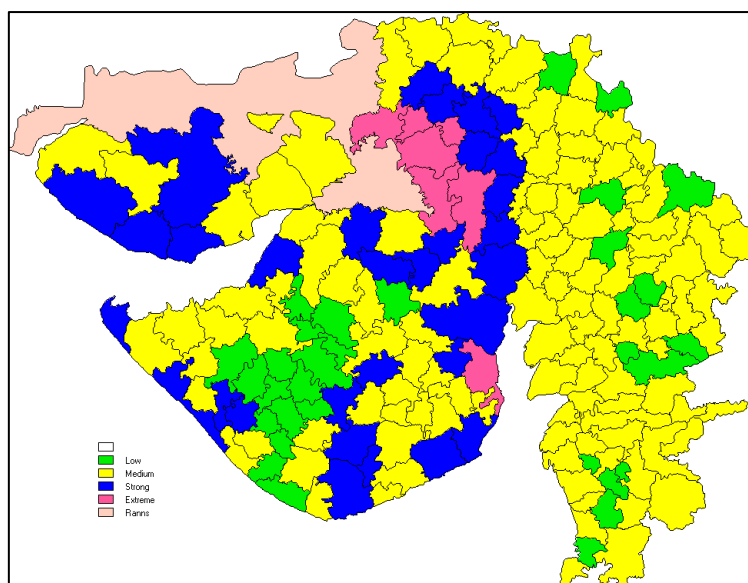


Figure 4: Soil degradation index

The Kachchh region is largely vulnerable to the following aberrations in climate:

- Drought
- Unusual/unseasonal rains
- Extreme events like heat waves and cyclones.

Low rainfall largely affects farmers practicing rainfed agriculture. The quality of soils in the region also gets affected due to drought and unseasonal rains.

- Black Soils of Abdasa, Mandvi, Nakhatrana, Bhuj,
- Sandy Soils of Rapar, Bhachau, Anjar, Lakhpata, Gandhidham, and
- Hydromorphic Soils of Mundra

The farmers using irrigation are generally affected by:

- Delayed release of water in canals due to low rainfall,
- Non-release of water in canals under delayed onset of monsoon in catchment,
- Lack of inflows into tanks due to insufficient/delayed onset of monsoon,
- Insufficient groundwater recharge due to low rainfall.

Continuous erratic rainfall with high speed winds in a short span leads to water logging and eventually flooding. Unseasonal rains also result in outbreak of pests and diseases. Moreover, the livestock in the region is affected by drought, feed and fodder availability, drinking water availability, health and disease mismanagement, and heat wave. The vulnerability of the coastal farmers can be seen through how climate change affects the fishery sector in the district.

Drought

Fish-catch is affected due to:

- Changes in water quality and temperature, especially in shallow regions.

Aquaculture is affected due to:

- Shallow water in ponds due to insufficient rains/inflow
- Impact of salt load build-up in ponds/ change in water quality

Floods

- Infrastructure damage (Boats, houses, pumps, aerators, etc.)

- Loss of stock
- Change in water quality
- Health and diseases
- Aquaculture (change in freshwater-brackish water ratio)

Degradation of land is visible in agricultural land as well as grasslands; which can be seen in the maps given below:

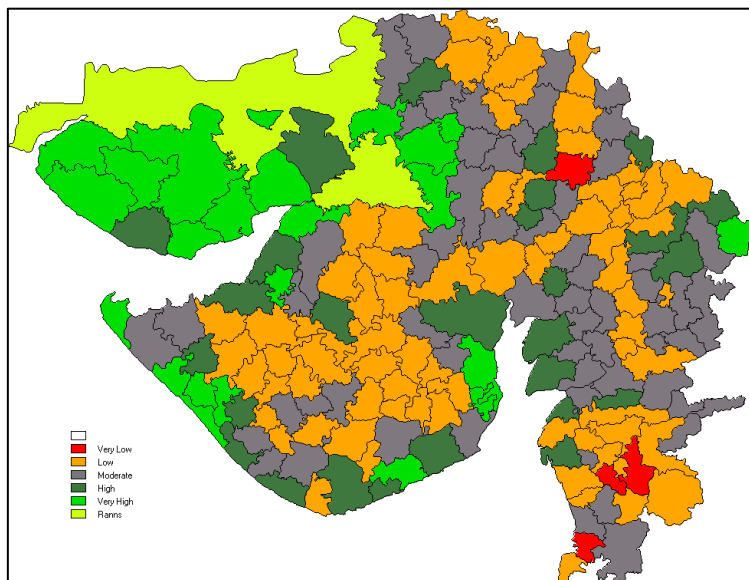


Figure 5: Land degradation index

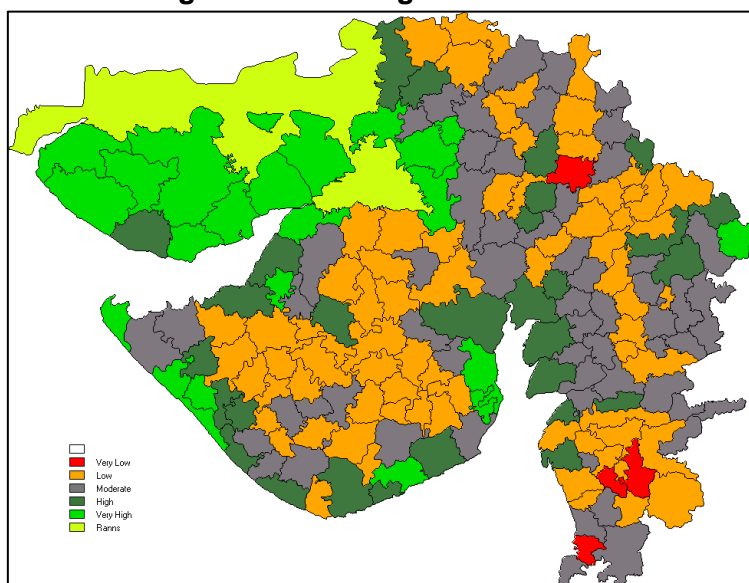


Figure 6: Land degradation risk map

Apart from these pressures, Kachchh region also has one of the highest grazing pressures for any district in Gujarat.

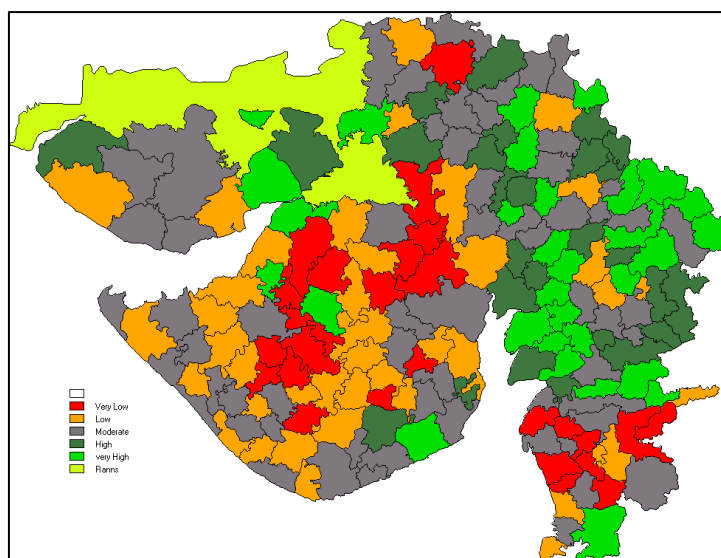


Figure 7: Grazing pressure index

d. Project Location details – villages, block/ mandal, district

Kachchh district is the largest district of India. Spread across 23.27% of total geographical area of Gujarat State, it is bigger than countries like Bhutan and Switzerland and Indian states like Haryana and Kerala. Kachchh also has the longest coastline of 406 km among all districts in India. However population density of 46 persons per sq. km. (Census, 2011) is the lowest for any district in Gujarat. The Kachchh region is one of the rare ecological zones in the world having a rich bio-diversity. It comprises of mangroves, coral reefs, mudflats, seaweeds, commercial fishes and several rare marine species. A prominent feature of the Kachchh coast is the vast intertidal zone comprising a network of creeks, estuaries and mudflats. The coast of Kachchh provides conducive environment for several sea based traditional occupations like fishing, sea-weed/prawn culture, salt making apart from land based occupations like agriculture, livestock rearing and breeding, handicrafts etc. Industrialization post-earthquake has made mineral mining and industrial sector as another important economic sector in the district.

The project activities are proposed to be implemented in the Kachchh district, Gujarat. Based on socio-economic and vulnerability assessment due to climate change of the district, project will be implemented as per the following details: (Maps of the identified project locations is given in **Annexure-2**).

- i. 10 villages in Khadir Betin Bachua taluka-for agricultural communities.*
- ii. 10 villages in Abdasa taluka-for coastal fishing communities.*
- iii. 12 wands (hamlets) in Banni grassland in Bhuj Taluka-for pastoral communities.*

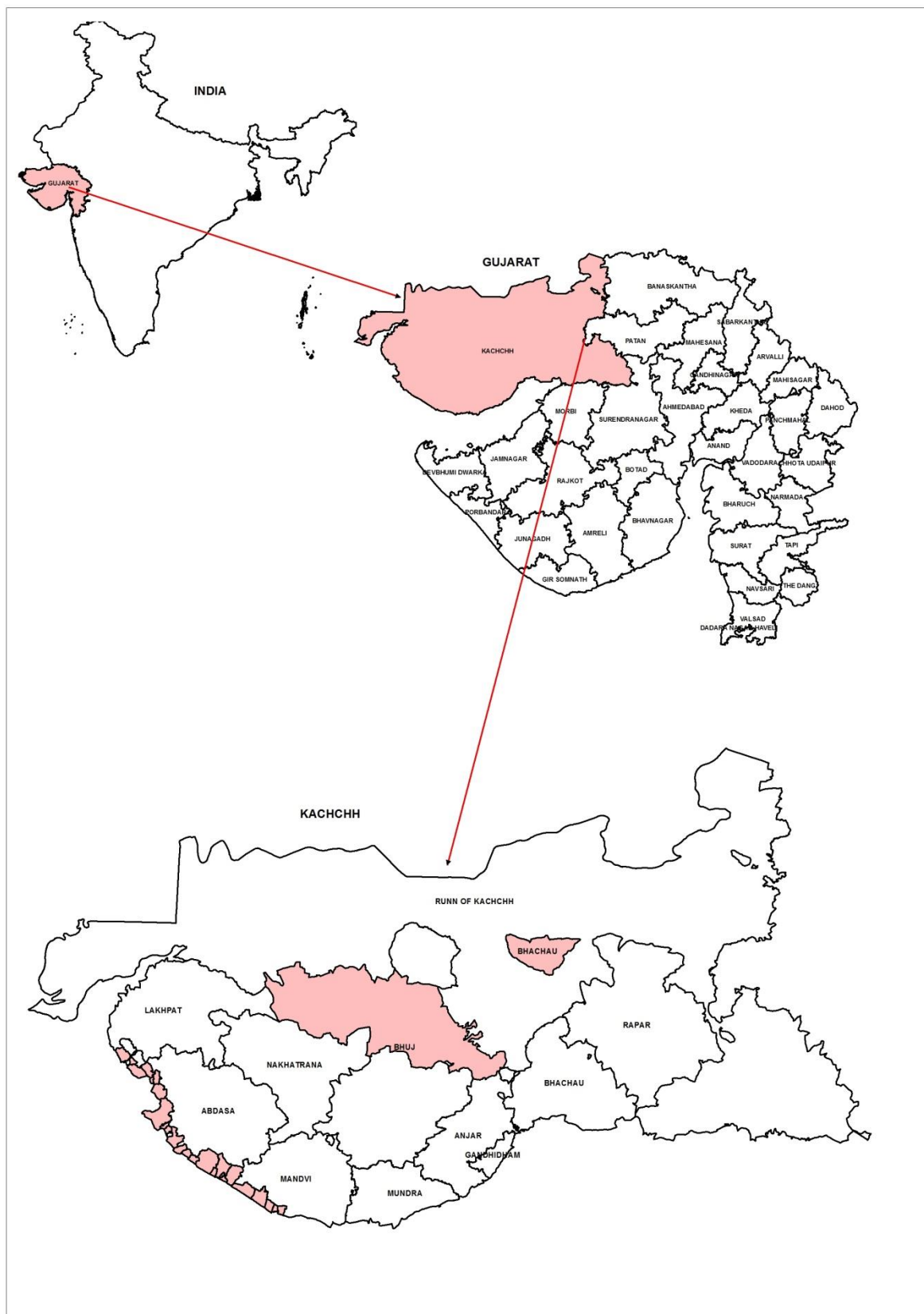


Figure 8: Project Location Map and Identified Zones for NRD Communities



Figure 9: Goole Earth Image of Kachchh District

Agricultural zone:

Khadir bet is an island completely surrounded by the Great Rann of Kachchh, and thus the 10 villages in Khadir are among the most vulnerable agricultural communities in the district. The nearest town with medical facility and higher education is Rapar. Regions where the ratio of the mean annual precipitation to the mean annual evapo-transpiration is in the range of 0.05-0.65. CCD considers arid, semi-arid and dry sub-humid regions as dryland. The hyper-arid region, where the P/PE ratio is less than 0.05, forms the arid deserts, of which Rann is an example. The Köppen-Geiger climate classification for Khadir Bet is BWh. Desert/Arid climate (in the Köppen climate classification BWh and BWk, sometimes also BWn), also known as an arid climate, is a climate that does not meet the criteria to be classified as a polar climate, and in which precipitation is too low to sustain any vegetation at all, or at most a very scanty shrub.

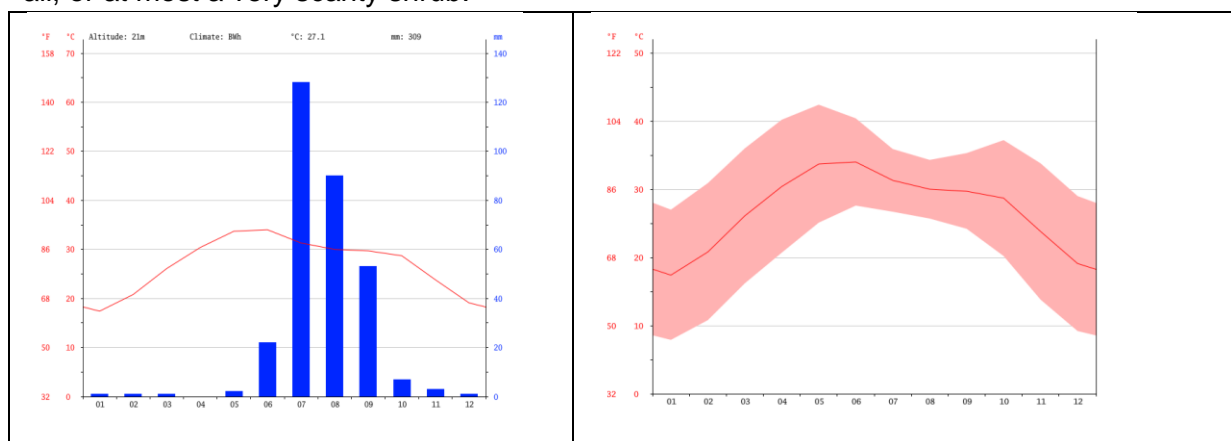
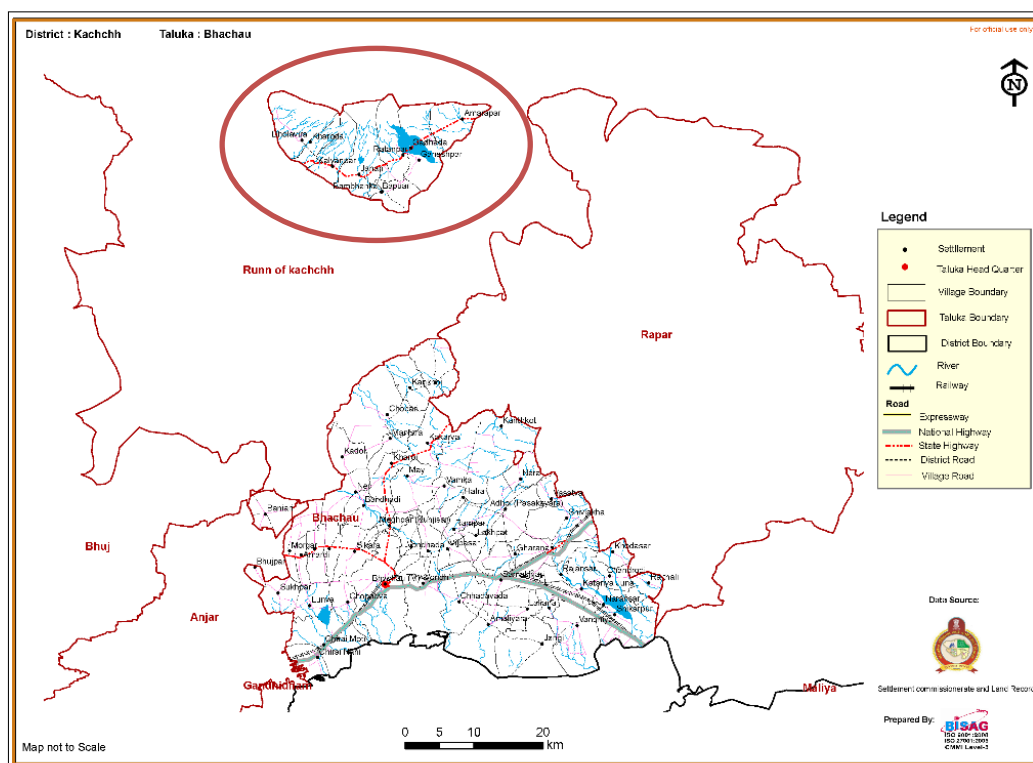


Figure 10: Rainfall and temperature recorded at Dholavira village at Khadir Bet

Rain runoff into GRK happens quickly, and there is little percolation. Some check dams and percolation ponds have now been constructed which helps in retaining water for some more time. But interventions such as bhungroo will be of immense help in ensuring quicker refill of rain water. Also by choosing such a region for deploying interventions it is assured that interventions are focussed on one region, which can also result in positive multiplier effect, and quicker success of such interventions.



**Figure 11: Khadir bet in Bachau Taluka (Agricultural zone) – inside the circle
Coastal zone:**

Interventions planned in the coastal zone include seaweed farming, polyculture and mangrove restoration. All these activities will be carried out in Abdasa taluka.

Site Selection Criteria for Seaweed Culture:

Good site selection will reduce the capital investment and increase the success by good yield of seaweed. Site selection depends on many of the following criteria.

1. Chosen sites should have adequate water motion that helps to clean the plants replenish oxygen within the rafts.
2. Sites should not have any fouling organisms since that can wrap on seaweeds and reduce photosynthesis.
3. The selected sites do not have vigorous hydraulic forces, fast moving water and severe wind actions.
4. The chosen sites should protect from the weather and sea conditions.
5. Secure from human inference (e.g. pilferage, vandalism and accidental damage from boats).
6. The selected site should have suitable depth of at least 2 m during low tide.
7. The site should have appropriate water motion for seaweed culture; usually seaweed can grow fast in moving water. Water motion helps to clean the plants, bring fresh nutrients, removes metabolites and stimulating plant growth.
8. Presence of less fouling faunal composition, it indirectly shows that site is suitable for

seaweed culture. Usually the fouling flora can grow over the culturing plants as well as on the rope. Fouling fauna may cause extensive damage to growing parts of the seaweeds by merely clipping them with their chelipeds as they crawl about amongst the seaweeds.

- The culture sites should be located slightly far from fish landing centre, therefore the vessel movement might be less and it may not disturb the culture activities.

Site Selection Criteria for Polyculture:

- The selected sites should have adequate sunshine throughout the year, it is ideal for polyculture.
- The chosen sites should protect from flooding, vigorous hydraulic forces and severe wind actions.
- The selected sites should be located far from population centers and free from possible impact of inland water discharges especially agricultural pesticides and domestic or industrial waste.
- Site should accessible to both land and water transport for fast and convenient delivery of supplies and marketing of culturing species.
- The chosen sites should be located at some distance from navigation routes as waves created from the wake of passing vessels may pose physical damage to cage structures.
- The sites should be a creek or estuarine system, which should have at least 3 m depth at the lowest low tide.

Based on the above said characteristics the following sites are selected in Abdasa for seaweed culture and polyculture study.

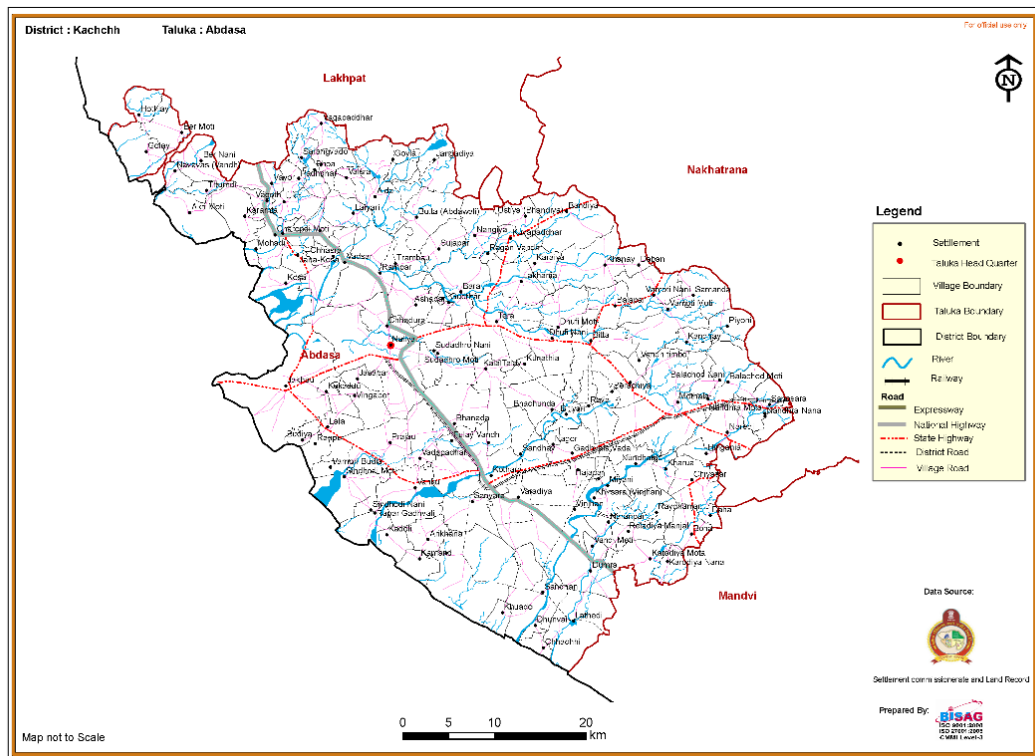


Figure 12: Abdasa Taluka (Coastal Fishing zone)

The specific sites selected in Abdasa taluka for seaweed cultivation and polyculture are given below:

- Near Sanghi Jetty/Port:

Coordinates: 23° 23' 17.0" N, 68° 33' 24.2" E

This site is located towards north direction from Sanghi Jetty, and opposite to Vankal Kripa Hotel. This site is easy to approach from the inland that has a wide creek system, and boat activities are absent. Akri is the nearest village from this site. This site is suitable for both seaweed culture and polyculture.

b) Near Ultra-Tech Cements Jetty:

Coordinates: 23° 20' 14.6" N, 68° 37' 15.5" E

This creek is located opposite to Ultra-Tech Cement's Jetty, i.e. towards the north direction from the Jetty. The nearest Village is Mohadi. This site is also suitable for both seaweed culture and polyculture.

c) Opposite to Jakhau Harbor

Coordinates: 23° 15' 17.8" N, 68° 36' 53.0" E

This creek system is located in front of Jakhau fish landing centre and it has a good depth. The nearest village is Jakhau Bundar & Asirawandh. This site is suitable for polyculture and seaweed culture.

d) Near Jakhau Salts (Towards West)

Coordinates: 23° 11' 06.4" N, 68° 37' 53.5" E

The site is located behind the Jakhau salt works towards the sea. The nearest village is Jakhau Bundar and Asirawandh. This site is suitable for seaweed culture.

e) Asirawandh (Opposite to Coast Guard Station)

Coordinates: 23° 11' 06.4" N, 68° 37' 53.5" E

This site is located opposite to the Coast Guard station. The nearest village is Asirawandh.

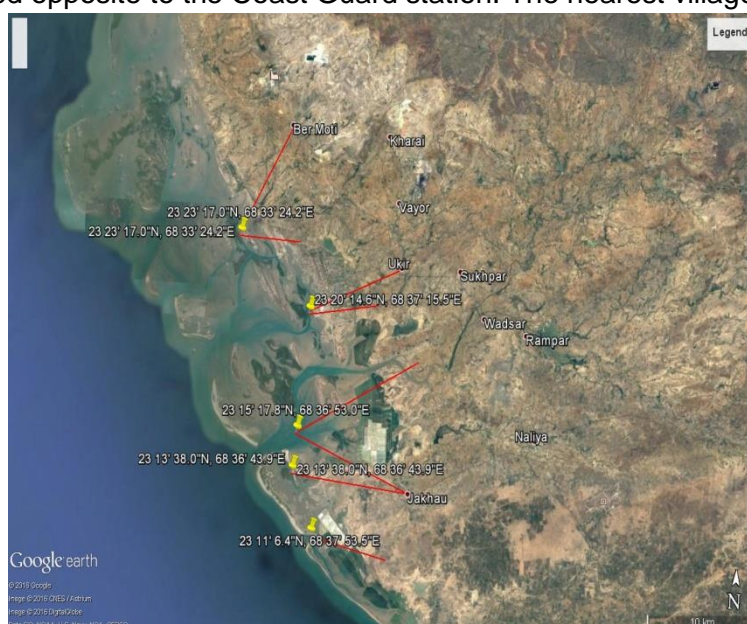


Figure 13: Asirawandh site

f) Nana Layza Creek

The Nana layza village is located 2 km distance from the culture site. This site is suitable for seaweed culture based on the following criteria. This site is mud mixed sandy shore, because the water turbulence is less than other sites that would helps for photosynthesis. The site has suitable water motion for seaweed culture; usually seaweed can grow fast in

moving water. Water motion helps to clean the plants, bring fresh nutrients, removes metabolites and stimulating plant growth.

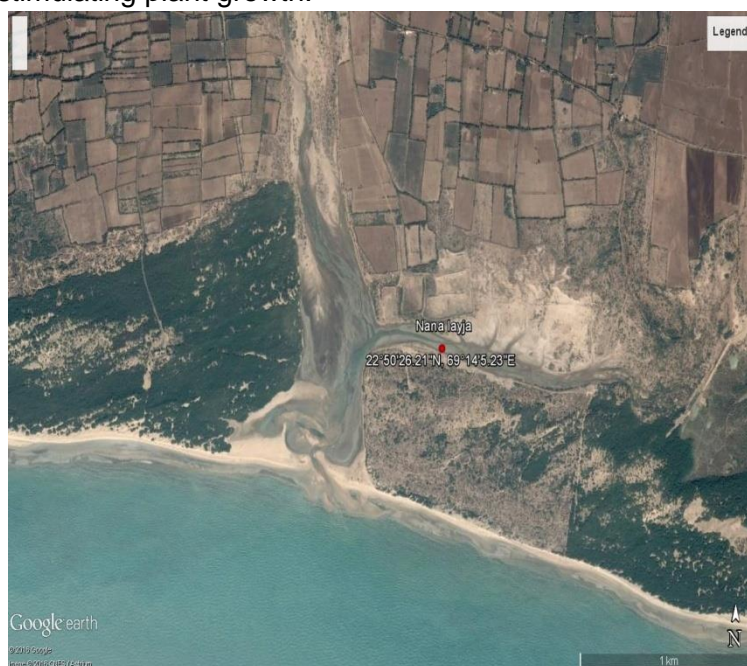


Figure 14: Nana Layza Creek

Panchotiya

The site falls under open sea. However, looking of the site suitability, site is appropriate for seaweed farming. Fishing community is absent in this village. Even though, selected site is sandy in nature, very clear water that may provide optimal amounts of photosynthetic active radiation is undoubtedly as essential for seaweed.

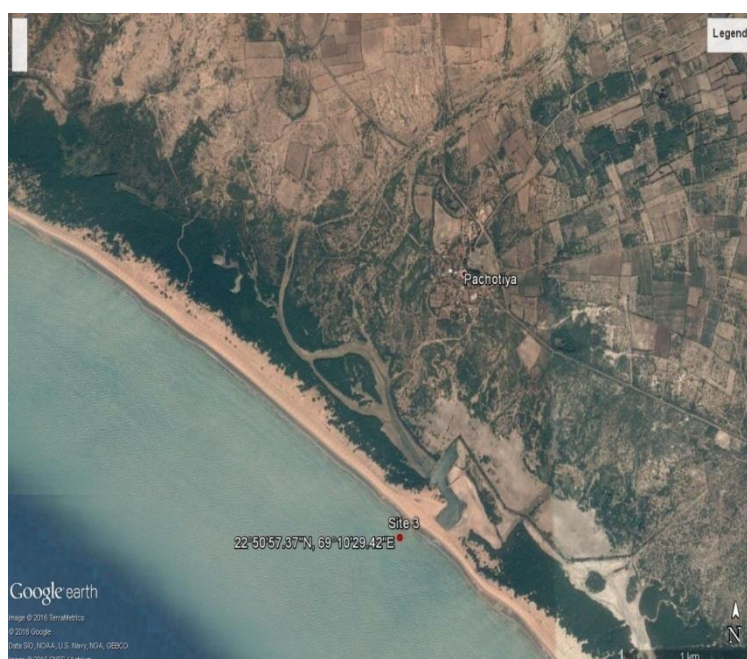


Figure 15: Panchotiya site

Mangrove restoration site will be selected on multiple criteria such as extreme degradation, proximity to community etc. The area will be selected from the existing mangrove patches which has already been mapped.

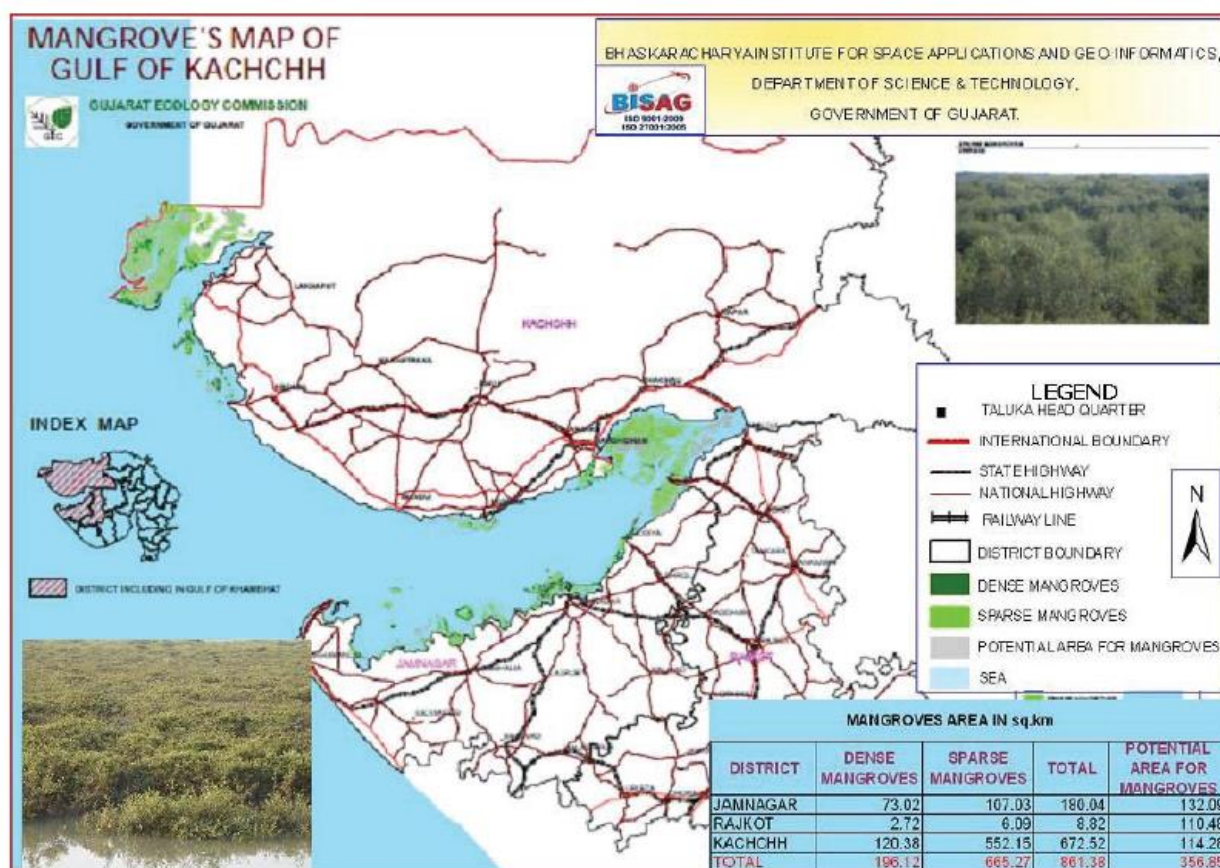


Figure 16: Mangroves in the coastal districts of Gujarat (source: Patel A. et. al, 2014)

Pastoral zone:

Kachchh district in the state of Gujarat is characterized by vast stretches of saline desert (Great Rann of Kachchh and Little Rann of Kachchh), salt marshes and patches of grasslands encompassing an area of 5,078 km². Among the grasslands, Banni (2,617 km²) and Naliya are important due to its vast extend. The grasslands in Kachchh district are popularly known as 'Banni' which are spread over an area of ca. 2,618 km² and account for about 5.73% of the geographical area in the district. Flanked by Greater Rann of Kachchh in the north, Banni represent the largest stretches of contiguous grasslands in India. The word 'Banni' is derived from Kachchhi dialect, '*Banna*', which means newly made, signifying the land that has been formed by detritus and sediments brought down by the rivers such as Indus, Luni, Banas and Saraswati, which in recent geological past, flowed through this area from the north and the east (Kadikar, 1994). Banni region has a very fascinating history, geography, biodiversity and culture, which is one of the reasons for selecting this area to be one of the sites under the NAFCC project.

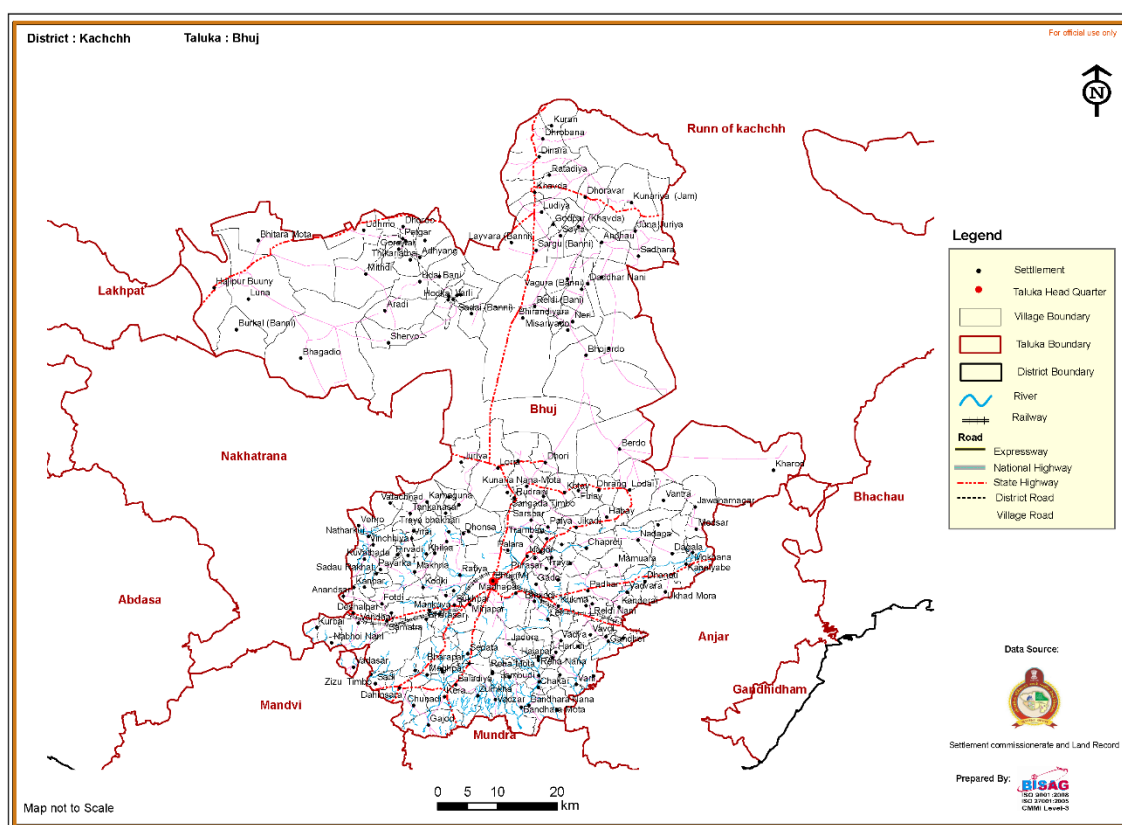


Figure 17: Banni in Bhuj taluka (Pastoral zone)

Altogether, 13 different communities inhabit the area (commonly known as *Maldharis*) who reside in 48 villages. Many 'wand', each consisting of 15-20 households, join together to form villages and 2 to 4 villages join together to form panchayats. There is a traditional form of human-livestock-grassland interaction, which is still predominant in Banni. *Maldharis* have inherited traditional fresh water harvesting system known as *Virda*, traditional knowledge of medicinal plants and breeding drought tolerant highly productive livestock.

Table 4: Fodder demand on Banni grasslands for the last 50 years

Year	Human Population (Lakhs)	Year	Livestock Population (Lakhs)	Livestock – ACU (Lakhs)	Fodder Demand (Per Day)
1961	6.96	1962	9.40	6.64	4648 Tones
1971	8.50	1982	16.51	7.72	
1991	12.6	1997	16.57	6.48	
2001	15.83	2002	15.73	9.09	
2011	20.90	2007	17.07	9.48	6639 Tones

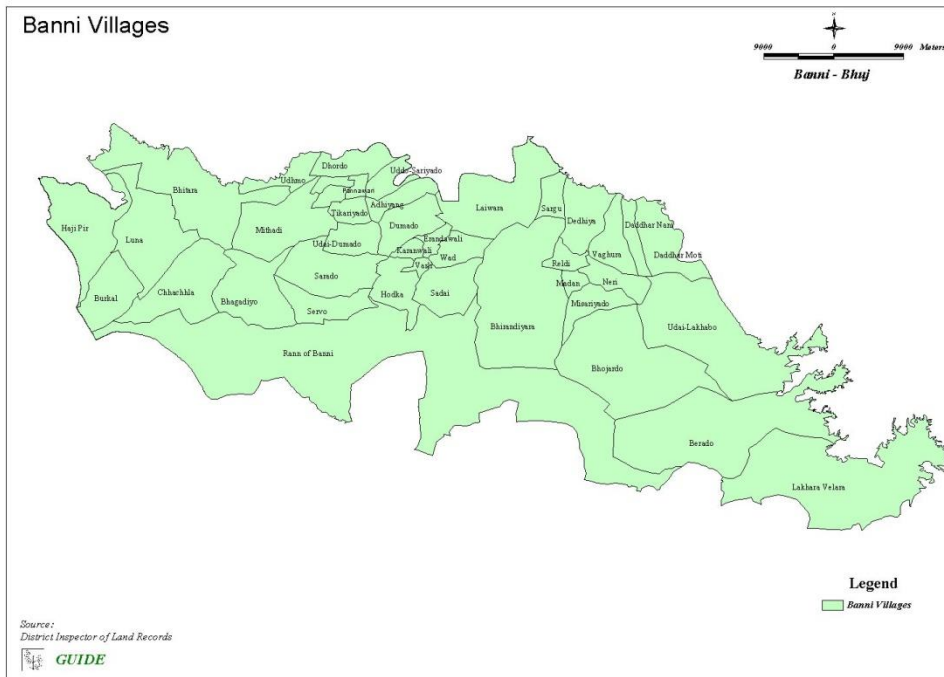


Figure 18: Banni grassland reserve (Protected Forest) with the villages

Banni was traditionally a cattle breeding tract. The herders, especially the *Maldharis* of the area keep animals of superior breeds, supplying them to various parts of the state and even to other neighbouring states. During recent decades, due to establishment of milk cooperative societies, the people of Banni are inclined towards selling milk and keeping the animals as means for dairy farming. The Livestock of Banni area include cattle, buffaloes, sheep, goats, horses, donkeys and camel. There are two breeds of cattle, viz., Kankrej and Gir, of which Kankrej is the heaviest breeds of the Indian cattle and known for excellent drought resistance capacity. 12 wands (hamlets), preferably in 3 clusters from the Banni region will be selected for interventions in grasslands.

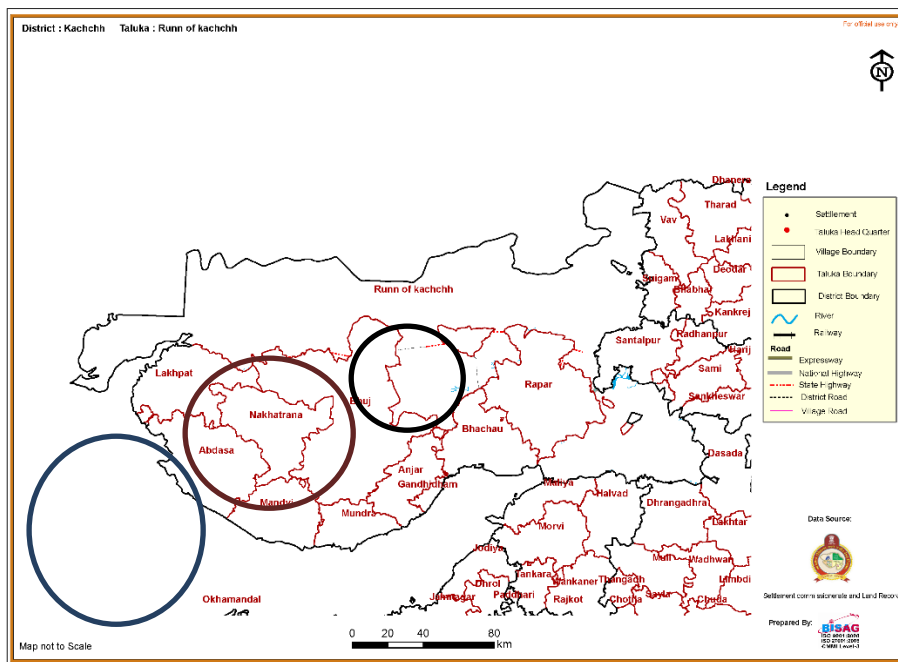


Figure 19: All the three zones in Kachchh district, coastal, pastoral and agricultural in that order from left to right

A detailed map is given in Annexure 2 to this report detailing all the project locations.

e. Demographic details of the population – total population (for area in operation), sex- disintegrated data, small and marginal, etc.

A demographic detail of the selected Talukas as well as the other Talukas of Kachchh District is given in Annexure-4. It includes inhabited villages, population, number of households, gender ratio, main workers and marginal workers under industrial categories of cultivators, agricultural labourers, households industry workers and other workers as per the Census 2011. These demographic details indicate an average of 46 persons per sq. km. in the district with a total of 924 villages (of which 877 are inhabited) in 10 Talukas. Working population is 38% of the total population in the District, of which 33% are main workers and 5% are marginal workers. Amongst the main workers, 47.4% are occupied in agricultural activities, whereas 51.5% are involved in other works such as fishing, industrial labours livestock rearing etc. The village level data of the agricultural zone is given below:

Table 5: Demographic details of Khadir Bet (Agricultural zone)

Village Name	Total Households	Total Population of Village	Main cultivator population	Main Agricultural Labourers Population Person	Marginal Cultivator Population Person	Marginal Agriculture Labourers Population Person
Dholavira	422	2222	252	94	25	477
Kharoda	69	388	21	37	27	121
Kalyanpar	276	1363	210	53	13	275
Janan	234	1043	87	89	19	43
Ratanpar	203	989	144	31	0	36
Gadhada	118	528	88	124	0	3
Amarapar	156	688	97	82	0	1
Ganeshpar	239	1144	310	0	341	0
Bambhanka	154	829	123	130	0	0
TOTAL	1871	9194	1332	640	425	956

Source: Kachchh District Census Handbook, Census 2011

1.2 Project / Programme Objectives:

The proposed project activities aim to enhance the adaptive capacity of natural resource dependent communities (Agriculture, Coastal Fishing and Pastoral communities) to climate change in targeted villages of Kachchh district, Gujarat. The project objective will be fulfilled by undertaking the following activities:

- **Baseline data collection and vulnerability assessment** of selected villages/Talukas for understanding climatic and socio-economic scenario through secondary sources as well as various sample surveys, Participatory Rural Appraisal (PRA)/Focused Group Discussion (FGD) etc.
- **Enhancing capacities for implementing climate change adaptation activities** for ensuring the implementation of the proposed interventions in a scientific manner and the continuation of implementation of those activities once the project concludes.

- **Undertake concrete locally appropriate and cost-effective adaptation interventions that are sector/ community specific in the selected villages** (*listed in 2a ii*). This activity will be implemented through active participation and co-financing from various partner departments and organisations.
- **Knowledge management and mainstreaming** so as to help the local communities in coping up with changes in climate (especially including indigenous groups and women groups) on climate change adaptation. This will also ensure continuity of the activities after the project duration ends.

1.3 Details of Project/ Programme Executing Entity:

a. **Name**– Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar, Gujarat

RegistrationNo. & Date:No. Guj/50/Gandhinagar of the Asst. Registrar of Societies Registration, Ahmedabad Division dated 24-11-1982

Registered Address – Indroda Nature Park, P. O. Sector-7, Gandhinagar – 382007

Project Office Address - Indroda Nature Park, P. O. Sector-7, Gandhinagar – 382007

b. **Available technical manpower for the proposed project implementation:**

The Foundation has a project based team of more than 30 technical staff engaged on contract basis. They have diverse areas of expertise and experience. It has full time managers (cum project coordinators), ornithologists, wetland ecologists, forest ecologist, wild life ecologists, botanists, zoologists, entomologist, environmental scientists, natural resources scientists and researchers with proficiency in climate change.

c. **Three largest Climate Change Adaptation Projects handled** (if already implemented)

Table 6 highlights the largest climate change adaptation projects handled by the Executing Entity.

Table 6: CCA projects handled by Executive Entity

Project	Objectives & geo. Coverage	Amount sanctioned (INR in lakhs)	Funding Agency	Geographical coverage	Implementation Period & Outcome
Regional Climate Variability and Disaster Patterns in wake of Climate Change – Case of Gujarat State	1. Analyze the long term climate variability and change in the state of Gujarat. 2. Understanding and interpreting the relationship between climate variables and natural disasters in the state of Gujarat. 3. Attempt a baseline vulnerability assessment of the state to natural disasters.	20	DoFE, GoG	Entire Gujarat State	Oct 2010 – 2013
Carbon sequestration potential of Forests, trees outside forests, mangroves and coral reefs of Gujarat	To survey, analyse and estimate the carbon storage potential of natural ecosystems in Gujarat viz. forest areas, trees outside forests, mangroves and coral reefs of Gujarat.	71.5	DoFE, GOG	Entire Gujarat State	Jan 2010 – 2015
Sensitize Rural communities towards Climate change, its causes & impacts, mitigation and adaptation through Radio show “Dharti-nu-Jatan”	Spread the awareness among the local communities of Gujarat (<i>especially the rural audience</i>), through expert radio talks, on climate change, global warming and its various impacts on different ecosystem elements and human activities, and ways to tackle these climate related problems	10.4	DoFE, GoG	Entire Gujarat State was covered through All India Radio	March 2010 – 2012

d. Three large community based NRM based projects handled –

- i. Integrated Watershed Management Programme (IWMP-9) for Anjar Taluka, Kachchh district (2011-16) – INR 1,078 Lakhs (GUIDE, Bhuj)
- ii. Socio-economic mapping (as part of Conservation Mapping) of Little Rann of Kachchh Landscape under BCRLIP of the MoEF&CC and the World Bank. Project funded by the BCRLIP Society, Gandhinagar under the central grants of the World Bank – INR 115 Lakhs
- iii. Ecological Significance of Forests and Economic Dependence of local communities in Junagadh, Vadodara, Surat and Valsad Forest Circles in Gujarat. Project funded by the Gujarat Forest Department– INR 49 Lakhs

e. Three large Climate Change Adaptation / NRM projects of State / Central Government

- i. A large scale umbrella project on Climate Change Research, Trainings and Public Awareness in Gujarat funded by the Department of Forests and Environment, GoG with a total grant of Rs. 273 Lakhs
- ii. Integrated Grassland Development in Banni Kachchh District, Gujarat– INR 664 Lakhs (By GUIDE, Bhuj)
- iii. Watershed Development Project in Mundra (4 villages) and Bhuj (3 villages) Talukas, Kachchh, Gujarat – INR 227.24 Lakhs (By GUIDE, Bhuj)

f. Comment of availability of suitable infrastructure for implementation proposed projects (vehicles, computers, required software/ tools, etc.)

- The Foundation has three dedicated four-wheel vehicles and three motor-bikes for field purposes. In need of more vehicles to meet the field requirements, it hires vehicles based on an annual contract with a third party.
- The Foundation has more than 40 operational computers with internet connectivity and printing / scanning facilities and more than 8 laptops that the technical staff use for project works.
- The Foundation has a dedicated GIS Cell/ Lab, with software like ERDAS Imagine, I-GIS, Arc-GIS, ARC View, Geo-Media, MGE Modules and hardware like Plotters, scanner, printers and high configuration systems with graphics.
- The Foundation also has a well-equipped and dedicated Scientific Laboratory, to facilitate experimental research, with capacity to analyse environmental-physicochemical parameters of water, soil and air samples, bio-chemical analysis of different plant species, taxonomic identification (plants and animals) and microbial studies including identification and quantitative studies.
- GEER Foundation also has a specialized Library consisting of more than 2000 books on diverse subject like Ecology, Insect, Birds, Environmental Science, Wildlife, Botany, Remote Sensing, Marine Biodiversity, Zoology, Ecological Conservation, Climate Change etc. It also has 150 reference books and more than 200 reports on various subject and CDs. The library is computerized using CDSISIS library software. It also has a good number of subscriptions to a number of scientific journals and magazines.
- It is also equipped with an audio-visual Studio for recording, editing and broadcasting radio programs and for developing scientific and educational video documentaries on various themes of nature, biodiversity, environment and climate change.

g. Whether Executing Entity (EE) was blacklisted, barred from implementation of projects, faced any charges / legal cases related to mismanagement of project and funds. (please list any such incidences and reasons):

Not Applicable

1.4 Project / Programme Components and Financing:

Fill in the table presenting the relationships among project components, activities, expected concrete outputs, and the corresponding budgets.

Project/ Programme Components	Expected Concrete Outputs	Expected outcomes	Amount (INR)
<p>1a.. Baseline Survey – climatic and socio-economic parameters and Scenario building – for villages in the identified Zones of Kachchh</p> <p>1.b. Vulnerability and Impact Assessment (economic losses due to erratic climate and related events) – for villages in identified zones of Kachchh</p>	<ul style="list-style-type: none"> • Baseline data on key climatic and social parameters for the identified villages and communities. • 10 villages from agricultural community, 10 from coastal fishing community and 12 wands from the Banni region (pastoral community) will be covered • Vulnerability index based on sensitivity and exposure will be developed • Impacts on account of loss in resource productivity, income, livelihood, etc. will be identified. 	<ul style="list-style-type: none"> • Correlation between climatic and socio-economic parameters for key natural resource dependent communities in identified locations is established. • Risks, vulnerability and impacts of climatic changes on socio-economic settings of the key natural resource dependent communities of Kachchh is assessed. • Selection of beneficiaries in agricultural zone for bhungroo and drip irrigation, households in coastal region for seaweed farming and polyculture, selection of villages (wands) in the Banni region (pastoral zone) 	<p>65,43,600</p>

Project/ Programme Components	Expected Concrete Outputs	Expected outcomes	Amount (INR)																					
2. Capacity building of communities on EbA & CbA interventions	<ul style="list-style-type: none"> • Capacity building of community for enhancing knowledge, skills, and climate resilient agriculture methods. • 24 trainings will be training / focussed workshops for those who specifically are the beneficiaries and will be directly involved in the intervention actions. Champions who will take forward the climate resilient actions will also be a part of these ToB/ workshops. • 57 trainings will be on public awareness and skill development in general. <p>Details of trainings per intervention activity is given below:</p> <table border="1" data-bbox="400 1048 852 1727"> <thead> <tr> <th>Intervention activity</th> <th>No. of ToB, works hops</th> <th>No. of open trainings</th> </tr> </thead> <tbody> <tr> <td>Water Recharge Units (Bhungroo)</td> <td>3</td> <td>12</td> </tr> <tr> <td>Mangrove restoration</td> <td>3</td> <td>10</td> </tr> <tr> <td>Seaweed & Poly culture</td> <td>6</td> <td>10</td> </tr> <tr> <td>Grassland restoration</td> <td>6</td> <td>15</td> </tr> <tr> <td>Climate resilient agriculture*</td> <td>6</td> <td>10</td> </tr> <tr> <td>Total</td> <td>24</td> <td>57</td> </tr> </tbody> </table>	Intervention activity	No. of ToB, works hops	No. of open trainings	Water Recharge Units (Bhungroo)	3	12	Mangrove restoration	3	10	Seaweed & Poly culture	6	10	Grassland restoration	6	15	Climate resilient agriculture*	6	10	Total	24	57	<ul style="list-style-type: none"> • Atleast 4020 local communities will be trained on EbA and CbA through this capacity building exercise • Communities will be trained for the successful implementation of the practices even after the conclusion of the project. • Trainers will also be able to mobilise more young farmers/fishermen/ maldharies/ local entrepreneurs for the implementation of practices. • Preparing brochures on interventions for effective outreach and replication in other districts etc. • Publishing a vernacular magazine on the various success stories of the project • Developing audio-visual documentaries • Community mobilization through effective PR, advertising and community involvement exercises • Publishing project reports and value-added dissemination 	1,06,59,000.00
Intervention activity	No. of ToB, works hops	No. of open trainings																						
Water Recharge Units (Bhungroo)	3	12																						
Mangrove restoration	3	10																						
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Climate resilient agriculture*	6	10																						
Total	24	57																						

Project/ Programme Components	Expected Concrete Outputs	Expected outcomes	Amount (INR)
3. Implementation of Climate Change Adaptation for the identified communities for water security, livelihood security, enhancing climate resilience and ecosystem restoration	Locally appropriate, sustainable and low cost concrete adaptation interventions (highlighted under 2a(ii)) will be deployed in the selected villages. 10 community based adaptation interventions (CbA), 3 ecosystem based adaptation (EbA) interventions have been planned under this project- 5 each for agricultural and coastal communities, and 3 for the pastoral communities.	<p>Ensure livelihood and water security of the marginal natural resource dependent communities in the project locations. This includes:</p> <ul style="list-style-type: none"> • Water security by managing water at supply and demand side: At least 30 units of 'Bhungroo' will be constructed in agricultural zone and 2 in coastal region. 800 ha of agricultural land in the identified zone will be brought under drip irrigation. 100 solar water [pumps also shall be installed by giving 10% seed money (the rest 90% coming as subsidy)]. 200 units of bio-energy systems for bio-char preparation for soil health and fertility, and alternate income enhancement through livestock rearing. Extension and capacity building of communities to handhold farmers in using these technologies / measures will also be provided. • 200 fodder kits each will be distributed each year (800 total) to promote fodder cultivation for livestock to overcome fodder shortage and reduce dependence on grasslands and mangroves. • Alternate livelihood option for 450 families through seaweed cultivation and 150 	18,41,24,248.00

Project/ Programme Components	Expected Concrete Outputs	Expected outcomes	Amount (INR)
		<p>families through polyculture in 10 villages in coastal area.</p> <ul style="list-style-type: none"> • Water security in coastal and pastoral villages through feasibility study and appropriate intervention to enhance water recharge in existing structures • Deployment of 10 automatic weather stations at coastal areas for database generation and inputs for early warning system • Restoration of highly degraded mangroves in coastal region, which has multiple benefits for community-better catch of fish near shoreline, better catch of crustaceans (such as crabs and prawns), protection during extreme climatic event such as sea surge and cyclones. Finally, can be used as mangroves fodder under extreme incidents of unavailability from other sources. • Restoration of grassland in 500 ha of Banni region, where conservation of 50 ha each will be overseen by one wand (hamlet). • 100 ha of grassland will be developed as seedbank of indigenous grass varieties • Skill building of women artisans in pastoral villages 	

Project/ Programme Components	Expected Concrete Outputs	Expected outcomes	Amount (INR)
6. Project Management cost by the Executing Entity – GEER Foundation (3%):			60,39,805.00
7. Total Project/ Programme cost:			20,73,66,653.00
8. Cost of Monitoring and Evaluation - NABARD (@3%)			62,21,000.00
Amount of Financing Requested			21,35,87,653.00

*including thematic trainings on horticulture, soil improvement, micro-irrigation, vermi-compost, organic pest control, agro-horti-silvi-pastoral approach, climate resilient agri practices, heat tolerant varieties, fodder cultivation etc.

1.5 Projected Calendar:

Indicate the dates of the following milestones for the proposed project/programme (projects which have four or more than four years of implementation period would require having mid-term review after two years of implementation).

Milestones	Expected Dates
Start of Project/Programme Implementation	July 2017
Selection of villages	January 2018
Mid-term Review (if planned)	June 2019
Third Quarter term Review	June 2020
Project/Programme Closing	June 2021
Terminal Evaluation	April 2021

The Project has been planned for a period of four years starting July 2017 to June 2021.

2. PROJECT / PROGRAMME DESCRIPTION AND JUSTIFICATION

i. What is the business-as-usual development for the targeted sector?

The business as usual scenario for each zone targeted under the NAFCC project is explained below:

Agricultural zone:

Khadir Bet area in Bhachau taluk in Kachchh district has been selected as the 'Agricultural zone'. Khadir Bet, spread across 331 km², harbouring 1871 households across 10 villages, is surrounded by the Great Rann of Kachchh from all the sides, which results in greater vulnerability due to changes in rain patterns. From the stakeholder consultations and site visit observations, it noted that even though the land holding perfarmer is high, actual land under irrigation is low. Water is highly saline, with high fluoride content and TDS ranging till 2200mg/L (which is above the permissible limits set by Bureau of Indian Standards and World Health Organisation)¹⁴, and is often not fit for many of the crops. At present, major agriculture happens is Cumin (*Cuminum cyminum* or jeera), and vegetables that are resistance to high salinity. Irrigation is mainly done through flood irrigation, where water is pumped out from bore-wells using diesel water pumps. So far, piped water for

¹⁴ <http://www.isca.in/IJENS/Archive/v3/i5/11.ISCA-IRJEvS-2014-73.pdf>

drinking has reached only two villages, and villagers depend on the ground water to meet all their domestic and livestock requirements.

One major impact of erratic monsoon is heavy rainfall in a short duration, where all such water runs off quickly. Around 10 check dams and 40 percolation ponds have been built in the area to conserve the water. However, water retention does not happen beyond 2 months. In case of heavy rains over a short duration, quick percolation of water does not happen, which results in heavy runoff. During extreme droughts, people of Khadir Bet migrate to other parts of Gujarat with livestock, as agriculture becomes difficult, and fodder is unavailable. As mentioned in section 1 of this report, Khadir Bet is a dryland, with high evapo-transpiration rates¹⁵. Therefore, large check dams or ponds are not the best solution to retain water. The percolation ponds that were built was constructed only in and around Dholavira village, however such percolation tanks are not available in other villages. Further, small scale and marginal farmers, and those whose lands are away from such percolation tanks are not able to avail any benefit. At present around 100 households are able to pump water from such tanks for around 3 months. Small farmers however, usually are not been able to afford the price of diesel required for water pumps even if their land is situated close to such tanks. There also have been some cases of drip irrigation facility being deployed in some area in Dholavira village. However a majority of these are unused as there is no facility to pump water. It will be important for people of Khadir Bet to have access to water throughout the year, which can be made possible through state-of-the-art water percolation technologies such as bhungroo. If solar water pumps are associated with each unit of bhungroo and with existing bore wells, drip irrigation will be very fruitful. Both crop and fodder cultivation will be made possible through water demand and supply interventions planned under this project. At present there are no schemes that provides for seed money of drip irrigation, solar water pumps or small and compact water conservation units in private lands.

Coastal zone:

There are mainly two types of fishermen in Abdasa taluka – those who use boats to catch fish and those who catch fish on foot by wading in sea water in the coastal regions (pagadiyas). Under the NAFCC project, the primary target is the pagadiyas, who are also the most marginalized and vulnerable to changes in climate. From surveys, consultations with people and site visits, it has been found that fish catch of pagadiyas has been declining over years. For some years, when the fish catch is very low, the pagadiyas have tried to earn daily wages by working as labour in fish boats, or do other manual labour. Even among the fishermen, a majority own small boats (and not trawlers), which do not go into deep sea. There has been a decline in the fish catch also over the years among this community. This has pushed many among the community to seek avenues of alternate income including work as labourers in salt fields nearby.

At present there are no government schemes promoting seaweeds cultivation, even though there is a demand. The industries import seaweed from Tamil Nadu and Kerala at

¹⁵Regions where the ratio of the mean annual precipitation to the mean annual evapo-transpiration is in the range of 0.05-0.65. CCD considers arid, semi-arid and dry sub-humid regions as dryland. The hyper-arid region, where the P/PE ratio is less than 0.05, forms the arid deserts, of which Rann is an example. The Köppen-Geiger climate classification for Khadir Bet is BWh. Desert/Arid climate (in the Köppen climate classification BWh and BWk, sometimes also BWn), also known as an arid climate, is a climate that does not meet the criteria to be classified as a polar climate, and in which precipitation is too low to sustain any vegetation at all, or at most a very scanty shrub.

present. Polyculture and aquaculture have been piloted in some places by research institutes and as part of CSR activity. No such alternative income generation activity has been noted to be conducted in the villages shortlisted for the NAFCC project.

Mangroves replantation is a major work undertaken by the forest department and coastal protection activities mandated to be undertaken by industries. However, there are no schemes that specifically target only degraded mangroves, and work towards their restoration. Under the mangrove restoration work proposed under NAFCC, only those areas where mangroves are degraded over many years will be targeted. No new plantation (except some gap plantation) will be undertaken, as it is already being carried out by the forest department and other agencies. Restoration activity where channel management for effective tidal flushing is one of the main activities, is being carried out in the identified project areas.

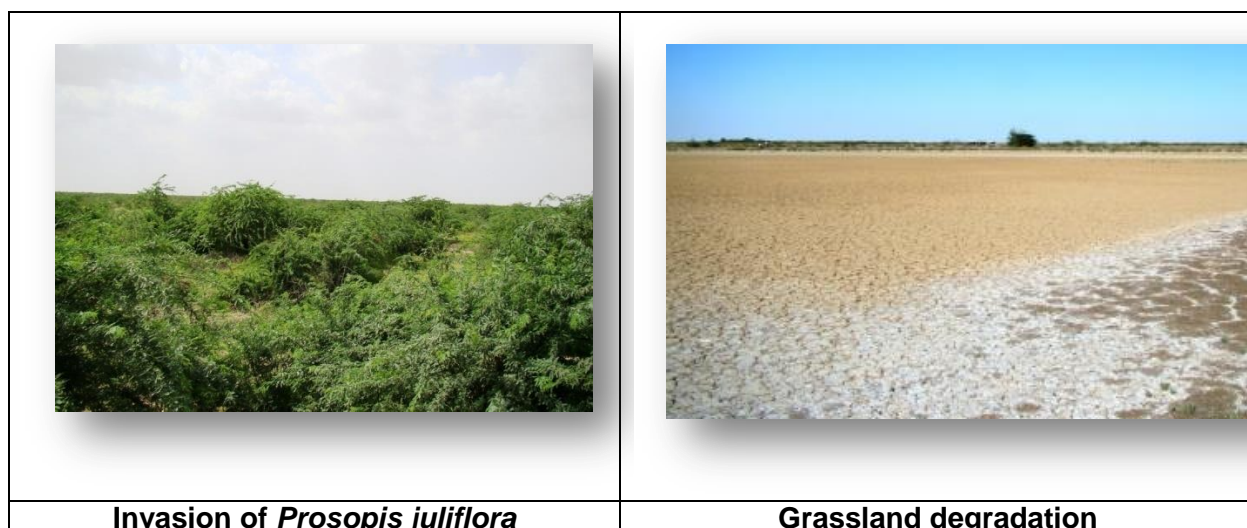
Pastoral zone:

The grassland in Kachchh region is in a state of **Moderate to Severe** degradation. No agriculture is practiced in Banni, and livelihood is completely generated from livestock. There has been an increase in the population, and there is associated increase in demands. Salinity ingress due to increased evapo-transpiration, frequent consecutive droughts. Invasion of *Prosopis juliflora*, expansion of agricultural land and urban settlements etc. are some of the reasons behind this degraded condition of the grassland. Over the years, there has been increased pressure over these grasslands for fodder, which is exacerbated by the changes in climatic patterns.

Table 7: Fodder demand on Banni grasslands for the last 50 years

Year	Human Population (Lakhs)	Year	Livestock Population (Lakhs)	Livestock – ACU (Lakhs)	Fodder Demand (Per Day)
1961	6.96	1962	9.40	6.64	4648 Tones
1971	8.50	1982	16.51	7.72	
1991	12.6	1997	16.57	6.48	
2001	15.83	2002	15.73	9.09	
2011	20.90	2007	17.07	9.48	6639 Tones

Fodder availability and demand was found to be 7kg/ACU/Day (Ahuja, 1994). In Kachchh, the total ACU is 9.48 Lakhs resulting in a yearly fodder demand of 24.22 lakh tons. Yearly production of fodder in Banni region is 3,30,026 ton. Considering other sources also, there is a deficit if fodder availability by around 80%. Due to changes in weather patterns, there has been a depletion of palatable species of grass over the years, there is loss of diversity of grass species and less soil moisture for healthy grasses owing evapo-transpiration and allelopathic effects of *P. juliflora*. There is adire need to reclaim/restore the entire grassland (5077km²) under production of at least an average 4800 kg/ha to curtail migration and hardships.



At present, there is a wide spread of prosopis in the Banni region, as presented in the map below:

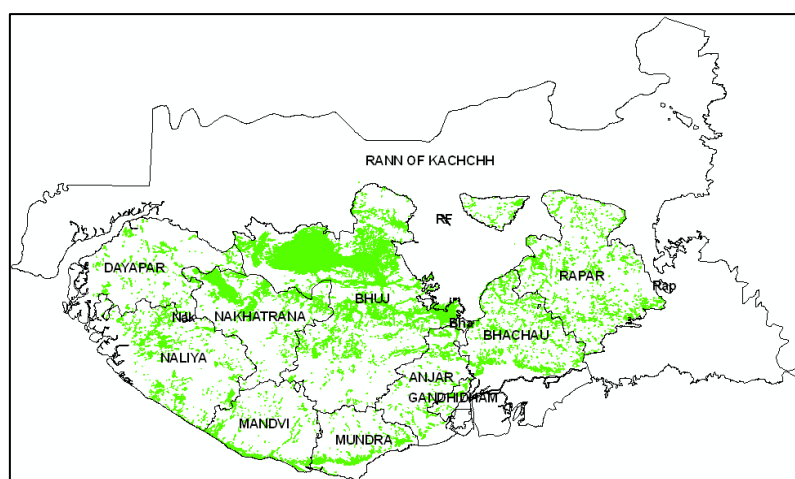


Figure 20: Spread of *Prosopis juliflora* in Kachchh district

This shift in land use in Banni region is also evident in the figures given in the table below

Table 8: Change in land use in Banni region

S. No.	Major Land Use Classes	Area in 1997 (km ²)	% of Area in 1997	Area in 2009 (km ²)	% of Area in 2009
1	<i>Prosopis</i> Dominant area	161.34	6.16	865.69	33.07
2	<i>Suaeda</i> scrub (Including Barren Land)	608.89	23.26	765.73	29.25
3	<i>Prosopis</i> with other vegetation	1,178.79	45.03	438.67	16.76
4	Grass with sparse <i>Prosopis</i>	513.96	19.63	440.91	16.84
5	Water bodies	154.74	5.91	106.72	4.08
	Total area	2,617.72	100.00	2,617.72	100

At present, the fodder requirement is met either through fodder which is transported from other regions, or purchased in the market, or migration of livestock happens in the extreme fodder scarce times. Restoration of grassland will ensure fodder and livelihood security for people of Banni. There is huge co-benefit to this, as restoration of grassland will also help conserve the ecosystem and the biodiversity of the sensitive Banni grassland region.

Forest department is doing grassland restoration in some places based on the Banni working plans. However, these are often scattered, and not taken up with an intention of providing fodder. After the life of these working plans, many of such grassland restoration plots again gets degraded due to invasion of *Prosopis juliflora* and grazing. Under this NAFCC project, a paradigm shift will be brought to manage the fodder around the year by participatory eco-restoration of grassland.

All these intervention activities are sustainable and can be replicated once the NAFCC project stops. This is detailed under each intervention in the next section.

ii. *What are the specific adaptation activities to be implemented to reduce the climate change vulnerability compared to the business-as-usual situation?*

A total of at least 20 villages, (10 each from agriculture coastal zones) and 12 wands (hamlets) from pastoral zone for three types of local natural resource dependent communities in Kachchh District (located as per the zones indicated in the map in **Annexure-2**) will be identified for climate change adaptation activities and interventions viz.

- a) Coastline and coastal fishing communities – Abdasa coastal zone-10 villages
- b) Grasslands and dependent pastoral communities – Banni Grassland reserve- 12 wands (hamlets)
- c) Farmlands and agriculture communities – Khadir bet in Bachau taluk agriculture zone- at least 10 villages

The project shall be led by GEER Foundation. Based on the consultative process, it has been decided that the project will have following four major components (Details of the departments and institutions involved is mentioned below each component):

(i) Baseline survey and Vulnerability Assessment

To be implemented by GEER Foundation.

(ii) Enhancing capacities for implementing Climate Change Adaptation and Knowledge Management and Mainstreaming

To be implemented by GEER Foundation.

(iii) Implementing Climate Change adaptation interventions

To be implemented by various departments/institutions/agencies such as Dept. of Agriculture & Co-operation (DoA), Dept. of Forests & Environment (DoFE), Gujarat Forest

Department, GUIDE¹⁶, GEDA¹⁷, PGVCL¹⁸, Commissioner of Fisheries (under DoA), GGRC¹⁹, GEC²⁰, Directorate of Animal Husbandry (under DoA) and GEER Foundation.

Details of activities under each component is given below:

Component 1: Baseline survey and Vulnerability Assessment:

This activity will involve baseline climatic/environmental and socio-economic survey of the identified clusters for the respective categories through various standard scientific sampling methods, Participatory and Rapid Rural Appraisal (PRA, RRA) /Focus Group Discussion (FGD) etc. Climate scenario would be developed for 10 villages each from agricultural and coastal zone and for 12 wands from Banni region (pastoral zone). Through this, an assessment of climate impending risks and vulnerability assessment shall be carried out. As a part of this project, ten villages each will be identified from the coastal and agricultural communities for the implementation of interventions under the proposed project. The villages will be distinctly categorized as those with agricultural and coastal ecosystems.

Based on consultations with stakeholders in Kachchh district, Khadir bet and 10 villages situated there has been selected as the agricultural zone. The intervention activities planned will be implemented in these 10 villages. A C&I framework is proposed for beneficiary identification as given below:

For the coastal communities, criteria such as dependency on fisheries and livestock, overall livelihood options of the coastal community etc. will be taken into consideration. The change in the number of fishermen over the years and the prices of fish at landing would serve as indicators to estimate the dependency of people on fisheries. Availability of livelihood options in the villages would be understood by using the migration pattern. Increased rate of migration would point towards a decline in the livelihood options in the particular village. The indicators to estimate the dependency on mangroves would be the coastal community's proximity to mangroves as well as fodder collected from mangrove as cattle feed. The potential for women-centric interventions will also be derived by looking at the women empowerment and ownership situation in the village. Based on these criteria and indicators among the coastal communities, interventions like introduction of alternate income sources through seaweed cultivation or polyculture, restoration of mangroves etc. would be implemented.

The interventions for pastoral community will be implemented in Banni grasslands, which is being managed by the Forest Dept. 12 wands will be selected to be given responsibility of managing 50 ha each. Of these 500 ha will be under grassland restoration and 100 ha will be designated for development of grass seed bank. Based on this, the Criteria and Indicators proposed for selection of villages in Agricultural, Coastal and Pastoral zones are given below:

Agricultural community: Selection of beneficiaries	
Criteria	Indicators
Vulnerability to Climate change	<ul style="list-style-type: none"> • Villages witnessing flash floods. • Villages listed as drought prone.

¹⁶<http://gujaratdesertecology.com/>

¹⁷<http://www.geda.gujarat.gov.in/>

¹⁸<http://www.pgvcl.com/>

¹⁹<http://ggrc.co.in/webui/home.aspx>

²⁰<https://gec.gujarat.gov.in/>

Agricultural community: Selection of beneficiaries	
Criteria	Indicators
Drought, increase in temperature and lack of rainfall	<ul style="list-style-type: none"> Village with less access to water resources based on number of ponds/bunds/wells/borewells etc.
Vulnerability of farming community to agriculture	<ul style="list-style-type: none"> Number of cropping cycles in a year-focus on those villages with one crop per year. Landholding- small and marginal farmers in a village gets priority. Incidents of crop loss due to extreme climatic events. Number of dry borewells. (can be cost effective way of installing more units of bhungroo as a new bore need not be drilled)
Empowerment of farmers through technology transfer and technological self-reliance	<ul style="list-style-type: none"> Villages where women SHGs are present. Beneficiaries are willing to form a group and manage the bhungroo collectively.
Progressive farmers (identifying villages with 'champions')	<ul style="list-style-type: none"> Farmers who have adopted vermi-composting and organic farming. Farmers using water harvesting technologies.
Bringing more barren lands under cultivation: Improve Soil fertility, increasing the yield	<ul style="list-style-type: none"> Villages with higher area with degraded soil. Lands left barren or not cultivated in recent years due to lack of water supply and are subjected to erratic rainfalls.
Demand and Supply gap of chemical fertilisers	<ul style="list-style-type: none"> Remote villages facing acute shortage of water. Villages where Gujarat Green Revolution Company is already involved (for convergence potential).

Coastal community	
Criteria	Indicators
Dependency on fisheries	<ul style="list-style-type: none"> Number of people dependant on fishery as means of livelihood (in % of population of the village). Number of people who have migrated from fishing as means of livelihood (more migration means livelihood options from fishery in the village have declined.). Number of people in the village who catch fish on feet or by means that do not include a fishing boat.
Dependency on mangroves	<ul style="list-style-type: none"> Proximity of village to degraded mangroves (mangroves falling into lower canopy density classes). Villages close to those mangroves that have undergone rapid decline in density over the last 10 years.
Community participation	<ul style="list-style-type: none"> Number of women SHGs in the village. Villages where similar activities as those interventions for coastal zone under component 3 are being piloted (eg: as a part of CSR activity).
Availability of potable water	<ul style="list-style-type: none"> Villages identified as highly prone to salt water (both potable and irrigation water).

Coastal community	
Criteria	Indicators
Site suitability and management	<ul style="list-style-type: none"> • In close proximity to good creek system (that meet the parameters decided by GUIDE). • Existing market linkages for easy disposal of seaweed and products from polyculture.

Pastoral community	
Criteria	Indicators
Dependency on livestock	<ul style="list-style-type: none"> • Number of people dependant on livestock as means of livelihood (in % of population of the wand). • Number of people who have migrated from the livestock to other livelihood options (Migration pattern: More migration means livelihood options in the wand from livestock management have declined.). • Number of cattle head in the wand in the current year. • Number of people with 1, 2 3 or 4 cattle heads in the wand (More number of people). • Number of cattle heads lost due to extreme weather in the last 3 years.
Community participation	<ul style="list-style-type: none"> • Number of women SHGs in the village. • Wands which are a part of similar restoration work earlier as a part of other schemes. • Existing village grassland committees/cooperatives.

Component 2: Enhancing capacities for implementing Climate Change Adaptation interventions

GEER Foundation will identify needs for capacity development of communities for better delivery of the solutions. Training will be provided for each of the intervention activities explained in component 3. One training module is not linked explicitly to capacity building of interventions under component 3, but is on climate resilient practices, that includes organic farming, vermi-compost, exposure to drought resistant crops etc. Each of the training module, description of the training event and other details are explained in the **Table 9**.

GEER Foundation will also lead capacity development of communities on each intervention planned as indicated under Component 3; where technical lead will be some of the partner organisations. GEER Foundation will also be responsible for conducting the awareness and capacity building of local key stakeholders from all the project locations on Climate Change Adaptation, specifically Ecosystem based Adaptation (EbA) and Community based Adaptation (CbA) along with the concerned departments.

Trainings will include Training of Beneficiaries (ToB)/workshop and open trainings/ awareness campaigns targeting 25-30 and 60 participants respectively. The ToBs shall be only for the beneficiaries and champions identified from each village; where focussed training on the interventions will be undertaken. Open awareness campaigns and skill development training camps will be bigger events, targeting 60 participants on awareness creation and skill development on various climate resilient practices and income generating skills.

Table 9: Details of the planned trainings

Thematic focus of the training	Description of the training event	Number of ToB/ Workshop	Number of open trainings and awareness camps
Climate resilient agriculture	<ul style="list-style-type: none"> - In each of the 10 villages in agricultural zone, one day awareness and training camps will be organised on promoting horticulture plantation in crop land. The awareness and training camps will also include climate resilient farming techniques such as exposure to indigenously developed drought resistant crop varieties, drip irrigation etc. This will also include 2 focussed workshops on vermi-composting where people will be encouraged to start vermi-composting units for their farmlands. Number of participants is estimated to be around 60. - ToBs/Workshops for on how to take up horticulture plantation as an agro-horti-forestry intervention on building resilience to vagaries of climate change can help in diversification of sources of income and build resilience against losses due to extreme weather. Apart from horticulture species, farmers will also be encouraged to plant NTFP species eg: Aonla. - ToBs for 25-30 beneficiaries each on advantages of drip irrigation and techniques involved will also be organised. This is apart from open training on drip irrigation which is a component of the open training explained below on climate resilient practices. 	6	10

Thematic focus of the training	Description of the training event	Number of ToB/ Workshop	Number of open trainings and awareness camps
Bhungroo in agricultural villages, at least 2 in coastal villages	<ul style="list-style-type: none"> - 3 ToBs for the owner groups of the Bhungroo, of which 1 ToB will be in the first year for the owners of the first batch of Bhungroo installed in year one, 2 ToB in the second year. Representatives from each of the bhungroo women beneficiary groups will attend these ToBs. - In each of the 10 villages one day awareness and training camps will be organised on water conservation and efficient utilisation of water for agriculture. Number of participants is estimated to be around 60 in each of the awareness events and 25 in the ToBs. Apart from this, trainings for beneficiaries in the coastal region also shall be undertaken. 	3	12
Mangrove restoration in coastal villages	<ul style="list-style-type: none"> - Mangrove restoration will occur in three major clusters from where villages will be chosen to lead the activities. In the chosen clusters, 3 workshops will be organised on restoration of mangroves and other related subjects, where the target group is a focussed team of 25 people who will spearhead efforts from the community on mangrove restoration work. Additionally, 10 open trainings (cluster-wise) will be conducted for the general public on mangrove restoration in year 1, which will again be repeated in the second and third year. So, together 3 workshops and 10 open trainings are planned. 	3	10

Thematic focus of the training	Description of the training event	Number of ToB/ Workshop	Number of open trainings and awareness camps
Seaweed cultivation and polyculture	<ul style="list-style-type: none"> - 450 households will be selected from 10 villages to take-up seaweed cultivation. These households need focussed training. Since effective training will be in smaller groups, 4 such trainings/workshops are planned. In each of the selected 10 coastal villages, awareness campaigns on seaweed cultivation and polyculture will be organised. - Same type of participation as indicated under Seaweed cultivation section. However, since the households selected for polyculture will be different from those selected for seaweed farming, 4 workshops on polyculture will be conducted. Both these intervention activities will be discussed in the same open trainings, which is explained above under seaweed farming. Total number of households specially trained on polyculture is expected to be 50. 	6	10
Grassland restoration	<ul style="list-style-type: none"> - Workshops and training will be on grassland restoration in villages identified in the 3 clusters. - 15 awareness campaigns will be organised on sustainable controlled grazing practices and fodder densification, storage etc. 	6	15
Total		24	57

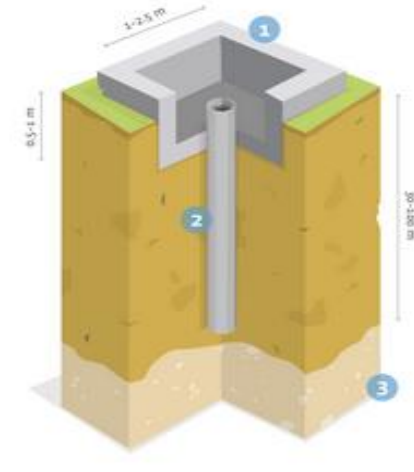
Component 3: Implementing Climate Change adaptation interventions

This component would involve identification and implementation of sector and community need based concrete climate change adaptation interventions in the project locations and clusters. 10 interventions have been proposed; 4 each targeting agricultural and coastal communities and 2 targeting pastoral communities. The intervention activities are given in community based and ecosystem based adaptation intervention framework as below:

I. Agricultural communities

Agricultural Intervention Activity (AIA) No.1

Name of the intervention:	Construction of at least 30 units of 'Bhungroo', in 10 villages selected from agriculture communities in Khadir region and 2 units of bhungroo in the coastal zone.
Description of the problem	In the otherwise drought-prone state (semi-arid zone), high intensity rainfall over a few days leads to water logging in the fields resulting in destruction of crops, soil erosion and soil degradation. The problem is two pronged- scarcity of water coupled with excess water during rains. Erratic rains due to change in weather patterns makes this community highly vulnerable. Similarly, decreased salinity in potable water in coastal region is one of the major outcomes for installing bhungroo in coastal zones.
Description of the solution	Bhungroo is a water management system that injects and stores rain runoff in soil. This can also be used for irrigation, and after appropriate treatment for human consumption. Bhungroo stores excess rain water in soil. This can be to the tune of 40 million litres of water over 10 days, which can then be used for 7 months. Artificially recharging water in the underground aquifers also results in decrease of water salinity. Availability of water for irrigation makes multiple crops in a year possible. This system can provide guaranteed water for irrigation, which will also be adhering to the honourable Prime Minister's stated vision of " Convenient Actions " i.e. Climate Change mitigation within Gandhian principle of 'Antyodaya'.

<p>Description of the technology</p>	<p>Bhungroo technology, recognized by UNFCCC²¹ as a viable community oriented solution to adapt to the vagaries of climate change, is an open source technology. The technology works on ensuring maximum recharge of rain runoff in a specific small area by construction of injection points in different layers of soil based on the geology of the area. A diagrammatic representation of the technology is given in Figure 21. This technology, is now being adapted by diverse users, even cricket stadiums, to have a long-term solution on water recharging for grass restoration on grounds. Figure showing cross-section of Bhungroo:</p> <p style="text-align: center;">The Bhungroo</p> <p style="text-align: center;"><small>The technology is open source so that it is scalable in other places. Bhungroo does have a non-negotiable principle, however—that the technology should be used by poor people only.</small></p> <div style="text-align: center;">  </div> <p style="text-align: center;"><small>For more information, visit Momentum4Change.org</small></p> <p style="text-align: center;">Figure 21: Structural representation of Bhungroo technology</p>
<p>Partner institutes</p>	<p>GEER foundation (Selection of farmers, handholding, training women farmers' groups) Technical lead will be finalised by GEER foundation after due diligence. (Some organisations works on this technology such as Naireeta Solutions Ltd., GGRC etc.)</p>
<p>Implementation plan</p>	<p>At least 30 units of Bhungroo will be installed in 10 villages from agrarian community in such a way that there are at least two units of Bhungroo in</p>

²¹ Some of the recognitions for this open source technology include:

1. Government of Gujarat case study as part of our CM's Green Gujarat award program (Which was inaugurated by our honble CM at his first Vibrant Gujarat summit as PM)
2. UNFCCC award certificate as one of the best climate change mitigation program across the Globe (after due diligence from UN team)
3. Millennium Alliance Award copy and certificate as one of the best innovative poverty eradication model across the Globe (after due diligence from USAID and Government of India team)
4. Government of India's Dept of Science and Technology certificate as one of the best innovation from India for Global growth with due diligence and evaluation by Government of India Panel alongwith technical panel from Lockheed Martin R&D and FICCI and Stanford
5. Harvard Univ publication on Bhungroo as one of the best social innovation for community development in SE Asia
6. Gujarati Case study and Evaluation report as part of Gandhian Peace & development award

	<p>each village. The technical lead for construction of Bhungroo will be decided at a later stage. Selection of beneficiaries will follow the C&I developed under component 1. Beneficiaries will be identified and selected by GEER Foundation through baseline and Vulnerability Assessment studies (explained in component 1 of this proposal). The technical organisation will be responsible for survey of the location to identify the exact spot for constructing the Bhungroo, civil construction (which will take approximately 7-14 days for each Bhungroo) and conduct capacity building for operation and maintenance/repairs.</p> <p>Instead of diesel pumps, solar pumps will be encouraged to be installed with each bhungroo. The EE will assist the beneficiaries in availing 90% subsidy for solar water pump as provided by the State Government (Department of Energy and Petrochemicals), and through the NAFCC project will provide the seed money not more than Rs. 45,000.00 per bhungroo. However, for any solar water pump installations, it will be mandated that demand side water management be done in a proper way, and that water pumped from solar pump is not used extensively for flood irrigation. Beneficiaries will be sensitized on the importance of proper irrigation, and not waste water which is a risk associated with installing solar water pumps. Since the major crops in this area include jeera, which needs less water, risk of unchecked irrigation is comparatively low.</p> <p>Co-financing from the beneficiaries shall include financing procurement and installation of the preferable pumping system, financing the irrigation channels etc. These are to the tune of INR 42,382.00 (for premium diesel pump sets or INR 45,000.00 for Solar powered pumps) and INR 22,100.00 (for 1,000 metres of 'anaconda' pipes used for irrigation) respectively. Further the operation and maintenance costs (O&M) will also be co-financed by the BWFG, which will be around INR 4,000 per year. So, the total co-financing from BWFG in 5 years is INR 78,482.00. This co-financing can be absorbed by the BWFG as revenue from increased agricultural production.</p> <p>Having peer groups in a village will help in maintaining the Bhungroo system; so at least 2 units of Bhungroo in one village will be targeted. Installation of bhungroos can lead to creation of many real mandays in the rural economy. This is in three tranches:</p> <ol style="list-style-type: none"> 1. Survey and installation of Bhungroo (both skilled and unskilled) 2. Maintenance of Bhungroo (unskilled) 3. Manday for associated agricultural activity due to increased availability of water (skilled and unskilled).
<p>Identified barriers</p>	<ul style="list-style-type: none"> • Lack of gender sensitization of women groups are to manage bhungroo-Cultural barrier • Less instances of women as owners of water systems-Cultural barrier • Lack of finances- Financial barrier • Technology permeation- Technological barrier

<p>How will these be overcome through NAFCC project?</p>	<p>Sensitization meetings will be held at every identified village by GEER Foundation and technical lead. Ownership of bhungroos by women is a tested and successful strategy, which can also be replicated in Kachchh region. Cultural barrier can be overcome with comparative ease, considering that the installing bhungroo will lead to guaranteed source of water for irrigation and hence increased agricultural productivity.</p> <p>The technical agency will provide all technical support, including capacity building by training and hiring local drillers. GEER foundation will manage all knowledge related aspects, including capacity building and sensitization. The technology is a tried and tested one, the material used in construction will be of adequate quality. Financial barrier can be overcome through the grant under NAFCC; scaling up of more Bhungroo can be taken up under other schemes based on the success of these pilots.</p>
<p>Sustainability and replicability</p>	<p>Sustainability: Bhungroo has a life of 30 years. Therefore, bhungroo will be continued to be used even after the life of the NAFCC project. Training will be provided to the beneficiaries on its operation and maintenance.</p> <p>Replicability: Bhungroo under the NAFCC is being installed on lands of small and marginal farmers. Main cost involves survey and drilling. Survey will be conducted in Khadir under the NAFCC project. Hence, farmer willing to install bhungroo in their own land will be able to do it by availing service of the service provider at a cheaper cost. Drilling costs will be similar to the cost incurred during construction of bore-wells, hence, without much increase over baseline spending, other people can replicate bhungroo construction. Since water availability ensures more yield, repayment will be viable. GEER Foundation may consider encouraging local MFIs to fund construction of bhungroo under income generation activity based on the success and uptake of bhungroo in the first three years.</p>
<p>Estimated mitigation (in tCO₂ per year)</p>	<p>Soil water conservation can result in better carbon sequestration as part of Soil Organic Carbon (SOC); and decreased emissions from soil as there will be reduced soil erosion and less emissions of CO₂ and N₂O from soil. However, the exact amount of emissions saved due to Bhungroo installation is not estimated <i>ex-ante</i>. Estimation of SOC before installation of bhungroo and their annual estimations will be conducted by GEER Foundation.</p>

Agricultural Intervention Activity (AIA) No. 2:

Name of the intervention:	Micro-irrigation initiatives including drip irrigation
Description of the problem	The area is prone to drought, farmers are at risk of crop failure due to the erratic nature of rainfall and high dependency on ground water.
Description of the solution	Micro-irrigation initiatives like drip, sensor-based irrigation can dramatically improve the farm productivity. This also helps in judicious use of water, including water conservation from the Bhungroo units. This also forms finding solution at demand side of water conservation, given that supply side issues will be tackled to some extent by construction of bhungroo.
Description of the technology	Drip irrigation is a mechanism of efficient irrigation by supplying water to plants either directly to the root zone, or to soil surface near the plant through a network of pipes, valves, tubing etc. This method has been well tested, and has been found to be highly effective especially in areas facing water scarcity ²² .
Partner institutes	GEER Foundation will be the lead, where expert inputs will be solicited from Gujarat Green Revolution Company Ltd (GGRC) and Agriculture Dept.
Implementation plan	<p>Micro-irrigation and drip irrigation will consist of the following activities in the 10 villages in Khadir bet that will be selected from the agriculture community and 100 solar water pumps to individuals and groups.</p> <ol style="list-style-type: none"> 1. Selection of 800 ha land among all the farming community in such a way that all farming households are benefitted. The primary target group will be small and marginal farmers, followed by medium and large scale farmers. 2. Priority shall also be given to farmer cooperatives; where farmers are willing to pool in resources at adjoining fields for better efficiency, 3. Priority also shall be given to women farmers. 4. Drip irrigation measures will be taken up in a phased manner with technical help from GGRC and overseen by GEER Foundation. 5. Surveillance to measure crop canopy index for estimation of crop health and need for irrigation will be considered during the baseline and VA assessment. 6. Semi-automated irrigation using soil moisture sensors, drip irrigation, etc. will be tested on a pilot scale. 7. Further, farmers without electricity connection will have a priority in installing the solar water pumps. 8. Those who organise in groups will be given priority to install such solar water pumps. <p>Those lands where Bhungroo are to be installed is proposed to adopt a micro-irrigation method for efficient irrigation. In such instances, co-financing by the owners of Bhungroo will be solicited.</p> <p>The farming community will be given help in installing solar water pumps by partial contribution of Rs.45,000/- per solar water pump. Priority will be</p>

²²<http://www.iitk.ac.in/3inetwork/html/reports/IIR2007/07-Irrigation.pdf>

	<p>given to those beneficiaries who are willing to pool in the water resources, and avail this benefit in groups. <u>This will ensure that more people are brought under a mixture of solar water pump and drip irrigation for cultivation of crop such as cumin.</u> However in case there are no beneficiary groups formed to avail the 10% seed money for installing the pump under NAFCC, this can also be allotted to individual beneficiaries. Total number of solar water pumps installed in this way will be at least 100, but in optimistic scenarios, the number of beneficiaries can cover the entire agricultural community if members decide to form groups and avail the benefit. Due attention shall be given to ensure that solar water pumps are used for irrigation of spices and agriculture products such as jeera and that no flood irrigation is done. Total area under drip irrigation will be 800 ha.</p>
Identified barriers	<ul style="list-style-type: none"> • Lack of awareness about innovative irrigation methods.(institutional barrier) • Lack of technical know-how among farmers. (technological barrier) • Lack of finances to adopt new irrigation techniques. (financial barrier)
How will these be overcome through NAFCC project?	<ul style="list-style-type: none"> • Workshop and training on innovative techniques of irrigation, awareness and communication. • Making access to credit easier by handholding farmers to access subsidies if required by GEER foundation.
Sustainability and replicability	<p>Sustainability: As long as water is available to be pumped, drip irrigation will be used. This will be ensured through the training camps. Solar water pumps usually have a service guaranty extending upto 25 years. Any technical issue in this regard is usually taken care of by the agency that install the pump.</p> <p>Replicability: GGRC is offering 50% subsidy on drip irrigation. Once the income from agriculture increases, people will be able to get further subsidies to increase arable area through drip cultivation. 90% subsidy is available for solar pumps, which can be availed by those after the life of the NAFCC project.</p>
Estimated mitigation (in tCO₂ per year)	None

Agricultural Intervention Activity (AIA) No. 3

Name of the intervention:	Fodder seed kits
Description of the problem	Due to climate variations, sustenance of livestock production is at threat due to scarcity of fodder during drought periods and difficulty in computing a balanced feed for animals (especially for illiterate farmers).
Description of the solution	Providing special fodder seed kits that farmers can use to grow fodder in their own land. Training on fodder tree species will be provided as part of component 2 under climate resilient agriculture training.
Description of the technology	Fodder seed kits are specially designed seed kits of 10 kg each containing seeds of various species that can be grown as fodder. Once farmers start growing fodder in the fields, this will be part of the cropping system by the end of the NAFCC project.
Partner institutes	GEER Foundation will take lead with technical help from the Dept. of Animal Husbandry.
Implementation plan	200 fodder kits will be distributed among 10 villages selected in Khadir bet in each year of the NAFCC project. This in total 800 households will benefit from the fodder seed kits during the 4 years of the NAFCC project.
Identified barriers	<ul style="list-style-type: none"> • Technical knowhow in growing fodder • Incomparability of fodder seed to the local conditions
How will these be overcome through NAFCC project?	Training will be provided to all community members on growing fodder species along with other crops. It shall be ensured that the seed shall be of indigenously developed fodder crops that are saline resistant.
Sustainability and replicability	<p>Sustainability: Fodder can be grown from these fodder kits. Seed from good yield can be stored for future use.</p> <p>Replicability: Training is being provided to all farmers to take up fodder cropping, as availability of fodder even in water scarce months will ensure a steady livelihood. Once the NAFCC project ends, fodder kits will help in fodder cultivation which will be routed through the Dept. of Animal Husbandry.</p>
Estimated mitigation (in tCO₂ per year)	None

Agricultural Intervention Activity (AIA) No. 4

Name of the intervention:	Bio-char for maintaining soil health, fertility and carbon sequestration
Description	The farm residue will be used to prepare what is called as 'bio-char' which works as an excellent and organic soil enrichment manure and enhances the farm productivity and water retention, besides reducing GHG emissions due to residue burning and carbon sequestration in soil. Bio-char is a fine-grained, carbon-rich, porous product remaining after plant biomass has been subjected to thermo-chemical conversion process (pyrolysis) at low temperatures (~350–600°C) in an environment with little or no oxygen (Amonette and Joseph, 2009).
Partner institutes	GEER Foundation will take lead with technical help from CRIDA.
Implementation plan	Distribution of 200 bio-energy system (type of a kiln) among the farmers and their training on it by experts
Identified barriers	<ul style="list-style-type: none"> • Technical knowhow in producing Biochar and its application process • Availability of crop residue for this purpose
How will these be overcome through NAFCC project?	Training will be provided to all community members on producing bio-char by using bio-energy system by experts and its technique of application will also be explained. The Bio-energy system will also be provided under this project
Estimated mitigation (in tCO₂ per year)	Several studies across the world have established that bio char application increases conventional agricultural productivity and mitigate GHG emissions from agricultural soils. The conversion of biomass carbon to biochar leads to sequestration of about 50% of the initial carbon compared to the low amounts retained after burning (3%) and biological decomposition (less than 10-20% after 5-10 years) (Lehmann et al. 2006)

Agricultural Intervention Activity (AIA) No. 5

Name of the intervention:	Livelihood security through alternate income enhancement
Description	Livestock rearing provides the crucial alternate income source to the farmers in Khadir bet especially in the years when their rain fed crops fail due to rains. The project will target such marginal farmers (based on land holding and owns less than 5 livestock). The project will work on formation of Milk Producers Organization by collectivising dairy farmers in 10 villages identified in agriculture intervention zone for managing their milk produce- collection, processing, storage and marketing value-added products for enhancing income of those marginal farmers.
Partner institutes	GEER Foundation will take lead with technical help from local animal husbandry department.
Implementation plan	One farmer's milk producers' organization shall be formed in each of the identified village and they will be trained on milk collection, storage and value-added products processing and marketing. The PO may comprise of about 20-30 marginal farmers or more from each village who would work together for its operations and benefit sharing.

II. Coastal communities

Coastal Intervention Activity (CIA) No. 1:

Name of the intervention:	Community-based assisted natural regeneration and restoration of mangroves
Description of the problem	Continued destruction and degradation of mangroves is increasingly resulting in loss of livelihood to the coastal fishing community. Further, loss of mangroves also increases the extreme climatic events such as storms and sea surge. The fishing community in the coastal region depend on mangrove as cattle feed for livestock during lean season.
Description of the solution	Regeneration and restoration of mangroves will provide ecosystem goods and services to the coastal communities, thus helping them with better fish and crustacean (prawns and crabs) catch in the coastal belt, storm protection and provide fodder for livestock during very lean seasons. Restoring mangroves has high co-benefits, such as conserving biodiversity, carbon sequestration etc. Under this proposal, plantation of new mangrove plantations are not proposed, as it is being already undertaken by forest department. Under this NAFCC project restoration of highly degraded mangroves is planned.
Description of the technology	<p>For restoring a degraded mangrove area, following two methods are proposed.</p> <ol style="list-style-type: none"> 1. Fish Bone Canal Method 2. Desilting and Removing blocks in the natural canals in the sparse mangroves to facilitate natural regeneration <p>Major objective in these two methods is to restore tidal flushing to degraded mangrove sites or enabling regeneration of mangroves in areas with sparse mangroves. There are no fixed rules to use these different methods and it is the judgement and experience of the personnel involved in restoration activities to decide which method is best suited to restore mangroves in a particular coastal belt. Each site condition will warrant different approaches and methods.</p> <p>Fish Bone Canal Method</p> <p>Fish Bone canal or trench method was extensively used to restore degraded mangrove areas to restore large tract of degraded mangroves. In this method, canals constructed like a fish bone with a main canal and alternating branching canals extend tidal water reach in areas which were not flushed adequately earlier. New channels create new flushing regime thereby improving stand structure and density of mangroves. In many mangrove formations, trough shaped intertidal belt where removal of mangroves and further sediment subsidence led to water stagnation was successfully restored using fishbone canal method. The main canal is connected to a creek system which supplies water to the main canal and other branching canals. This system of canals creates suitable condition for regeneration of mangroves. Fish bone canal method could be applied to restore degraded areas up to 50 ha with different topography which is not properly inundated. This method could also be applied in sparse mangrove stands where mangroves are stunted and sparse due to poor tidal flushing.</p>

<p>Description of the technology Contd...</p>	<p>Fish bone canal will produce better results where the intertidal belt has become trough shaped either due to clear felling of mangrove trees or in intertidal belts where sparse mangroves are present. In this area, ground level of degraded portion is below Mean Water Level (MSL). Canal method will adequately flush the area and create conducive condition for regeneration of mangroves. This method could also be applied successfully in areas where the periphery of the mangrove belt is an elevated landmass preventing free exchange of tidal currents.</p> <p>Areas beyond the intertidal belt where tidal flow does not reach is not suitable for fish bone canal method. Similarly, canal method is not suitable in sandy intertidal belt since the canals will collapse easily during monsoonal rains and get closed very fast due to heavy sedimentation. Likewise, accreting coastal belt where heavy siltation will close the mouth of the main canal is also not suitable for canal method. Hence, utmost care is to be taken before applying this method. In north-western Kachchh and coastal belt of Devbhoomi Dwaraka where this method was applied indiscriminately did not yield expected results.</p> <p>Desilting, Removing Blocks in Natural Canals</p> <p>Thoroughly surveying the sparse mangroves and identifying reasons for its sparseness and efforts to remove the physical blocks that render the mangroves sparse would be a best method to restore sparse mangroves to a dense condition. Tidal flushing in majority of the sparse mangroves could be improved by desilting minor creeks that form a network within the sparse mangroves. Desilting, removing blocks along its path, slightly altering the course of the minor canals and widening/ deepening its mouth has proved to produce excellent results in some sparse mangrove formations. Besides being simple, this method is highly cost and labour effective and takes lesser time.</p>
<p>Partner institutes</p>	<p>GUIDE will take the lead in this activity associating with forest department and GEER foundation.</p>

<p>Implementation plan</p>	<p>Priority for mangrove restoration will be given to those areas close to the identified 10 coastal villages for seaweed farming and polyculture. Apart from restoration work, training to coastal community shall also be provided on mangrove restoration/regeneration so that conservation activities are continued even after the project. Such sites have already been identified by GUIDE, given in the table below. A map of these sites is given as Annexure 6 to this report. 500 ha from these locations will be selected after detailed discussions with partner organisations; and weighing the potential community participation in the restoration efforts. This will also ensure sustainability of the practice after the end of this proposed project under NAFCC.</p> <p>The first selection of 1,000 ha has already been made, as given in the table below. From this, 500 ha will be finalised during the implementation phase.</p> <p>Potential Mangrove Restoration Sites at Kachchh District</p> <table border="1" data-bbox="440 748 1358 1128"> <thead> <tr> <th>Taluka</th> <th>Potential sites-ha.</th> <th>Sites for Mangrove Restoration</th> </tr> </thead> <tbody> <tr> <td>Lakhpāt</td> <td>100 ha.</td> <td>Rodasar-Lakhi, Bhutao</td> </tr> <tr> <td>Abdasa</td> <td>500 ha.</td> <td>Akri Moti, Mohadi, Jakhau Bundar</td> </tr> <tr> <td>Mandvi</td> <td>--</td> <td>Nil</td> </tr> <tr> <td>Mundra</td> <td>200 ha.</td> <td>Kotadi, GMB Port, Baradimata</td> </tr> <tr> <td>Anjar</td> <td>200 ha.</td> <td>Tuna, Vira, Rampar</td> </tr> <tr> <td>Gandhidham</td> <td>--</td> <td>Nil</td> </tr> <tr> <td>Bachau</td> <td>--</td> <td>Nil</td> </tr> <tr> <td>Total</td> <td>1,000 ha.</td> <td></td> </tr> </tbody> </table>	Taluka	Potential sites-ha.	Sites for Mangrove Restoration	Lakhpāt	100 ha.	Rodasar-Lakhi, Bhutao	Abdasa	500 ha.	Akri Moti, Mohadi, Jakhau Bundar	Mandvi	--	Nil	Mundra	200 ha.	Kotadi, GMB Port, Baradimata	Anjar	200 ha.	Tuna, Vira, Rampar	Gandhidham	--	Nil	Bachau	--	Nil	Total	1,000 ha.	
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<p>Identified barriers</p>	<p>Difficulty in restoration/regeneration of mangroves due to insufficient awareness among coastal community (technological and institutional barrier)</p>																											
<p>How will these be overcome through NAFCC project?</p>	<p>Training will be provided to coastal community on mangrove restoration. Members of the community will be hired to do the restoration work so that there is hands-on training. A mangrove conservation volunteer group under the aegis of an identified organization will be formed with help from GUIDE and GEER foundation for sustainability of the activity.</p>																											
<p>Sustainability and replicability</p>	<p>Sustainability: Community is being trained to ensure protection. Mangroves restored will continue to be in the same condition even after the NAFCC project. The incentive for community is the increased yield of fish catch (prawns and crabs) from the mangroves.</p> <p>Replicability: Department of Climate Change and GEER Foundation are in touch with agencies already involved in mangrove plantation under CSR. These agencies are willing to undertake mangroves restoration work under more area apart from mangrove replantation. Since technical guidance from GUIDE will be a good demonstration of success in mangrove restoration, it is expected that more area of mangroves can be brought under restoration work under CSR and other such measures.</p>																											

Estimated mitigation (in tCO₂ per year)	Mangroves have huge carbon sequestration co-benefits apart from biodiversity enrichment. GEER foundation has conducted a detailed survey of carbon sequestration potential of mangrove forests of Gujarat. A brief regarding the potential co-benefit as mitigation is attached as Annexure 8 to this DPR.
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Coastal Intervention Activity (CIA) No. 2²³:

Name of the intervention:	Promoting seaweed cultivation among coastal villages
Description of the problem	<ol style="list-style-type: none"> 1. Declining fish-catch due to climate variations is affecting the livelihood of coastal communities. 2. Existence of vast barren lands in Kachchh coastal area is unsuitable for agriculture activity due to high salinity. 3. Relatively Kachchh district has low population density (37 persons/sq.km) than other districts, which indicates the arid condition, drought and inadequate alternative livelihoods. 4. Livelihood options are limited under the prevailing scenario for the coastal communities of Kachchh. Consequently, there is a need for alternative livelihood options to enhance their socio-economic standards.
Description of the solution	<p>Due to improved technological intervention in fishing, fisher folk with larger vessel get more benefits, which necessitated alternative livelihood options for small and marginal fisher folk. There are many examples of the promotion of alternative livelihoods for coastal communities and small-scale fishers, especially the introduction of seaweed culture. The main objective for the promotion of alternative livelihood is to raise the economic standard of fishers and coastal communities, and reduce the fishing effort. Smith (1979) recommended that alternative income source from seaweed farming is reduce fishing pressure as long as they are attractive to reduce full-time fishing. However, he has also reported that only 50% of fishers are willing to change their occupation due to poor fish catches.</p> <p>The demand for seaweed is immense. This seaweed culture will help to revolutionize the rural economy along the coastal region through training and demonstration. The training part includes an initial orientation training,</p>

²³Chennubhotla VSK, 1988, Status of seaweed culture in India, Seminar report on the status of seaweed culture in China, India, Indonesia, ROK, Malaysia, Philippines and Thailand (FAO Archive), NACASF/WP/88/5, <http://www.fao.org/docrep/field/003/AB719E/AB719E03.htm>

Chung, I.K., Beardall, J., Mehta, S., Sahoo, D., Stojkovic, S. 2011. Using Marine Macroalgae for Carbon Sequestration: A Critical Appraisal. *J Appl Phycol.* **23**: 877-886.

Erlania and I.N. Radiarta. 2014. "Difference of Seaweed, *Kappaphycus Alvarezii*, Cultivation Cycles on Variability of Carbon Sequestration Rate." *Jurnal Riset Akuakultur* 9 (1): 11-124. (in Indonesian, abstract in English).

Erlania, K. Nirmala, and D.T. Soelistyowati, 2013. "Carbon Absorption in Seaweeds aquaculture *Kappaphycus alvarezii* and *Gracilaria gigas* in Gerupuk Bay, Central Lombok, West Nusa enggara." *Jurnal Riset Akuakultur* 8 (2): 287-97. (in Indonesian, abstract in English).

subsequent training at the appropriate time for the different phases of culture operations, post-harvest technology and final refresher training. The second set of training will be offered for entrepreneurs who can interest to invest money for seaweed and seaweed by-products.

Providing alternative livelihood to marginal fishers that simultaneously improves their economic standard as well as reduces the fishing pressure in some instances. However, in few cases where fishers do not fully exit the fishery and a shift from full time to part time fishing is likely, a limited degree of effort reduction can result, at least temporarily. Whether seaweed cultivation leads to entry or exit from fishing depends to some extent on world market and prices for seaweed. However, non-economic factors often keep fishers in the occupation of fishing. The viewpoint of supplemental livelihood rather than alternative livelihood makes better sense as this strategy attempts to reduce household dependence on fishing but acknowledges that some fishers may still like to engage in fishing. However, with population growth and low employment, exit from fishing does not prevent entry as well, so even if some fishers leave to take up alternative employment, there will be new entrants. These new entrants will still be faced with the same dilemma of previous fishers, too many fishers and not enough fish, exacerbating the over fishing problem and driving down earnings per fisher. Without some form of limited entry, the fishery will tend to move to the economic equilibrium point of opportunity wages. As previously noted, there may be several reasons why the fishery moves below the open access equilibrium point as predicted by classic bio-economic model of a fishery. In addition, while some fishers may do well, others will do poorly as some degree of income variability and non-equity will always exist. Only if regional employment and wages increase can overall wages of fishers increase.

Description of the technology

Chosen Model:

Four numbers of 12 feet (mainframe) and 6 feet (supporting frame) bamboo poles will be used for the construction of bamboo raft with the help of nylon ropes. The interior part of mainframe will be 3 x 3m in size. Fish nets will be attached under the bamboo rafts to avoid the fish grazing. In seeding rope, roughly, 20 braid knots present in single rope and in each braid knot, approximately 40 grams of seed materials will be inserted; thus, 400 seed materials present in a single raft. Stones or anchors to be used for anchoring the raft, usually 10 mm breadth with 10 m length ropes are to be used for this study (Figure 22).

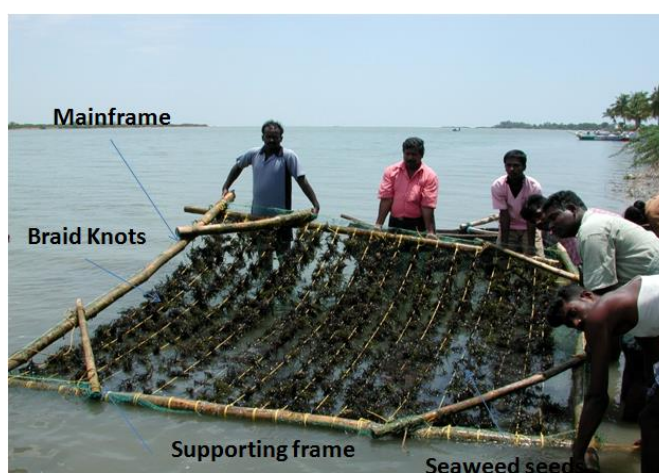


Figure 22: Small scale seaweed raft culture model

Methodology:

The initial investment would be Rs. 4,000/raft and the raft could be extensively used for more than 6 years. Raft technology, would be an ideal technique in Indian coastal waters. The environmental condition of Kachchh coast is suitable for seaweed cultivation in Gujarat. The present study 150 households will be selected from few coastal villages from along the Kachchh coast and involve them in seaweed farming. Each family will maintain 31 rafts, if one or two members from a family involved in seaweed farming in a day other members can do their regular fishing activity. An alternative member in a family involved in seaweed farming, this model provides viable income for marginal fishers and coastal dwellers. Duration of the culture period is 45 days for each cycle, after that farming and harvest is a regular process in a day. This technique would generate a minimum income of Rs. 14,000 to 15,000 a month per family. If, they involved in regular part time fishing activity, they can also earn a minimum of 10,000 to 12,000 additional incomes per month per family. If members of a family handle more rafts, amount will be automatically multiplied.

What is Raft Culture?

Floating raft culture is recent advance model in aquaculture. This cultivation method is suitable for Indian coastal waters. Normally, a floating construction or raft (typically a 3x3 m square bamboo frame with polypropylene ropes stretched parallel in one direction between the

bamboos) is used to suspend the seaweed about 50-cm below the surface. The seedling is inserted to the ropes and the rafts are anchored in the bottom. The off-bottom line method allows easier access since the farmer can walk around the lines at low tide, but the floating lines have the advantage that they can be easily moved to another place if necessary, and removed from the water altogether in bad weather.

Why Raft Culture

1. Capital investment is very less as compared to other culture techniques.
2. Raft installation is very simple.
3. Inspection is feasible during all low tides.
4. Fish nets attached under raft aids in avoiding the fish grazing.
5. Processing and harvesting are very simple techniques as compared to other culture activities.

Culture Species:

Gracilaria sp., *Hypnea*, *Caulerpa* is the most common species of India. It grows very fast and has high agar content. Field culture of seaweed is an established practice in many parts of Indian coastal waters. The seed materials of seaweed would yield on an average 8kg/m² in raft culture within 45 days. Six harvests could be made in a year. Some of the following advantages of seaweed is as follows:

1. It is very fast growing aquaculture species.
2. Culture period could be as short as 45 days under optimal conditions.
3. Culture is easy and not complicated.
4. Culture technique is eco-friendly; it does not need fertilizer for their growth.
5. Capitalization is less than any other aquaculture species and a profitable one.
6. Demand for seaweed is high in the local and international markets.

Market Value and Demand

Seaweed raw materials are used produce three hydrocolloids like agar, alginate and carrageenan. A hydrocolloid is a non-crystalline substance with very large molecules and which dissolves in water to give a thickened (viscous) solution. Agar, alginate and carrageenan are water-soluble carbohydrates that are used to thicken (increase the viscosity) aqueous solutions, to form gels (jellies) of varying degrees of firmness, to form water-soluble films, and to stabilize some products, such as ice cream (they inhibit the formation of large ice crystals so that the ice cream can retain a smooth texture). The alginate products are used as binders, stabilizers, emulsifiers, and moulding materials in the pharmaceutical industry, cosmetics and soaps, dental and food technology, bakery and

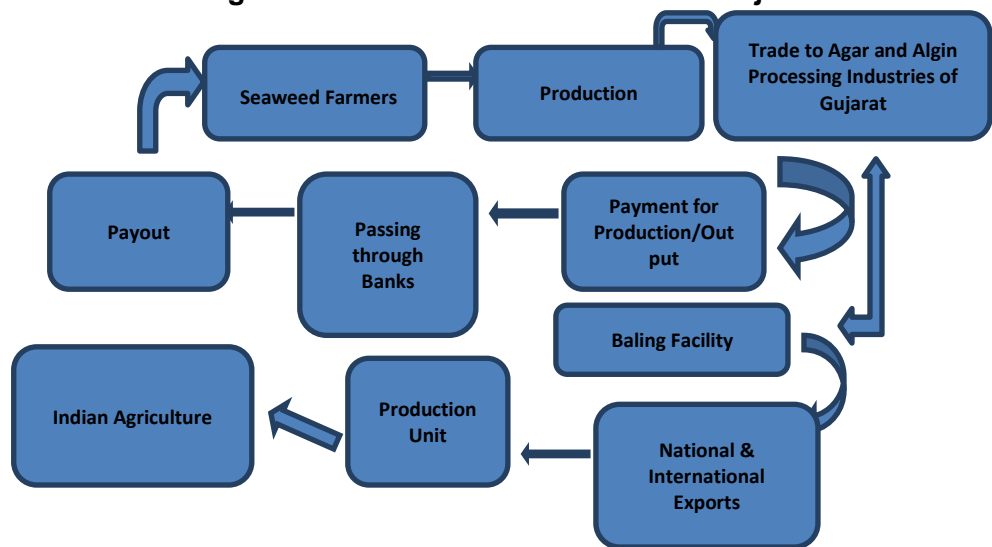
candy products, dairy products, and fish, meat, sausage and beverage processing. They are also used in a wide range of industrial products including dyes, paints and other coatings, binding briquettes and explosives, producing paper and cardboard products, filters and absorbents, textile production, pesticides, polishes and lubricants, fire retardants and extinguishers, enamelling, ceramics and other miscellaneous applications.

Demand for seaweed is excellent, because this seaweed yields agar-agar. It is a non-crystalline substance with very large molecules dissolving in water to give a thickened (viscous) solution. Agar-agar is water-soluble carbohydrates that are used to thicken (increase the viscosity) aqueous solutions, to form gels (jellies) of varying degrees of firmness, to form water-soluble films, and to stabilize some products, such as ice cream (they inhibit the formation of large ice crystals so that the ice cream can retain a smooth texture). The products from *Gracilaria* is used as binders, stabilizers, emulsifiers, and moulding materials in the pharmaceutical industry. It also used in cosmetics, soaps, bakery, candy and dairy products. They are also used in a wide range of industrial products including dyes, paints and other coatings, binding briquettes and explosives.

Potential Buyer

In 2009, Rs. 80/kg was offered for dried seaweed. Dried seaweed is exported to foreign countries for usage in many industries like food, fertilizer and pharmaceutical industries. Local market is also available in Gujarat, recently Vivekanad Rural Training Institute (Excel group of Industries) is offering excellent price for fresh and dried seaweeds.

Marketing Channels of Seaweed farmers in Gujarat



It is estimated that the Indian industry currently requires around 400 tonnes of agar annually, but only 30 percent of this total is being produced domestically.

- Mumbai and Ahmedabad, the textile hubs of India, are the major purchasers of textile-grade alginate.

	<ul style="list-style-type: none"> Erode, the hosiery hub, is also supplied by alginate producers in Tamil Nadu. Food-grade alginates are mainly supplied to the ice cream industry. Pharmaceutical and food-grade alginate, which are manufactured according to Indian and international standards, are priced around Rs 275-300/kg. <p>Estimated harvestable potential of wild seaweeds in India, by State</p> <table border="1" data-bbox="411 495 1366 775"> <thead> <tr> <th>State</th> <th>Potential (tonnes)</th> </tr> </thead> <tbody> <tr> <td>Gujarat</td> <td>250,000</td> </tr> <tr> <td>Maharashtra</td> <td>5,000</td> </tr> <tr> <td>Kerala</td> <td>100,000</td> </tr> <tr> <td>Tamil Nadu</td> <td>250,000</td> </tr> <tr> <td>Andhra Pradesh</td> <td>100,000</td> </tr> <tr> <td>Andaman & Nicobar Islands</td> <td>300,000</td> </tr> </tbody> </table> <p><i>Source of above information: Modayil (2004)</i></p>	State	Potential (tonnes)	Gujarat	250,000	Maharashtra	5,000	Kerala	100,000	Tamil Nadu	250,000	Andhra Pradesh	100,000	Andaman & Nicobar Islands	300,000
State	Potential (tonnes)														
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Andhra Pradesh	100,000														
Andaman & Nicobar Islands	300,000														
Partner institutes	GUIDE will be the lead organisation in this activity.														
Implementation plan	<p>Activities to be carried out</p> <ul style="list-style-type: none"> Appropriate site selection for seaweed culture Selection fisher folks from nearest coastal villages of Kachchh Awareness creation programme among the fisher folks including inventory and procurement of required capacity building materials Raft installation and seed stocking Physico-Chemical Analysis during culture period Harvest, drying and processing the Seaweed Trading for harvested seaweed materials Re-installing seaweed seed materials in regular interval for next cycle (45 days/cycle) Harvest, drying and processing of seaweed in regular interval Evaluate the community experiences in seaweed culture 														
Identified barriers	<ul style="list-style-type: none"> Lack of awareness about market value of seaweed Difficulty in cultivating seaweed Lack of technical know-how for plantation seaweed 														
How will these be overcome through NAFCC project?	<ul style="list-style-type: none"> Training on seaweed cultivation and its market linkage through the proposed NAFCC project. Providing market and credit access through B2B meetings and handholding coastal community and industry interfaces. 														

<p>Sustainability and replicability</p>	<p>Sustainability: Market for seaweed culture exists in Gujarat. GEER Foundation and GUIDE will help in forming an industry linkage.</p> <p>Replicability: Since demand for seaweed exists, beneficiaries under NAFCC will continue seaweed cultivation even after the NAFCC project. Any investment required in the form of frames can be borne by the beneficiaries themselves, which are relatively less costly and can be bought through the earning from sea weed cultivation activity. Success of this intervention depends on the demand and market price of seaweed, which is not expected to decline in the coming decade. Seaweed cultivation can be replicated through programs such as Mangalam Sagarlakshmi to get more beneficiaries under seaweed cultivation.</p>
<p>Estimated mitigation (in tCO₂ per year)</p>	<p>Seaweed farming can positively reduce CO₂ from the atmosphere relating to the role of ocean ecosystem on blue carbon context (Erlania <i>et al.</i>, 2013; Nellemann <i>et al.</i>, 2009). The combined ability of seaweeds to sequester carbon and as an economic source was made best use by the Marine and Fisheries Industrialization Program started by Ministry of Marine Affair and Fisheries, Indonesia for national production and enhancement of seaweed farming. It was clearly demonstrated that development of seaweeds farming not only can increase national production, but also raise the economic standards of coastal people and improving environmental conditions through its carbon sequestration capability. It is attractive to note that 3.5 tons of seaweed production utilizes 1.27 tons of carbon, about 0.22 tons of nitrogen and 0.03 tons of phosphorus (Sinha <i>et al.</i>, 2001). Seaweed farming can reduce a huge amount of CO₂ from the atmosphere and assist to mitigate global climate change. Planning and implementation processes, policy and management of blue carbon for climate change mitigation are possible through stakeholders and community involvement in both climate change mitigation and coastal livelihood activities (Herr and Pidgeon, 2012).</p> <p>Large scale seaweed farming could be used to absorb CO₂ very proficiently. It is also used to produce methane for energy production and substitute for natural gas and nutrient cycling. The previous investigation revealed that if seaweed farming covered an area of 9% of the ocean they could generate a sufficient bio-methane to restore all of today's requirements in fossil fuel energy, while removing 53 giga tonnes of CO₂ (about the same as all current human emissions) per year from the atmosphere. It could also enhance sustainable fish production to provide 200 kg per year, per person, for 10 billion people. Additional uses include decreasing in ocean acidification and increasing primary productivity and biodiversity (Tim Flannery, 2015).</p>

<p>Estimated mitigation (in tCO₂ per year) Contd...</p>	<p>The carbon sequestration ability is positively correlated with seaweed farming productivity and growth rate (Erlania and Radiarta 2014). Productivity and carbon sequestration potentials are generally influenced by cultivation period, farming techniques, physical and chemical conditions of water quality parameters (Ask and Azanza, 2002). Seaweed growth and age are also responsible for its performance during farming practices <i>K. alvarezii</i> and <i>Gracilaria gigas</i> showed the highest daily growth rate at the beginning of cultivation (Erlania <i>et al.</i>, 2013; Erlania and Radiarta 2014).</p> <p>About 120 metric ton seaweeds can be grown in 1 ha (0.01 sq km) area in sea-coast (Chennubhotla, 1988). The CO₂ sequestration by red, brown and green seaweeds in 1 ha area are 173, 720, 1,200 ton/Yr respectively. Carbon sequestration potential of seaweeds, <i>Gracilaria corticata</i>, <i>Sargassum polycystum</i> and <i>Ulva lactuca</i> was estimated by Kaladharan <i>et al</i> (2009) under laboratory conditions. The green seaweed <i>Ulva lactuca</i> registered 100% utilization of CO₂ towards carbon fixation from the ambient water up to 15 mg/l and beyond that it declined to 60%. It is estimated that the seaweed biomass along the Indian coast is capable of utilizing 9,052 t CO₂/d against emission of 365 t CO₂ /d indicating a net carbon credit of 8,687 t/d Kaladharan <i>et al</i> (2009). Similarly, removal of CO₂ by natural and man-made seaweed communities have been clearly demonstrated in the coastal region of South Korea (Chung <i>et al.</i>, 2012). Thus there is clear and unequivocal evidence that seaweed communities invariably contribute to Carbon sequestration process.</p> <p>The cultivation of red, brown and green seaweeds in 1 sq km (100 ha) area gives rise to 12 thousand metric ton wet seaweed which can be able to sequester 17, 72, 120 thousand tonCO₂/Year respectively. India has 7,517 km of coastline including Anadaman Nicobar Islands in the Bay of Bengal and Lakshwadeep Islands in the Arabian sea. Length of coastline of Indian main land is 6,100 km. Coastline of India is surrounded by Arabian sea in the west, Bay of Bengal in the east and Indian Ocean in the south. Some of the coastline area is not suitable for seaweed cultivation due to high sea current and low salinity. For practical purpose, about 5,000 km coastline region is considered for seaweed cultivation and up to about 0.5 km on the sea. So the considered area is 2,500 sq. km (=5,000 km x 0.5 km). The red, brown and green seaweeds cultivated in 2,500 sq. km area in the Indian coastline can yield 30 million ton of wet seaweeds which can be able to sequester ~ 43, 180 and 300 million ton of CO₂ /Year respectively.</p> <p>The annual per capita emission of CO₂ from India is 1.67 metric ton and the population of India in 2016 is ~1324 million. The total annual CO₂ emission from India is ~ 2211 million ton. It is estimated that the seaweed biomass along the Indian coast is capable of utilizing 3,017 t CO₂/d against its emission of 122t CO₂/d indicating a net carbon credit of 2,895 t/d. However, this estimate could be realised only if seaweed culture is popularized and taken up in a widespread manner.</p>
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Coastal Intervention Activity (CIA) No. 3²⁴:

Name of the intervention:	Promoting polyculture among coastal villages.
Description of the problem	<ol style="list-style-type: none"> 1. Declining fish-catch due to climate variations is affecting the livelihood of coastal communities. 2. Existence of vast barren lands in Kachchh coastal area is unsuitable for agriculture activity due to high salinity. 3. Relatively Kachchh district has low population density (37 persons/sq.km) than other districts, which indicates the arid condition, drought and inadequate alternative livelihoods. 4. Livelihood options are limited under the prevailing scenario for the coastal communities of Kachchh. Consequently, there is a need for alternative livelihood options to enhance their socio-economic standards.
Description of the solution	<p>Polyculture is the practice of culturing more than one species of aquatic organisms in the same unit area (marine, pond, streams and rivers). The principle of Polyculture is that production of more organisms in the particular unit area having different food habits. During the present study, three species (Seaweeds and Fishes) will be cultured simultaneously in different harvest time. This is simple technology, easily adapted by farmer.</p> <p>The increasing world demand for fish cannot be met by capture fisheries. Aquaculture production is increasing and nowadays, polyculture in cage system has an important role in meeting the world's fish demand. Polyculture in cage system in the marine environment is the most recent advance model in Indian mariculture scenario. Cage is an good aquaculture production system through floating frame technique, net materials and tie up system (with synthetic mooring rope, buoy, and anchor) as a square or round shape floating net pen to hold and culture large number of fishes and can be installed in open sea or estuary. Generally, HDPE float frames installed in open unprotected water can withstand wave conditions. Round cage (volume depends on diameter) with floatation system made of butt-welded HDPE pipes, designed for the culture of fishes such as milkfish, mullet, sea bass are used in many countries. By integrating the cage culture system into the marine aquatic ecosystem, the carrying capacity per unit area is optimized because the free flow of current brings in instantaneous exchange of water and removes metabolic waste and excess feed. Thus economically speaking,</p>

²⁴Herr, D., and E. Pidgeon, 2012. "Guidance for National Blue Carbon Activities: Fast-Tracking National Implementation in Developing Countries." *Brief of Third Workshop of International Blue Carbon Policy Working Group-The Blue Carbon Initiative.*

Kaladharan P, Veena S, Vivekanandan E (2009). Carbon sequestration by a few marine algae: observation and projection. *J.Mar. Biol.Ass. India*, 51 (1): 107 – 110

Nellemann C., E. Corcoran, C.M. Duarte, L. Valdés, C. De Young, L. Fonseca and Grimsditch, G. (eds.). 2009. *Blue carbon: The Role of Healthy Oceans in Binding Carbon.* A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal. Birkeland Trykkeri AS, Norway, 78.

	<p>cage culture is provide high economic returns other than r aquaculture activity. In view of the high production attainable in cage culture system and the presence of large sheltered coastal waters in many countries, marine cage farming can play a significant role in increasing fish production.</p> <p>Polyculture in cage system is a simple technology and locally available resources used for cage construction and operation, making it economically, socially and environmentally sound. Cage culture system reduces the predation and facilitates prophylactic measures to contain any outbreak of disease, allowing very high fingerling survival rates. It makes effective use of manpower, as daily maintenance routines and monitoring are relatively simple, and harvesting is rapid, easy, sure and complete. If cage culture will be practiced intensively that may give high yields in minimum capital investment.</p> <p>Seaweeds: Seaweeds are commercially important marine living and renewable resources of India. They contain more than 60 trace elements, minerals, protein, iodine, bromine, vitamins and several bioactive substances therefore, are of great economic value. They also serve as both feeding and breeding grounds for invertebrates and fishes. Seaweed culture would enable creation of industries for manufacturing agar-agar, algin, carrageenan and bio-fertilizer in coastal areas, results in substantial increase in revenue to fisher folk and farmers.</p> <p>Fishes Milkfish, seabass, mullet and cobia are the most important saltwater finfish species being cultured in Asia. Fish fry occur along the Indian coast, large numbers during the months of March-June and October-November. Fish culture has to be economically viable and competitive compared to shrimp and other fresh water fish culture. In India, milkfish, seabass, cobia and mullets has been cultured experimentally in Marine ecosystem. Fishes are high quality food fish with a rapid growth rate and it is highly resistant to diseases²⁵.</p> <ul style="list-style-type: none">• Polyculture is an alternative livelihood option for Pagadiyas and marginal fishers. It also serves as a solution to reduce over-exploitation of marine resources.• Polyculture model can facilitate to improve the socio-economic standards of marginal fishers, coastal communities, and Pagadiyas.
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²⁵Sinha, V.R.P., L. Fraley and B.S. Chowdhry 2001. "Carbon Dioxide Utilization and Seaweed Production." In *Proceedings of NETL: First National Conference on Carbon Sequestration*.

Tim Flannery, 2015. *Atmosphere of Hope – Solution to the Climate Change Crisis*. A Penguin Special Publication, December, 2015.

Zou, D. 2005. Effects of elevated atmospheric CO₂ on growth, photosynthesis and nitrogen metabolism in the economic brown seaweed, *Hizikia fusiforme* (Sargassaceae, Phaeophyta). *Aquaculture*, 250: 726-735.

	<ul style="list-style-type: none"> • Culture, harvesting and processing can generate the new industrial opportunity that could be provide a direct and indirect employment for the coastal populace. • In each family will be benefited from this polyculture. This technique would generate an average income of Rs. 25,000 per month. If members of a family handle more cages, retrospective amount will be automatically multiplied.
<p>Description of the technology</p>	<p>Chosen Model Generally cages are small to medium-scale with a simple design 4m x 4m with 4-3m depth), made of locally available materials for the frame (bamboo, wooden board, steel pipe) and for floats (plastic container or drum and polyurethane foam) similar to other Asian countries. The floating cage model preferred for this present study. This type cages are connected together to form a large floating raft in order to reduce the effects of wave action and strong currents. The high tidal influence leads to strong currents in many coastal areas of Gujarat. Thus, floating cage model is flexible for such ecosystem.</p> <p>Justification for this Model</p> <ol style="list-style-type: none"> 1. Capital investment is very less as compared to other culture techniques. 2. Installation of cages is easy. 3. Inspection of fishes and feeding is much easier. 4. Cultivable fishes inside the mesh have less chances of predation. 5. Harvesting is very simple; it helps to maintain the non-seasonal supply of fishes. <p>Methodology: The initial investment would be Rs. 10,000/- for cage model. The cage could be extensively used for more than 6 years. Floating raft cum cage technology would be an ideal technique in Indian coastal waters. The environmental condition of Kachchh coast is suitable for polyculture of seaweed and fish in Gujarat. The present study about 50 households will be selected from Kachchh coastal villages and engage them in polyculture activities. Each family will be maintained 10 rafts cum cages, if one or two members in a family involved in polyculture in a day other members can do their regular fishing activity. An alternative family involved in polyculture setup model that may provide viable income for the families. Duration of the seaweed culture period is 45 days for first cycle, after that culture and harvest is a regular process in a month. Duration for fish culture is 6 month regularly. This polyculture technique would generate a minimum income of Rs. 13,000/- a month per family from seaweed and average of Rs. 20,000 from fish. If, they involved in regular part time fishing activity, they can also earn a minimum of 10,000 to 12,000 additional incomes per month per family. If members of a family handle more rafts cum cages, amount will be automatically multiplied.</p>

Description of the technology
Contd...

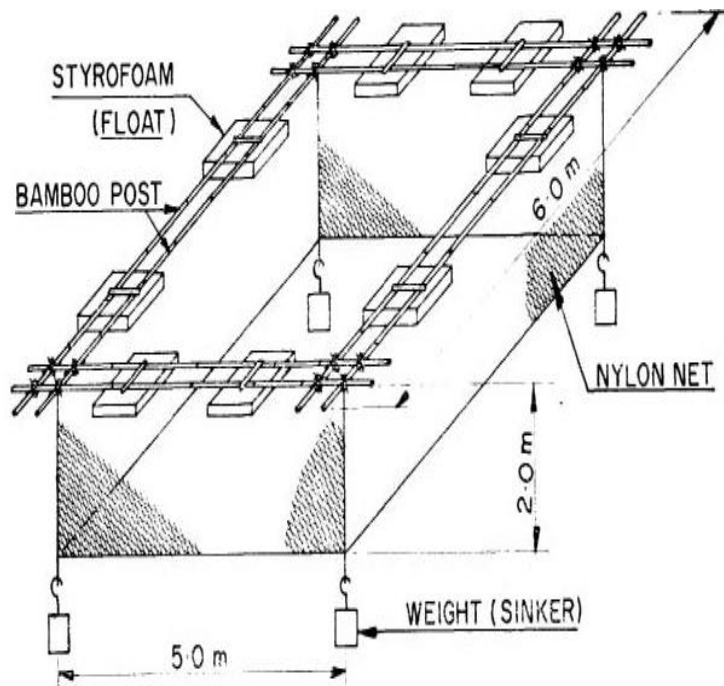


Figure 23: Cage structure model for polyculture



Figure 24: HAPA net installation in cage structure for nursery rearing



Figure 25: Fingerling stocking in HAPA net for polyculture

What is Cage Culture?

Cage culture is an emerging technology through which fishes are reared from fry to fingerling, fingerling to table size or table size to marketable size while captive in an enclosed space that maintains the free exchange of water with the surrounding water body. A cage is enclosed on all sides with mesh netting made from synthetic material that can resist decomposition in water for a long period of time. The on-growing and production of farmed aquatic organisms in caged enclosures have been a relatively recent aquaculture innovation.

Market Value:

Milkfish, mullet, seabass and cobia have the ability to grow in brackishwater, seawater and even in freshwater ponds and lakes. This fish consumes low protein pellet feed and grows up to 700 g size in 6 to 8 months. This is a boon for small and marginal farmers who can grow the fish at a low cost. Fish fetches Rs. 250-400/kg in local fish market and fish processing industries. Being a low cost fish, the fish can provide to the need of the common man in Indian domestic markets as a suitable source of animal protein and for nutritional requirements of human food in general. Representatives from the industry, fish farmers and fisheries scientists have welcomed this breakthrough.

Potential Buyer

Market is a major advantage of Indian sub-continent is excellent domestic market for fish and if supply is assured during fishing ban seasons; the returns to the fishers/farmers will be very attractive. Local peoples, fish markets and fish processing industries are the potential buyer for fishes and fish products. Marketing linkages and potential buyer details are given below.

Marketing linkages for Milkfish

	<pre> graph TD Producer[Producer] --> ExportMarketing[Export Marketing] Producer --> DomesticMarketing[Domestic Marketing] ExportMarketing --> E1["1. Financier cum Agent 2. Pre-Harvest Contractor"] E1 --> E2["1. Pre-processing centre 2. Pre-Harvest Contractor 3. Peeling shed agent"] E2 --> ProcessingCenters[Processing Centers] ProcessingCenters --> Exporter[Exporter] Exporter --> Buyer[Buyer] Buyer --> Consumer1[Consumer] DomesticMarketing --> D1["1. Wholesaler 2. Worker cum Vendor"] D1 --> D2["1. Fishermen vendor 2. Retail commission agent 3. Local market agent"] D2 --> Retailer[Retailer] ProcessingCenters --> Retailer Exporter --> Retailer Retailer --> Consumer2[Consumer] </pre>
Partner institutes	GUIDE will take the lead in this activity.
Implementation plan	<p>Activities to be carried out</p> <ul style="list-style-type: none"> • Suitable site selection for polyculture • Community Selection from nearest coastal villages • Awareness Creation Programme among the Community Peoples including inventory and procurement of required Capacity Building Materials • Cage fabrication/installation • Stocking of fish seed materials and seaweed seedlings <ul style="list-style-type: none"> • Grow-out period for fishes • Feeding will be done regular interval • Cage and Stock Maintenance • Physico-Chemical analysis during culture period • Harvest, drying and processing the Seaweed • Trading for harvested seaweed materials <ul style="list-style-type: none"> • Re-installing seaweed seed materials for 2nd cycle • Other process will be done regularly such as harvest, drying and processing of seaweed <ul style="list-style-type: none"> • Re-installing seaweed seed materials for 3rd cycle • Fish Fingerlings will be removed if it reaches 400 grams and above • Fishes will be segregated to batch wise (size wise) and sold to local fish market processing units <ul style="list-style-type: none"> • Evaluate the community experiences in polyculture • Community Based Training Programme will be Conducted at Village Level for Marketing Approach
Identified barriers	<ul style="list-style-type: none"> • Lack of awareness and technical know-how on polyculture • Lack of finances to switch to polyculture

How will these be overcome through NAFCC project?	<ul style="list-style-type: none"> • Awareness campaigns on benefits of polyculture. • Training of trainers on polyculture. • Making access to credit easier through industry interfaces as explained under seaweed intervention. • Technical handholding over 4 years.
Sustainability and replicability	<p>Sustainability: Same as seaweed cultivation, with the added advantage that beneficiary can also sell the catch in local market.</p> <p>Replicability: Same as seaweed cultivation- as long as there is a profit, beneficiaries should have no problem in procuring new batch offish-seeds. Since the activity is market linked, and can be easily trained, more people can take up polyculture as long as there is proper demand.</p>
Estimated mitigation (in tCO₂ per year)	In polyculture system, seaweed is one of the cultivable species that has potential to reduce the release of CO ₂ into the atmosphere and in helping to alleviate the trend toward global warming. This is explained in the section above.

Coastal Intervention Activity (CIA) No. 4

Name of the intervention:	Water security for identified of coastal villages
Description	Feasibility study for restoration/ recharge/ increasing capacity of existing farm ponds/ water harvesting structures/ percolation ponds/ open wells and other such structures, primarily for irrigation water availability, in the 10 target coastal villages and doing such interventions as deemed to be necessary for a particular location (in 10 villages)
Partner institutes	GEER Foundation along with local expert agency working on water security including WASMO
Implementation plan	First a feasibility study will be conducted in each village to identify the appropriate water harvest and recharge structures that can be restored for enhanced water availability Then appropriate strategy will be adopted to restore and recharge these structures so that maximum rainwater can be harvested in these structures. It may include deepening, widening, crating percolation pits, bunding creating check dams etc.
Identified barriers	<ul style="list-style-type: none"> • Low rainfall
How will these be overcome through NAFCC project?	The feasibility study will help identify appropriate location of water recharge so that every drop of rain water falling on the ground can be stored in these structures or underground to provide water even during low rainfall years.
Estimated mitigation (in tCO₂ per year)	-

Coastal Intervention Activity (CIA) No. 5

Name of the intervention:	Deploying automatic weather stations
Description	Installation of 10 automatic weather stations at appropriate locations to record real time weather data providing inputs for early warning system to make coastal community climate resilient
Partner institutes	GEER Foundation

III. PASTORAL INTERVENTIONS

Pastoral Intervention Activity (PIA) No. 1:

Name of the intervention:	Restoration of grassland by assigning 500 ha as control area for 5 years and conservation of natural varieties of grass.
Description of the problem	<p>Banni is facing high salinity problems which intern helps the invasion of <i>Prosopis juliflora</i>. Further, Banni is a duel ecosystem, during good rainfall years, part of low lying Banni forms seasonal shallow wetlands. The waterlogged and marshy saline areas get colonized by sedges like <i>Fimbristylis</i>, <i>Scirpus</i>, <i>Cyperus</i> spp. and <i>Eleocharis</i> whereas low to moderately saline areas are covered with the annual halophytic species such as <i>Zygophyllum</i>, <i>Cressa</i> and <i>Portulaca</i> species. <i>Suaeda fruticosa</i> is a predominant species in low-lying areas and at places density goes over 4000-8000 plants / ha. High saline areas are colonized by perennial grasses of low productivity and palatability such as <i>Aeluropes</i> and <i>Eurochondra</i> etc. The perennial, palatable grasses of high productivity of this area, which grows in low to moderate saline areas include; <i>Sporobolus pallidus</i>, <i>Sporobolus helvolus</i>, <i>Dichanthium annulatum</i>, <i>Cenchrus ciliaris</i>, <i>Cenchrus setigerus</i>, <i>Desmostachya bipinata</i> etc. (Singh and Kar, 1996).</p> <p>Among the tree species <i>Acacia nilotica</i> was once distributed all over the Banni, but it has been, in due course of time, replaced by <i>Prosopis juliflora</i>. The shrub and tree strata mainly composed of <i>Prosopis cineraria</i>, <i>Acacia nilotica</i>, <i>Acaciaeucophloea</i>, <i>Acacia senegal</i>, <i>Salvadora persica</i>, <i>Salvadora oleodes</i>, <i>Capparis decidua</i>, <i>Tamarix</i> sp. <i>Prosopis juliflora</i> etc. are seen even today in wilderness as well as near human settlements. Further, the tree species like <i>Azadirachta indica</i> and other plant species such as, <i>Ziziphus zozoba</i> and <i>Calatropis procera</i> are also found in the area. Nevertheless, the prominent tree species in Banni is <i>Prosopis juliflora</i> and it has been spreading very rapidly.</p>

<p>Description of the problem Contd...</p>	<p>The degradation of Banni grasslands is largely attributed to breakdown of traditional resource management system which had helped in the maintenance of equilibrium between environmental system and human activity since several centuries. Introduction of <i>Prosopis juliflora</i> and additional livestock have also been attributed to reduction in carrying capacity of these grasslands. There is a need to improve the productivity of the existing grassland resources and also reclaim or restore the degraded grasslands. This would enhance the sustainability of the system and help in coping up with the increasing demands from the livestock.</p> <p>Development of grassland area for fodder security and grazing regulations are essential for maintaining the grassland in a sustainable manner. Appropriate management plan is required for managing <i>P. juliflora</i> (example: sustainable harvesting and charcoal production) as an alternative livelihood options and employment generation in Banni and Kachchh.</p> <p>In drought years, the fodder situation worsens which results in large quantities of fodder being imported by the government agencies. The main focus of the government agencies is to provide relief supplies to relieve immediate suffering. In addition, the livestock is often forced to migrate to other parts of district or state, which leads to a host of other issues.</p>
<p>Description of the solution</p>	<p>A two pronged intervention activity has been planned for the banni region. One sub-activity involves focussed restoration of grassland in 500 ha. The second sub-activity involves creation of seed bank of saline resistant variety of grasses from Banni in 100 ha of grassland. Both the sub-activities will be implemented in participatory mode, with direct involvement of 12 wands, where each wand will be responsible for 50 ha of grassland each. Members of the wand will be rewarded by availability of grass for their livestock even in lean seasons.</p> <ol style="list-style-type: none"> 1. Creation of seedbank for native grass species of the Banni region in 100 ha. 2. Participatory restoration of grasslands in 500 ha in 3 clusters in Banni region.

<p>Description of the technology</p>	<p>Grassland conservation will be taken up in 500 ha. Grassland restoration is an ecosystem based approach to conservation; and involves multi-pronged approach in conservation to which people's participation is essential. 12 Plots of 50 ha each will be demarcated and will be fenced using barb wire. Cattle Proof Trenches (CPT) will be dug around the plots to ensure this area to be a no-grazing zone. One wand will be assigned the task of overseeing and protecting one 50 ha plot. Thus I total 600 ha of grassland will be demarcated in this manner, and will be associated with 12 wands. These wands will also function as social fence to ensure these no grazing in these 50 ha plots. The first major task in all these plots will be uprooting of <i>P. juliflora</i>, which will continue in year 2 as well. Ploughing, sowing of seeds and such activities will be taken up after complete removal of <i>P. juliflora</i>. In two plots, seeds of at least 20 species of grasses found in the Banni region will be collected and sown. In all these plots plantation of appropriate species in the border (near the bund) will also be taken up. Community will be allowed to cut grass after flowering and seed collection.</p>
<p>Partner institutes</p>	<p>Forest dept. will lead the project activities. GUIDE will be the technical lead. GEER will provide all requisite overseeing and other support to the activity.</p>
<p>Implementation plan</p>	<p>Major activities include:</p> <ul style="list-style-type: none"> • Ploughing • Trenching and fencing • Grass seed collection and Grass seed sowing • Land management and nutrient recycling • Sustainable grazing • Sustainable fodder collection <p>Villages from the Banni region will be chosen in such a way that 3 cluster of village each from east, central and western part of Banni grassland is selected. The Banni working plan (2012) is in place and a separate Banni division was formed under the Kachchh Circle of the Gujarat State Forest Department to manage these lands. Strategies for permanent solutions are being piloted under this proposal, which will be led by the forest department with technical inputs from GUIDE. <u>After the life of the NAFCC project, these grassland restoration plots will be integrated into the Banni workplan under the forest department, and thus long-term sustainability of the intervention activities will be guaranteed.</u> Silvo-pastoral systems are also planned to be promoted in the Banni region by the forest dept. Once grassland restoration work is successful, this could be taken up.</p>
<p>Identified barriers</p>	<ul style="list-style-type: none"> • Absence of work on conservation of native grass spp. (technological barrier). • Community dependency and related overgrazing (cultural barrier). • Conflict in land tenure (institutional barrier).

How will these be overcome through NAFCC project?	<ul style="list-style-type: none"> • Conservation of native grass species is a target intervention under the NAFCC project. • Community sensitization and social fencing is also being taken up in the NAFCC project. • Conflict in land tenure system might not get resolved through the NAFCC project, however providing viable solution to fodder problem for livestock and resultant increase in income among the community is anticipated.
Sustainability and replicability	<p>Sustainability: One wand is given the responsibility of looking after 50 ha of area. Since the restored grassland is expected to produce enough fodder for the livestock, it is expected that the community will maintain this patch of land. They will be trained in weeding, dung collection from the restoration plot (to ensure <i>prosopis</i> does not germinate) etc. Further, after the life of the project, all these plots will be included as apart of the Banni working plans of the forest department, which can ensure continued support of the forest department.</p> <p>Replicability: More areas near other wands can be brought under such restoration work through the forest department and GUIDE. However, the success of the NAFCC initiative will be instrumental in ensuring any such future work.</p>
Estimated mitigation (in tCO₂ per year)	Carbon sequestration through soil organic carbon is estimated to be significant.

Pastoral Intervention Activity (CIA) No.2

Name of the intervention:	Water security for identified of coastal villages
Description	Feasibility study for restoration/ recharge/ increasing capacity of existing farm ponds/ water harvesting structures/ percolation ponds/ open wells and other such structures, primarily for irrigation water availability, in the Banni area and doing such interventions as deemed to be necessary for a particular location
Partner institutes	GEER Foundation along with local expert agency working on water security including WASMO
Implementation plan	First a feasibility study will be conducted in each village to identify the appropriate water harvest and recharge structures that can be restored for enhanced water availability Then appropriate strategy will be adopted to restore and recharge these structures so that maximum rainwater can be harvested in these structures. It may include deepening, widening, crating percolation pits, bunding creating check dams etc.
Identified barriers	<ul style="list-style-type: none"> • Low rainfall
How will these be overcome through NAFCC project?	The feasibility study will help identify appropriate location of water recharge so that every drop of rain water falling on the ground can be stored in these structures or underground to provide water even during low rainfall years.

Estimated mitigation (in tCO₂ per year)	-
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Pastoral Intervention Activity (CIA) No.3

Name of the intervention:	Income enhancement for women artisan
Description	There are many women artisans in Banni that lack resources for meeting requirements of small start-up loans, skill enhancement, market linkages, fetching fair prices of their products and increasing their output and revenues etc. The project will intervene to form artisan women SHGs, federating it into artisan's PO for promotion of local handicrafts
Partner institutes	GEER Foundation with help of local NGO
Implementation plan	One women artisans' federation (SHG or the likes) will be created in each identified village in Banni. They will be imparted skill enhancement training from experts and certain revolving fund will be initially provided to manage the expenses – start-up, expansion, raw-material purchase, items, machineries and other such production related requirements. Skill development trainings will be conducted for 30 women from every village and their exposure visits will be conducted to various art and craft exhibitions to expose them to the market, the products in demand, to connect them to the various sales and marketing channels for promoting their handicrafts etc.
Identified barriers	<ul style="list-style-type: none"> Active participation from women
How will these be overcome through NAFCC project?	Women participation will be ensured through sensitizing them towards this alternate income source, and building their skills to produce such handicraft items and crating their federation, providing market exposure and linkage.
Estimated mitigation (in tCO₂ per year)	-

b. Details on Economic, social and environmental benefits project / programme

(Reference to the most vulnerable communities, and vulnerable groups within communities, including gender considerations)

EE would like to use following table to present the key benefits

Table 10: Economic, social and environmental benefits project

Components/ Activities	Key benefits (Direct)		
	Social	Economic	Environmental
1a.. Baseline Survey – climatic and socio-economic parameters and Scenario building – for sample sites	Baseline of socio-economic scenario for selected village clusters for three natural resource dependent communities in Kachchh District		Baseline of climate scenario

Components/ Activities	Key benefits (Direct)		
	Social	Economic	Environmental
1b. Vulnerability and Impact Assessment for sample sites	Understanding of community's vulnerability and losses incurred	Understanding of economic losses in terms of productivity or property losses	Understand how human activities are in turn impacting the environment and also what are the environmental/ ecosystem losses
2. Capacity building for EbA & CbA and knowledge mainstreaming	Social development	Economic well-being	Environment conservation
3. Implementation of Climate Change Adaptation interventions in the identified Talukas/ Districts	Livelihood security and social development for each of the component in agricultural, coastal and pastoral zones.	Minimize economic losses due to production loss or failure	Water security, soil and grassland conservation, mangrove conservation

c. Sustainability of intervention

i. *How will the project assure that the benefits achieved through its investments are sustained beyond the lifetime of the project?*

A multi-pronged strategy has been devised to ensure that benefits achieved through its investments are sustained beyond the lifetime of the project. Firstly, many of the training are training of beneficiaries (ToBs), where capable people from the vulnerable community are trained on various aspects to take it forward. Training is also provided on skill enhancement (e.g.: drillers in Bhungroo installation). Secondly, a proper market linkage will be provided by institutes such as GUIDE to help coastal community market and continue to grow seaweeds and polyculture. Thirdly, there is complete community ownership over each of the investments, which will ensure its longevity. Where possible, women groups will be the owners of the interventions. Finally, GEER Foundation also will identify some champions of the cause (e.g.: progressive farmers, community leaders etc.) to ensure that climate change adaptation investments are taken care of after the project duration ends. This peer pressure will ensure longevity of the investments.

Further, mid-term, third-quarter, end-term and terminal evaluation will be conducted of all the concrete interventions adopted for the project to ensure during-project success and long term sustainability of such interventions. Learnings from the project evaluations and monitoring would be incorporated in further action plan of adaptation interventions. Activity wise sustainability is explained in the component 3 as above.

In order to ensure that the investments are sustained beyond project interventions, the prime objective of capacity building exercises would be continual community development and training through departing knowledge, skills, techniques and creating sustainable systems.

d. Analysis of the cost-effectiveness of the proposed project / programme:

- i. ***Cost effectiveness will compare alternative options available and how the proposed components/ intervention are best for given climatic conditions. It will also compare how the community has preferred the selected interventions and their views / concerns are addressed while designing the project/ programme***

The proposal should compare to other possible interventions that could have taken place to help adapt and build resilience in the same sector, geographic region, and/or community.

A comparison of the chosen option vis-a-vis alternative options may be provided as per the table given below:

There are four major components and a number of sector and community specific interventions proposed under this project. There could be alternates for some of them, but not for all. These are highlighted in the table below:

Table 11: Alternate options for proposed actions

Proposed Activities	Alternate Options	Benefits
1a. Baseline Survey – climatic and socio-economic parameters and Scenario building – for sample sites	Make assessment from existing secondary literature	Baseline information on climatic and socio-economic scenario to aide further understanding and assessments will be required on the villages selected for each of the intervention. During the DPR phase no literature was found detailing the information required under this component. However, secondary literature analysis will be a part of this exercise.
1b. Climate Vulnerability and Impact Assessment for sample sites	Same as above.	Develop understanding of most vulnerable communities and the losses due to climate change for the specific villages selected in the three zones. As mentioned above, during the DPR phase no literature was found detailing the information required under this component. However, secondary literature analysis will be a part of this exercise.

Proposed Activities	Alternate Options	Benefits
2. Capacity building for EbA & CbA	Radio and television programs and mass communication.	Many of the interventions cannot be done without hands-on training and skill development. However, mass media campaigns will be a major activity for spreading the information to wider public. The Climate Change dept., GEER Foundation and Forest department will reach out to radio stations, other such mass outreach and communication devices for convergence of existing programs on communicating on climate change and building resilience to it.
3. Climate Change Adaptation Interventions (as per 2a(ii) above)	<p>Feasible and low cost adaptation options have been considered and proposed through a thorough stakeholder consultations.</p> <p>Water conservation and recharge mechanisms can have other options such as check dams, ponds etc. There also can be more options of alternative livelihood.</p>	<ul style="list-style-type: none"> • The final interventions selected are based on the feedback from community. Due to the water pipeline, almost all the villages (except some in Khadir) have access to potable water. Hence some of the traditional pond systems such as virdo etc. might no longer be practical. Recharge systems such as bhungroo also provide a cost effective solution to the dual problem of floods due to excessive rain in short duration and scarcity of water after rains, as water is fed into aquifers and soil in and around the bhungroo itself. Hence the investor is assured of returns. • Seaweed farming and polyculture are related skills to which fishermen can easily relate to. These does not include any sort of cultural interference or shifting of core area of work. Hence there are higher chances of adaptation of these climate resilient activities • Mangrove restoration and grassland restoration follows the most cost effective practices. No cheaper alternatives exist.

Proposed Activities	Alternate Options	Benefits
		<ul style="list-style-type: none"> • These interventions also promote community development through people's participation in adaptation interventions.
4. Knowledge management and mainstreaming	Video recording and film production on learnings from the interventions.	Documentation of indigenous people's knowledge on coping with changes in climate and environment, experience exchange visits. Film production is also costly, and might not be a cheaper alternative. But this could be taken up as co-financing through some other means; which will be explored by the Dept. of climate change and GEER foundation.

ii. Weighting of project activities:

How much funding will be allocated to 'investment activities', 'capacity building activities' and 'project management activities' respectively?

The table below details funds allocated for investment, capacity building and project management activities respectively.

Table 12: Fund allocated to investment, capacity building and project management activities

Type of Activity	List of Activities	Funding Requirement (INR)
Investment Activities	<p>1. Baseline Survey, Climate Vulnerability and Impact Assessment for sample sites</p> <p>2. Undertaking concrete locally appropriate, cost-effective and sector/ stakeholder specific adaptation interventions based on Community based Adaptation (CbA) and Ecosystem based Adaptation (EbA) towards activities including, but not limited to:</p> <ul style="list-style-type: none"> i. Atleast 30 units of Bhungroo in 10 agricultural villages and 2 in coastal zone. ii. Microirrigation/Drip irrigation in 800 ha in 10 villages and 10% of seed money for 100 solar water pumps. iii. Fodder seed kits to 800 households in 10 agricultural villages and selected coastal villages. iv. Water security interventions through restoration and enhancing recharge of existing old wells/ open surface or percolation ponds etc. in the coastal and pastoral zone (2-3 in each village) v. Formation of PO by collectivising livestock owning farmers in better dairy management activities 10 agri villages vi. Formation of artisan women SHGs, federating it into artisan's PO for promotion of local handicrafts vii. Mangrove restoration in 500 ha. viii. 150 units of Seaweed farming ix. 50 units of Polyculture x. Grassland restoration in 500 ha, 100 ha conserved as seed bank for saline resistant local variety of grass. <p>TOTAL ALLOCATION FOR INVESTMENT ACTIVITIES</p>	<p>INR 65,43,600.00 (Comp-1)</p> <p>INR 18,41,24,248.00 (Comp-3)</p> <p>INR 19,06,67,848.00</p>

Capacity building activities	<ol style="list-style-type: none"> 1. Sensitization towards climate change adaptation and resilience. Open training will be planned every 3-4 weeks which will be open for all villagers willing to participate, is extensive in reach and intensive in subject as it tries to tap existing schemes by handholding people to access subsidies and encourage people to adapt to climate friendly practices. 2. Training Capacity building workshops and exercises with communities on CbA and EbA where champions selected from villages will be trained on the interventions. 3. Preparing brochures on interventions for effective outreach and replication in other districts etc. 4. Publishing a vernacular magazine on the various success stories of the project 4. Developing audio-visual documentaries 5. Community mobilization through effective PR, advertising and community involvement exercises 6. Publishing project reports and value-added dissemination 	INR 1,06,59,000.00
Project Execution and management activities (INR 1.28 Crore)	<ol style="list-style-type: none"> 7. Project Management cost by the Executing Entity (3%) 8. Fees of NABARD (3%) 	INR 1,35,88,700.00
TOTAL	Investment Activities Capacity Building and Trainings Project Execution & Management Activities GRAND TOTAL	20,07,56,250.00 2,23,76,600.00 1,35,88,700.00 23,67,21,550.00

e. Alignment with the National and State Action Plans and other Policies / Programmes:

(Describe how the project / programme is consistent with national or sub-national sustainable development strategies, including, where appropriate, national or sub-national development plans, poverty reduction strategies, national communications, or national adaptation programs of action, or other relevant instruments, where they exist)

The following components of National Climate Change Action Plan as well as State Climate Change Action Plan will be directly aligned with the Project:

- **National Mission for Sustainable Agriculture** – by ensuring adoption of sustainable agricultural practices, organic farming, agri-silvi and agri-horti interventions, water and irrigation management, ground water recharge, natural pest control, renewable energy systems for farm utility etc.

- **National Mission on Strategic Knowledge for Climate Change** – by documentation of traditional knowledge of the indigenous ways of coping up with climatic variations in local lifestyle and livelihood practices, learning from them and disseminating them. As well as by creating baseline information on climatic and socio-economic profile of the identified study locations.
- **State Action Plan on Climate Change**– by ensuring that the interventions planned under the NAFCC project are concurrent with the sectoral and regional interventions detailed in the SAPCC. Further, GEER Foundation will develop a matrix on how each of the interventions under the NAFCC also can help reach the SDGs.
- **National Water Mission** - by ensuring recharge of the depleting ground water levels by controlling surface run-off (through traditional / new techniques), managing ground water harvesting for irrigation, rain water harvesting systems, and ensuring water security among communities for their various needs.
Besides the missions under NAPCC, following would be the alignment with other schemes of government of India and the State Government
- **Renewable energy goal of India** - penetration of renewable energy appliances among identified clusters / villages for energy self-reliance and energy security for sectors including agriculture and household.
- **Mangrove conservation** – Conservation and management of Mangroves along the coast line as natural barriers for sea water inundation / control salinity ingress, along with providing alternate livelihood opportunities from related co-benefits of mangrove ecosystems.
- **Restoration and reclamation of grasslands** – ensuring healthy grassland ecosystems along with its number of ecological and socio-economic co-benefits.
- **Gujarat State Action Plan on Climate Change (GSAPCC)**–The project activities are in line with the prioritized thematic areas identified under GSAPCC namely, Agriculture, Water, Forests and Biodiversity, Sea-level rise and coastal infrastructure, Energy Efficiency and Renewable Energy for the vulnerable Communities. The project activities will also provide employment opportunities to the vulnerable communities.

f. Component wise technical standards:

(Describe how the project / programme meets relevant national technical standards, where applicable, such as standards for environmental assessment, building codes, standards related to pollution control, etc. The details need to be provided for each of the interventions proposed)

Applicable standards for the components and for the interventions are given in the tables below:

Table 13: Component wise technical standards

Activity	Applicable Standard	Application to project
1a. Baseline Survey – climatic and socio-economic parameters and Scenario building – for sample sites	<i>Standard scientific research methodologies for sampling, survey, data gathering and compilations- like the UNFCCC Guidelines on Adaptation</i>	<i>Such standard methodologies shall be applied to frame the methodology for base-line surveys</i>
1b. Climate Vulnerability and Impact Assessment for sample sites	<i>Standard methodologies - like the UNFCCC Resource Guidelines on Vulnerability and Adaptation to Climate Change for National Communications OR IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations</i>	<i>Based on these guidelines, the climate change impact and vulnerability assessment of the communities of the identified clusters would be conducted</i>
2. Capacity building of communities for EbA & CbA	<i>IUCN guidelines on CbA and EbA (Concept, Principles, Options etc)</i>	<i>Such guidelines would be at the core of planning and conducting capacity building exercises</i>
3. Climate Change Adaptation Interventions (as per 2a(ii) above)	<i>Standard and best practices developed by respective national / international expert institutions for each of the intervention proposed/ planned (as listed in 2a(ii))</i>	<i>Such best practices would be identified, tested and followed for laying out concrete sector/ community specific adaptation measures</i>
4. Traditional knowledge documentation and Identifying strategies for adaptation	<i>Standard documentation reports by the UNESCO/ UNU/ UNEP/ other best practise documentations etc.</i>	<i>Such reports or documents would be referred to frame an efficient traditional knowledge documentation</i>

Table 14: Intervention wise technical standards

Component or Intervention activity	Applicable Standard	Application to project
AGRICULTURAL INTERVENTIONS		

Component or Intervention activity	Applicable Standard	Application to project
Activity 1: Construction of 'bhungroo'	Standard guidelines provided by Agriculture and co-operation department, water resource department on conservation of excess farm water and storm water.	Bhungroo is a recognized disaster mitigating and irrigation guarantee technology which filters, injects and stores excess farm water or storm water underground for usage in lean periods ensuring adequate water for irrigation on other sectors with low capital investment.
Activity 2: Micro-irrigation initiatives including drip irrigation which are linked to the Bhungroo system.	Standard guidelines provided by Agriculture and co-operation department, water resource department on sustainable utilisation of water.	Linking with the Bhungroos constructed across the villages, micro-irrigation initiatives like drip, sensor-based irrigation can dramatically improve the farm productivity.
Activity 3: Fodder seed kits	As advised by the animal husbandry dept.	Fodder security
COASTAL INTERVENTIONS		
Activity 4: Community-based assisted natural regeneration and restoration of mangroves (not planting)	Standard guidelines provided by state Forests and Environment department to afforest intertidal areas with suitable species of Mangroves.	Regeneration and restoration of mangroves will provide ecosystem goods and services to the coastal communities, thus helping them with storm protection, carbon sequestration. This will make the communities climate-resilient and socio-economically well-off.
Activity 5: Promoting seaweed cultivation among coastal villages	This will be in line with the state scheme ' Sagar Khedu Sarvangi Vikas Yojana ' (Multi-Dimensional Development Packages for coastal Communities).	Seaweed cultivation will work as an alternate source of income and as well as livelihood option to the coastal communities.
Activity 6: Promoting poly culture among coastal villages.	States Agriculture departments' Agro-climate based crop planning through Soil Health Card Programme and promotion poly cropping	Poly-cropping will reduce the risk of crop failure.
PASTORAL INTERVENTIONS		

Component or Intervention activity	Applicable Standard	Application to project
Activity 7: Restoration of grassland by a) assigning 500 ha as control area for 5 years b) Conservation of natural varieties of grass.	Gujarat state policies, schemes of various departments and initiatives for upliftment of weaker societies like tribal and coastal communities. Programs like Ten point program etc. Special attention also shall be made with any possible standards as defined under the Green India Mission.	Restoration of grasslands by assigning 500 ha as control area for 5 years. Alternate income sources through dairy products, handicrafts, etc.

g. Duplication Check:

(Describe if there is duplication of project / programme with other funding sources, if any)

There is no duplication of such a project in the project locations. This is explained in the table below:

Table 15: Duplicity check

Project	Objectives	Complementarily	Geographical Coverage/Agency
Water Conservation and Prevention of Wastage of Water²⁶	Under Water Supply Department various Information, Educational and Communication (IEC) activities are done as per requirement. For the awareness with respect to economic use of water, water conservation, rain water harvesting and storage, ground water recharge and water recycling activities can be done. The financial ratio of GoI: GoG is 100:00. Rural water supply scheme is there to supply clean drinking water to the communities.	Construction of 22 units of 'Bhungroo', targeting at least two in each of the 10 villages selected from agriculture communities.	Throughout the state/Water supply dept.
National Horticulture Board schemes²⁷	Establishment of nutritional gardens in rural areas. Distribution of fruit plant & vegetable seeds in mini kits etc ²⁸ .Rs. 250 fee per minikit per family 1. Development of Commercial Horticulture through Production and Post-Harvest Management of Horticulture Crops 2. Capital Investment Subsidy Scheme for construction/ expansion/ modernization of	Promotion of horticulture species in cropland.	Throughout the state/Dept. of Agriculture

²⁶ <https://gwssb.gujarat.gov.in/rural-water-supply-programme>

Project	Objectives	Complementarily	Geographical Coverage/Agency								
	<p>Cold Storages/Storages of Horticulture Products</p> <p>3. Technology Development and Transfer for promotion of Horticulture</p> <p>4. Market Information Scheme for horticulture Crops</p> <p>5. Horticulture Promotion Services / Expert Services</p>										
<p>Micro-Irrigation Scheme²⁹</p>	<p>Gujarat Green Revolution Company limited is an implementing agency for implementation of Micro Irrigation Scheme on behalf of Government of India and Government of Gujarat in Gujarat State through reputed authorized Micro Irrigation System suppliers, who supplies and installs the Micro Irrigation System and also provides agro services pertaining to Micro Irrigation System. It is aim to bring 2nd Green Revolution in the state by saving of water, electricity and enhancing agriculture productivity resulting in the farmers prosperity at large.</p> <table border="1" data-bbox="395 1227 914 1776"> <thead> <tr> <th data-bbox="395 1227 443 1339">S · N o</th> <th data-bbox="443 1227 595 1339">Category of Farmer</th> <th data-bbox="595 1227 707 1339">Non Dark Zone area</th> <th data-bbox="707 1227 914 1339">Dark Zone area for 57 talukas</th> </tr> </thead> <tbody> <tr> <td data-bbox="395 1339 443 1776">1</td> <td data-bbox="443 1339 595 1776">General Farmer: Small and Marginal farmer (Landholders of less than 2 hectares)</td> <td data-bbox="595 1339 707 1776">Upto 60% of MIS Unit Cost or Rs. 70,000 /- per hectares, whichever is less</td> <td data-bbox="707 1339 914 1776">Upto 70% of MIS Unit Cost or Rs. 70,000/- per hectares, whichever is less</td> </tr> </tbody> </table>	S · N o	Category of Farmer	Non Dark Zone area	Dark Zone area for 57 talukas	1	General Farmer: Small and Marginal farmer (Landholders of less than 2 hectares)	Upto 60% of MIS Unit Cost or Rs. 70,000 /- per hectares, whichever is less	Upto 70% of MIS Unit Cost or Rs. 70,000/- per hectares, whichever is less	<p>Micro-irrigation initiatives including drip irrigation.</p>	<p>Throughout the state/GGRC</p>
S · N o	Category of Farmer	Non Dark Zone area	Dark Zone area for 57 talukas								
1	General Farmer: Small and Marginal farmer (Landholders of less than 2 hectares)	Upto 60% of MIS Unit Cost or Rs. 70,000 /- per hectares, whichever is less	Upto 70% of MIS Unit Cost or Rs. 70,000/- per hectares, whichever is less								

²⁷ <http://nhb.gov.in/schemes.aspx?enc=3Z0O8K5CzcdC/Yq6HcdIxOVZI61DUqgouJqXNMGlcc=>

²⁸ <https://agri.gujarat.gov.in/nhb-schemes.htm>

²⁹ <http://ggrc.co.in/webui/Content.aspx?PageId=33>

Project	Objectives			Complementarily	Geographical Coverage/Agency											
	2	General Farmer: (Land holders of more than 2 hactares)	Upto 50% of MIS Unit Cost or Rs. 60,000 /- per hectar es, whiche ver is less	Upto 60% of MIS Unit Cost or Rs. 60,000/- per hectares, whichever is less												
	3	SC/ST Farmers (Tribal Farmers)	Upto 75% of MIS Unit Cost or Rs. 90,000 /- per hectar es, whiche ver is less	Upto 85% of MIS Unit Cost or Rs. 90,000/- per hectares, whichever is less												
<p>Promoting Solar Irrigation Pump-set Scheme by the E&PCD, GoG through DISCOMs</p>	<p>The Government of Gujarat, Dept of Energy and Petrochemicals vide its GR No.BUDGET-2014-1447-k1 dated 25.09.2014 and revised GR No. BUDGET-2014-1447-k1 dated 26.11.2014, is implementing the scheme of providing 1500 solar pump sets for agriculture purpose at an estimated cost of Rs. 60 crore. Applications are being invited through the 4 state DISCOMs from willing farmers. The DISCOMs have been given separate targets:</p>			<p>Converge with this scheme of the state government, and provide 100 solar irrigation pumps to the farmers in Khadir (which falls under PGVCL). The benefit will be integrated with the drip irrigation scheme, to ensure water conservation and will be extended to those farmers who will be willing to reap the benefits in a group/ sharing basis.</p>	<p>The scheme is being implemented throughout the state, however, the no. Of target solar pump distribution through PGVCL (under which Kachchh falls) is higher (as seen in the table in preceding column). The project will converge with the PGVCL/ GEDA under this scheme.</p>											
<table border="1"> <thead> <tr> <th data-bbox="392 1666 651 1742">DISCOM</th> <th data-bbox="655 1666 906 1742">Target No. Of Solar Pumps</th> </tr> </thead> <tbody> <tr> <td data-bbox="392 1742 651 1780">DGVCL</td> <td data-bbox="655 1742 906 1780">150</td> </tr> <tr> <td data-bbox="392 1780 651 1818">MGVCL</td> <td data-bbox="655 1780 906 1818">150</td> </tr> <tr> <td data-bbox="392 1818 651 1856">PGVCL</td> <td data-bbox="655 1818 906 1856">1050</td> </tr> <tr> <td data-bbox="392 1856 651 1895">UGVCL</td> <td data-bbox="655 1856 906 1895">150</td> </tr> <tr> <td data-bbox="392 1895 651 1935">TOTAL</td> <td data-bbox="655 1895 906 1935">1500</td> </tr> </tbody> </table>		DISCOM	Target No. Of Solar Pumps	DGVCL	150	MGVCL	150	PGVCL	1050	UGVCL	150	TOTAL	1500			
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DGVCL	150															
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Project	Objectives	Complementarily	Geographical Coverage/Agency
<p>Paramparagat Krishi Vikas Yojana (PKVY), Mission for Integrated Development of Horticulture, National Project on Management of Soil Health and Fertility (NPMSHF), under Rashtriya Krishi Vikas Yojana (RKVY)</p>	<p>The Government is promoting organic fertilizers by providing financial assistance under the following schemes:-</p> <ol style="list-style-type: none"> 1. Under Paramparagat Krishi Vikas Yojana (PKVY) financial assistance is provided for promotion of Organic farming through adoption of organic village by cluster approach and PGS certification. 2. Under Mission for Integrated Development of Horticulture financial assistance is provided for setting up vermi compost units @50% of the cost subject to a maximum of Rs.30,000/- per beneficiary. 3. Under National Project on Management of Soil Health and Fertility (NPMSHF) there is provision for promotion of organic fertilizer up to Rs.500/- per hectare. 4. Assistance is also available for organic fertilizers under Rashtriya Krishi Vikas Yojana (RKVY). 	<p>Soil improvement measures including promotion of organic farming along with drought resistant varieties of crops.</p>	<p>Throughout the state/GGRC</p>

Project	Objectives	Complementarily	Geographical Coverage/Agency
Mission Mangalam Sagarlaxmi Cultivation through SHGs/Sakhim andals	<p>Sagarlaxmi project³⁰</p> <ol style="list-style-type: none"> 1. Project for cultivation of seaweed (Kappaphycus) is under implementation. 2. Pilot project covering beneficiaries from 5 coastal districts. 3. Implemented by Gujarat Livelihood Promotion Company Ltd across districts. 4. Training will be imparted to beneficiary with support from Central Salt & Marine Chemicals Research Institute, Bhavnagar & Fisheries Department. 5. One time input investment per beneficiary comes to Rs 45,000/-. 6. Net returns per annum is estimated to Rs. 92,165/- by single beneficiary. 	Promoting seaweed cultivation among coastal villages	In coastal Gujarat
Mangroves and Coral Reefs³¹	Under this project, Government of India has finalized the four focal States for MFF India project namely Gujarat, West Bengal, Andhra Pradesh and Orissa. Gujarat Forest Department has one program ³² to conserve Mangroves.	Community-based assisted natural regeneration and restoration of mangroves is not a part of any such schemes. Under the NAFCC project, only restoration of existing highly degraded mangroves will be taken up, and will not include planting.	In coastal districts

³⁰<http://glpc.co.in/showpage.aspx?contentid=33>

³¹<http://envfor.nic.in/division/mangroves-and-coral-reefs>

³²<https://forests.gujarat.gov.in/aspects-of-mangrove-cover.htm>

h. Details on Stake-holder consultation:

(Describe the consultative process, including the list of stakeholders consulted, undertaken during project preparation, with particular reference to vulnerable groups, including gender considerations).

Table 16: Details of stakeholder consultations

Consultation	Date/ Place	Participation	Objective	Outcome
Interdepartmental consultation	11/01/17 and 12/01/17, Gandhi Nagar	Participant list has been attached as annexure 6 to this report.	To finalise the intervention activities to be deployed in the landscape, convergence options.	Final list of activities to be deployed in the landscape. Understanding and agreement on convergence.
Interdepartmental consultation at Bhuj	07/02/2017	List attached as annexure to this report	Exact interventions, site selection	Some interventions were merged, site selection of talukas finalised
Stakeholder consultation in Banni	08/02/2017	List attached as annexure to this report	Discuss interventions, gather opinion	Positive feedback on NAFCC project
Stakeholder consultation in coastal villages	09/02/2017	List attached as annexure to this report	Discuss interventions, gather opinion	Positive feedback on NAFCC project
Stakeholder consultation in Khadri bet	10/02/2017	List attached as annexure to this report	Discuss interventions, gather opinion	Positive feedback on NAFCC project

Photographs and attendance sheets of these stakeholder meetings are attached as annexure 9 and 10 to this document.

i. Learning and knowledge management component to capture and disseminate lessons learned for the proposed project.

As described earlier, the fourth component of the project viz. **‘Knowledge management and mainstreaming’** would lead to learning and knowledge generation from the indigenous communities of the area and in capturing and dissemination of the best practices. Moreover, the three-phase evaluation and monitoring to be adopted for the project would ensure lessons learned from implementing the project with various key natural resource dependent communities and building their resilience towards climate change through various adaptation

measures adopted during the course of the project. Experience exchange visits of villagers on the technology adopted, and exposure visits of officers to the sites will be organised. Experience dissemination roundtable/symposium will also be organized in Gandhi Nagar to disseminate the success stories of the NAFCC project.

j. Sustainability of the project/programme outcomes has been taken into account when designing the project / programme.

Table below details how the sustainability of the project outcomes has been taken into account when designing the project.

Table 17: Expected outcomes and sustainability mechanism

Expected Outcomes	Expected concrete Outputs	Sustainability mechanism	Responsible party/ies
Baseline information of climatic and socio-economic scenario of natural resource dependent communities in the selected project locations. Vulnerability index of natural resource dependent communities based on exposure and sensitivity, with special emphasis on indigenous and women groups	Baseline development of the selected villages in the three zones with reference to the NAFCC project. Identification of vulnerable groups and problems faced by them in terms of livelihood and earning, health, water, energy and food.	Indicators will be periodically measured and will be weighed against the baseline to evaluate the success of the interventions. No other sustainability is envisaged.	EE + local partner institutions (eg: Arid Communities and Technologies (ACT))
Local communities' capacity building, knowledge, skills and technology enhancement in coping up with climate change.	A total of 26 ToBs and 57 awareness camps and open trainings in all the three zones.	The intention of having 24 ToBs is to ensure that knowledge will be kept with the beneficiaries and passed on to other people. Champions from each village will be identified who will ensure the spread of knowledge. Finally presentations and other such modules from training programs will be made available in the website of GEER Foundation.	EE + local partner institutions

Expected Outcomes	Expected concrete Outputs	Sustainability mechanism	Responsible party/ies
<p>Locally appropriate, sustainable and low cost physical and concrete interventions for coastal, agriculture and pastoral zones</p>	<ol style="list-style-type: none"> 1. At least 30 units of bhungroo in 10 agricultural villages and 2 in coastal zone. 2. Micro-irrigation/Drip irrigation in 800 ha in 10 villages. 3. Fodder seed kits to 800 households in 10 agricultural villages and selected coastal villages. 4. Mangrove restoration in 500 ha. 5. 150 units of Seaweed farming 6. 50 units of Polyculture 7. Grassland restoration in 500 ha, 100 ha conserved as seed bank for saline resistant local variety of grass. 	<ol style="list-style-type: none"> 1. People will be trained on operating and maintaining bhungroo. Local skilled labor will be hired for drilling activities, resulting in local skill development in case of any repairs. 2. Drip irrigation is planned in such a way that all the farmers in the villages in Khadir bet be benefitted. GGRC will be roped into promoted drip irrigation in remaining areas. Handholding will be done in accessing subsidies and soft loans for bringing the rest of the agricultural area under drip irrigation. The intervention under NAFCC will kickstart this paradigm shift for better water management at demand side. 3. Fodder kits, once taken up by the beneficiaries will have seed stock from previous harvest to do fodder cultivation in the years to come. Dept. of Animal Husbandry will also conduct animal health camps and other awareness programs as a part of exiting mandates to encourage fodder cultivation. 4. A proper industry linkage will be created to market seaweed and polyculture. This will ensure the sustainability over a long period. The price will be market linked; but it is anticipated that the demand from industry will be stable as at present seaweed is being imported from other parts of the country to 	<p>EE, Dept. of Forests, GUIDE, Dept. of animal husbandry, Dept. of agriculture</p>

Expected Outcomes	Expected concrete Outputs	Sustainability mechanism	Responsible party/ies
		<p>Gujarat. Products of polyculture will be mainly for export and consumption in other parts of the country.</p> <p>5. Active industrial participation in mangrove restoration is expected. Even though only 500 ha of mangrove is being restored, it is anticipated that this can kickstart similar restoration work in other areas also. In areas where NAFCC will implement the activities, a village based mangrove conservation group will be formed to ensure that the sites are maintained well even after the exit of the project. Coastal community will also be able to access the benefits of restored mangroves by better catch of fish and crustaceans. This will be ingrained through training and awareness camps.</p> <p>6. Grassland conservation sites will be included by forest department as working circles under the Banni working plan after the NAFCC project. Hence these grassland restoration sites will be restored and maintained even after the lifetime of this project. One ward is being given the responsibility of maintaining grassland in 50 ha. They will continue to guard and look after this patch given their livestock gets enough fodder through the restoration activities.</p>	

Expected Outcomes	Expected concrete Outputs	Sustainability mechanism	Responsible party/ies
Document on traditional knowledge of those communities to cope up with local climatic variability in their life-style and livelihood practices and framing appropriate strategies for CbA and EbA	A handbook on local traditional knowledge of the communities for their own ways of coping up with climate variability, experience exchange visits, exposure visits and knowledge dissemination workshops.	All the knowledge tools and techniques will be made accessible to the public by hosting them on the website of GEER Foundation. At a later stage, GEER Foundation may also consider a dynamic web based solution for a digital repository of such traditional knowledge.	EE and DoCC

k. Provide an overview of the environmental and social impacts and risks identified as being relevant to the project / programme.

The table below details the environmental and social impacts and risks identified with reference to the project.

Table 18: environmental and social impacts and risks

Checklist of Environmental and social principals	No further assessment required for compliance	Potential impacts and risks – further assessment and management required for compliance
<i>Compliance with the Law</i>	All the activities proposed under the four components in this project are in line with national and states policies to protect environment and sustainable development of communities in the region. The project activities are in line with the Gujarat SAPCC as well as the priority thematic areas identified in the National Mission for Sustainable Agriculture, National Water Mission and other state and local statutory laws and regulations.	No negative impacts or risks are identified.

<p><i>Access and Equity</i></p>	<p>The intervention activities proposed will give equal opportunities to each and every section of the communities. All activities are based on identified vulnerability issues prevailing in the region.</p> <p>All intervention actions to be deployed will be undertaken in a participatory mode; where opinions from stakeholders will be invited in an open and transparent way. Free and prior approval of people will be obtained from people in the FGDs during the baseline and vulnerability assessment and during the training activities.</p> <p>Agricultural zone: The C&I developed to identify the beneficiaries will include weightage on parameters such as small and marginal farmers, no electricity connection and dry bores.</p> <p>Coastal: Weightage will be given to communities and people who are most marginalised such as pagadiyas (who do not own or rent boats for fishing).</p> <p>Pastoral: Weightage will be given to those wands where there are higher concentration of families with smaller number of cattle head per family.</p>	<p>Impact: Each of the identified interventions will specifically target the section that is identified as most vulnerable to Climate Change. This includes small and marginal farmers in agricultural zone, people with less than 5 cattle heads in pastoral zone and fishermen without boats (pagadiyas) in the coastal zone. It is expected that through the interventions all these vulnerable sections will have access to better and alternative livelihood. Better bonding of people in the village owing to participatory decision making in implementing interventions will ensure equity.</p> <p>Risks: Despite the best efforts to promote equity in the benefits of the project by selecting beneficiaries, in some cases, there may be a risk of diluting the principles of beneficiary selection. It is also possible that some members of the community may express their opinion and try to guide implementation of intervention.</p> <p>Mitigation option: GEER Foundation and members of the survey team will be cautious against such bias. Due care will be taken that there is due representation of people from all strata in ToBs and trainings. A common criteria for selecting the beneficiaries will be developed in order to have uniform selection of beneficiaries.</p>
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<p><i>Marginalized and Vulnerable Groups</i></p>	<p>A detailed survey will be conducted to identify marginal and vulnerable groups in the area during the baseline and VA assessment. As mentioned in the section above, a core target group of the interventions are marginalised and vulnerable group.</p>	<p>Impacts: These interventions are intended to benefit the marginalised and vulnerable in becoming resilient to climate change.</p> <p>Risks: In spite of best efforts, it is possible that some of the marginal sections of the society is left out from being included as direct beneficiaries.</p> <p>Mitigation option: Adaptation and capacity building measures are designed based on their adaptive capacities. Therefore, there is no risk for the community.</p>
<p><i>Human Rights</i></p>	<p>The proposed project will not violate any human rights of the communities and hence does not foresee any violation of human rights.</p>	<p>None</p>

<p><i>Gender Equity and Women's Empowerment</i></p>	<p>Project would ensure participation by women fully and equitably, receive comparable socio-economic benefits and that they do not suffer adverse effect. It is proposed that amongst the total beneficiary, 35% would be women.</p> <p>Agricultural zone: Weightage shall be given to women farmers as beneficiaries to installation of bhungroo and drip irrigation measures. and drip irrigation will be allotted where possible to women farmers</p> <p>Coastal zone: Participation of women in seaweed cultivation and polyculture will be ensured by having women as half of the participants in ToBs and training programs.</p> <p>Pastoral zone: Grassland restoration will give women opportunity in saved time for investing in alternative livelihood, such as embroidery and Kachchhi needle works.</p>	<p>Impact: Women empowerment and more active participation of women in ensuring community resilience to climate change is expected.</p> <p>Risk: The potential risk could be non-availability of interested among women and non-availability eligible woman groups to implement the activities. This may lead to diluting the objective of promoting equality in the region by selecting other gender people. Certain cultural barriers are also identified in coastal and banni areas as traditionally women in these zones do not venture out of the house for work.</p> <p>Mitigation option: Sensitization during baseline assessment and VA will be done with women separately in identified villages. As a part of training and capacity building program, an orientation training will be conducted among the communities stressing on the importance of gender equality is necessary in the society. Along with that, criteria for selecting beneficiaries will be formulated in advance to have fair opportunities to all sections of the community.</p>
<p><i>Core Labour Rights</i></p>	<p>All payments will be made as per prevailing Government policies and hence ensuring core labour rights.</p>	<p>None.</p>

<i>Indigenous peoples</i>	Kachchh is not a tribal district; and no indigenous peoples are identified in the three zones where interventions are to be carried out. Still as a part of Knowledge management and mainstreaming activity, traditional knowledge and practices of communities and indigenous people are documented by following prevailing government norms and policies. Workshops and FGDs will be organised with both local and scientific communities in order to validate the knowledge collected during orientation & training and institute scientific bases for the local knowledge.	<p>Impact: A permanent repository of all traditional wisdom and knowledge.</p> <p>Risk: Initially communities may hesitate to provide information on traditional knowledge and practices followed in the region due its confidentiality.</p> <p>Mitigation: Workshops with orientation programs and FGDs will be organised with both local and scientific communities to make them aware about the knowledge they possess and how it will help in mitigation and also boosts morality among communities about the significance of their knowledge and encourage them to utilise it effectively.</p>
<i>Involuntary Resettlement</i>	Not applicable to this project. None of the activities proposed in this proposal involves resettlement of communities.	None
<i>Protection of Natural Habitats</i>	None of the activities proposed in this proposal negatively affects natural habitats in any way. On the other hand, the project will improve the natural habitats by restoration of mangroves and restoration of grassland in the Banni region.	<p>Impacts: Ecosystem based adaptation by conservation of mangroves and grasslands. Grasslands of Banni support rich avaian population. Coastal zone has many endemic species including one species of prawn.</p> <p>Risks: Invasion of coastal region by the seaweed which will be used for cultivation.</p> <p>Mitigation option: It has been confirmed that the seaweed being used in cultivation is not invasive and is of indigenous variety. The same applies to polyculture also.</p>

<p><i>Conservation of Biological Diversity</i></p>	<p>None of the activities proposed in this proposal negatively affects biological diversity in any way. The interventions proposed in this proposal will take care of present biological diversity and boosts the possibilities improve over the conditions with the promotion of see weed cultivation and community-based assisted natural regeneration and restoration of grassland and mangroves</p>	<p>Same as above</p>
<p><i>Climate Change</i></p>	<p>All the activities are designed to in focus with climate change adaptation. Interesting aspects is the huge GHG mitigation potential many of the interventions have. Mangrove restoration (carbon sequestration and reduced emissions from degradation and deforestation), grassland restoration (carbon sequestration, soil organic carbon (SOC)), bhungroo (SOC), seaweed culture (carbon sequestration). So the intervention activities planned has huge climate change aspect.</p>	<p>Impact: Huge adaptation impacts with mitigation as major co-benefits apart from livelihood and income generation Risk: Carbon storage has risks of abrupt climatic events. There is also a risk of mitigation potential not being recorded appropriately. 4 years might be to small period to monitor some of the climate change adaptation changes. Mitigation option: GEER Foundation has already undertaken studies on carbon sequestration of mangroves. GUIDE has undertaken studies on GHG mitigation potential of seaweed cultivation. GEER Foundation will also undertake periodic assessment of the SOC in places where units of bhungroo will be installed.</p>

<p><i>Pollution Prevention and Resource Efficiency</i></p>	<p>While promoting the activities all the pollution prevention policies will be followed and equipment used will be in line with energy specification specified by the government. Seaweed cultivation, polyculture, does not include ant effluent release into water. Grassland restoration does not involve application of fertilizers or pesticides.</p>	<p>Impact: No activity involves pollution in form of leachate, effluents, smoke, particulate matter emissions etc. Risk: Diesel pumps can be used for pumping water from bhungroo. Appropriate system to discard plastic pipes used in drip irrigation might not be followed. Mitigation option: Pollution from diesel pumps will be negligible as compared to the baseline. Under the project no promotion of diesel pumps are being made; but is left to individual beneficiary to decide the pumping system as per their capacity. On the other hand, handholding will be done to avail electric and solar water pumps.</p>
<p><i>Public Health</i></p>	<p>None of the activities proposed in this proposal negatively affects public health.</p>	<p>No risks are identified.</p>
<p><i>Physical and Cultural Heritage</i></p>	<p>One of the project activity is to document the traditional knowledge and practices followed by the communities in a scientific way. This does not involve and is not complicit inthe alteration, damage or removal of anycritical physical and cultural heritage. The site selected for agricultural interventions is Khadir bet, which is also site of one of the Indus Valley Civilizations. Such sites will not be harmed in any way by installations</p>	<p>Impact: Can impact positively, potential to result in better tourism facilities at Dholavira site in Khadir owing to better water facilities and associated products available Risk: No risk has been identified. Mitigation action: None required.</p>
<p><i>Lands and Soil Conservation</i></p>	<p>Intervention activities proposed in these activities will conserve water, soil and as well as lands. Bhungroo conserves water. During training climate resilient agriculture including organic farming, usage of liquid fertilizers etc. will be promoted.</p>	<p>Impact: No negative impact envisaged. Risk: No risk identified. Mitigation action: No mitigation action proposed.</p>

3. IMPLEMENTATION ARRANGEMENTS

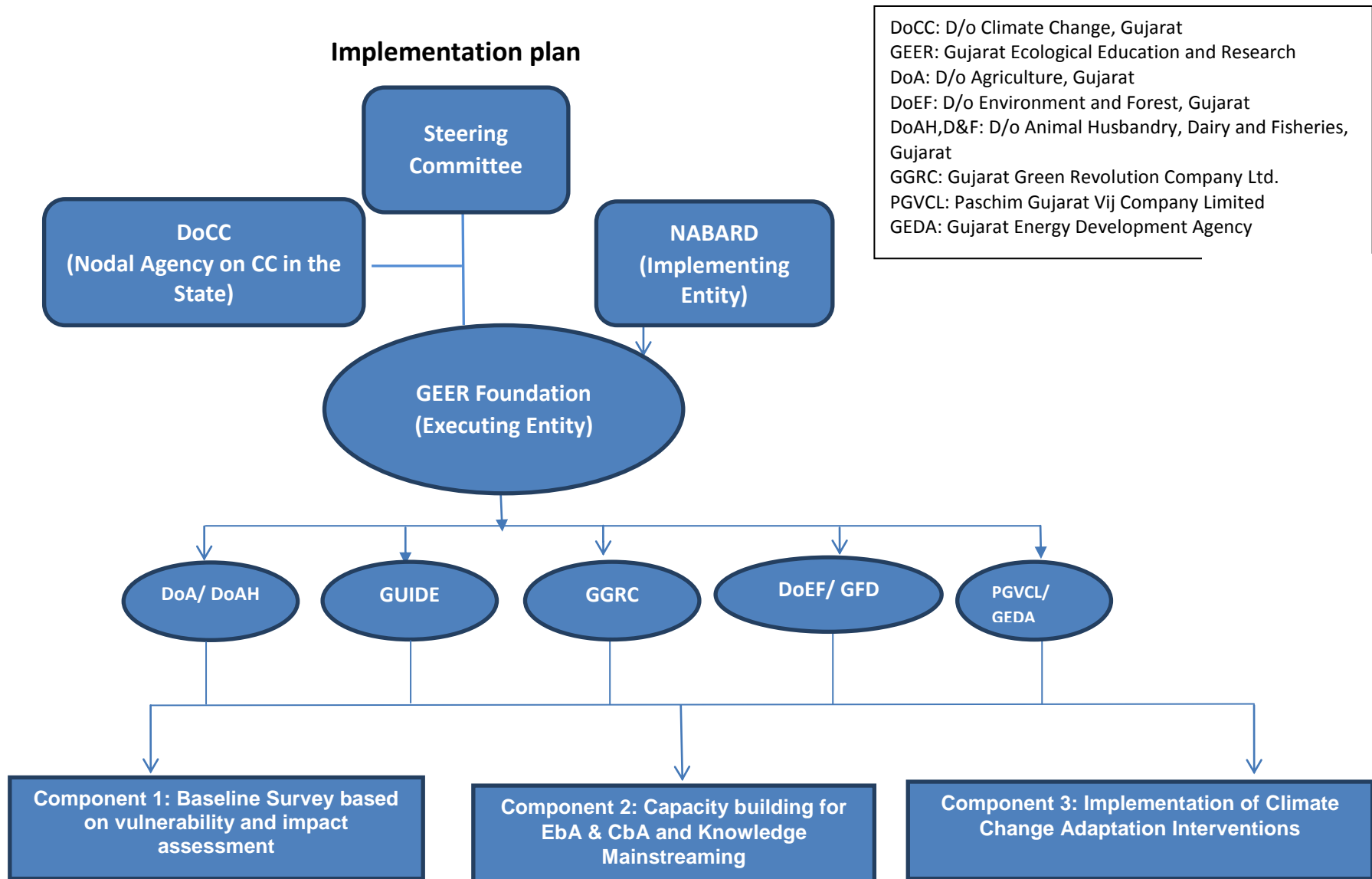
- a. Describe the arrangements for project / programme implementation.
 - i. Who will implement the project and what are their comparative advantages and capacity compared to other potential implementing institutions?

Gujarat Ecological Education and Research (GEER) Foundation, Gandhinagar, Gujarat (an autonomous organization under the Department of Forests and Environment, Government of Gujarat) would implement the Project as Executing Entity under the overall guidance of the Department of Climate Change, Govt. of Gujarat. The Foundation is engaged in ecological research and education since its establishment in the year 1983. It is a recognized Scientific Research Institute by the Department of Science and Technology, Government of India since March 1999 and is also a member of the IUCN, India. The Foundation has undertaken a large number of research studies on forest ecosystems, wetland ecosystems, marine ecosystems (including mangroves and coral-reefs), grassland ecosystems and saline desert ecosystems.

GEER Foundation will be functioning as the Executing entity of the project under the overall guidance of the Department of Climate Change, nodal agency for climate change for the State of Gujarat. The Department will act as a bridge between the MoEFCC, NABARD and executing entity. One of the major objectives of the department is to create core competencies within the government and capacity building of various departments, along with the general public, to integrate climate change perspectives in their planning.

ii. How will the project be coordinated with (and/or mainstreamed into) related development activities of the targeted sector?

The project will work in coordination with the respective related activities under the Agriculture, Horticulture and Animal Husbandry Department, Fisheries Department, Forest and Environment Department, Rural Development and Panchayat-Raj Department, as well as with those of the allied organizations, schemes etc. to ensure mainstreaming, avoid duplications and seek appropriate permissions for work.



b. Describe the measures for financial and project / programme risk management (also include environmental and social risk, if any).

Risk	Rating (High / Medium / Low, etc.)	Mitigation Measure
All intervention activities planned may not come to fruition as planned.	Low	Each activity is headed by exclusive entities with high level of competence and experience, outcome of all activities will be ensured. Continuous monitoring will be done to ensure that implementation of activities take place as planned.
Project Management and Implementation Risk	Low	The executing entity may not be able to reach all the villages where interventions are planned in an efficient manner. Local institutions would be associated in to ensure seamless project operations. However all local departments and GUIDE has a very strong ground presence. Bureaucrats dealing with the concerned subject will be special invitees for the State Steering Committee on Climate Change. This would enable the policy makers to be well versed with the progress of the project activities and thus ease in sanctioning of funds. Preliminary activities of the project will be initiated on time like baseline survey, capacity building of the community etc. and the information of initiation of project activities may be informed to the central ministry for ease in sanctioning of fund.
Selection of beneficiaries	Low	The project will be piloted in 10 agricultural villages, 10 coastal villages and 12 wands (hamlets) in the pastoral zone. Beneficiary selection will be made in a participatory manner, following a set and well defined criteria. The first version of this criteria is presented in section 2(a)ii of this DPR. This common criteria will be applied for selecting community in an unbiased manner. There could be certain social risks associated (like non-acceptance, non-cooperation), however, farmers would be capacitated at the inception level on the long-term benefits of the project interventions.
The stakeholders might not agree to do all the activities.	Medium	Conservation of grassland depends a lot on proper support from the communities residing in the Banni region. They have to act as a social fence and ensure no grazing takes place. It is however possible that this is not very successful; or some irresponsible or

		<p>disgruntled member might not agree to cooperate. There is also possibility that this happens midway, after year 1 and appropriate investments having taken place. Forest department and GUIDE has assured that only those wands which are known to be cooperative will be selected as partners for this intervention. Effective awareness campaigns shall be a part of the implementation to sensitize everyone involved on the need to conserve grassland.</p> <p>It is expected that O&M in all the instances will be contribution from the beneficiaries. This includes labour and maintenance of frames used for seaweed and polyculture etc.</p> <p>There is also risk involved in participation of women due to cultural barriers. However women will be equipped with all required know-how in each of the interventions.</p>
Environmental Risk	None	The project will not have any risk towards environment. The project will indeed contribute towards safeguarding ecosystem services and resource conservation such as water, energy, agricultural crops etc.
Events such as erratic rainfall, extreme high temperature may impact success of the interventions	Low	The interventions are designed to tackle exactly this issue. For instance, in events of prolonged drought even though bhungroo cannot help beyond a point, having micro-irrigation facility will ensure that irrigation can still be done to an extent. Extreme climatic weather (such as storm) can destroy the seaweed and poly culture frames. But these frames are not very capital intensive, and beneficiaries will be able to repair and rebuild the frames with comparative ease. In case such a prolonged extreme weather condition starts from the start of the project, EE may consider devising more effective solutions (eg: bhungroo inside ponds).
Timely execution	Low	Good coordination with implementing entities involved will be ensured. The project will have advisory panel who will guide the teams regularly with regards allotment of budget, workload etc.

Not establishing market linkage	Medium	Seaweed cultivation is being promoted with the expectation that there will be a good demand from the industries. However there is a possibility that this demand dries out or that establishment of proper market linkage failed. This will result in loss of the enterprise. GUIDE will ensure that during the lie of the project such strong industry linkages are made. Industrial associations also shall be made a part of the linkage. From market surveys conducted by GUIDE, there is ample demand, and the risk can easily be overcome. Any seasonal fluctuations in price can still occur, but these are expected to be just temporary.
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c. Describe the monitoring and evaluation arrangements and provide a budgeted M&E plan. (Monitoring and evaluation cost need to be included in executing entity management cost).

A technical advisory committee (TAC) under the chair of the Principle Secretary, DoCC, will be constituted comprising all the partner departments so as to manage the project. The Director, GEER Foundation will be the member secretary of the TAC. All the key implementing departments (indicated in the implementation plan) will be member of the meeting. The TAC will convene every quarter and monitor the progress of the project. TAC, DoCC and GEER Foundation will be responsible for providing information to NABARD and MoEFCC. After the information is received, M&E would be done by NABARD and third party appointed by MoEFCC.

Monitoring and Evaluation plan Activity	Responsible person	Yr. I	Yr. II	Yr. III	Yr. IV	Total	Timeframe
Mid-term Review	SSC/ EE		√			1	1 month
Third-quarter term Review	SSC / NSC			√		1	1 month
Terminal Evaluation	Third Party (as suggested by Funding agency)				√	1	1 month
TOTAL	-	0	1	1	1	3	3 months

Note: The Project would have three reviews / evaluations as follows:

- Mid Term Evaluation – to be conducted by the State Steering Committee along with the Executing Entity. It would include the assessment of components 1, 2, 3 at all the locations that would have been completed by the mid-term and components 4 and 5 that would have been initiated by the mid-term. The recommendations and learnings shall be incorporated in the further action plan. An evaluation report shall be submitted to the funding agency.

- Third Quarter-end term Evaluation - to be conducted by the State Steering Committee and / National Steering Committee Officials. It would include the assessment of components 4 and 5 at all the locations that would be in full flow during this phase of the project execution. The recommendations and learnings shall be incorporated in the further action plan. An evaluation report shall be submitted to the funding agency.
- Terminal Evaluation - to be conducted by a Third Party as suggested by the National Steering Committee. It would include the assessment of the entire project outcomes and at all the locations that would have been successfully completed. The recommendations and learnings shall be incorporated while further implementation and reporting. An evaluation report shall be submitted to the funding agency.

d. Include a results framework for the project proposal, including milestones, targets and indicators with gender disaggregated data (as per the format in Annexure1).

The detailed result framework is attached as Annexure-1. Below is the representation of the intervention activity result framework.

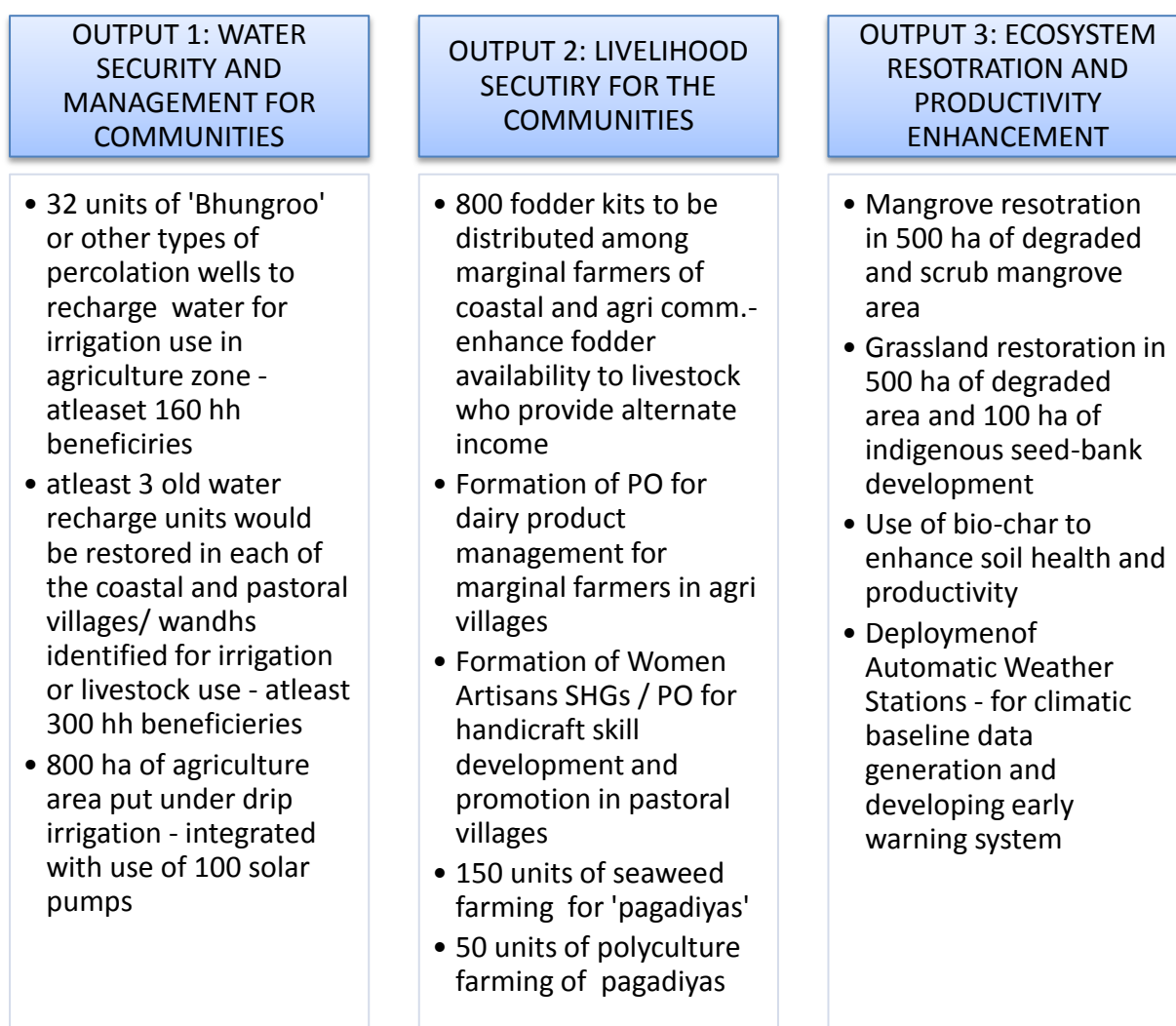


Figure 26. Activity Results Framework

Under this project, the GEER Foundation will mandate a Gender Assessments when developing intervention activities and conducting training. Guidance on how to do this will be developed by GEER Foundation at the inception stage of this project. Each activity should describe in what ways aspects of gender will be addressed in the implementation Plan. At a minimum, all indicators that could have gender aspects should be **sex-disaggregated in their data collection, analysis, and reporting**. This is, in the first instance, anything having to do with people involved in the activities as beneficiaries, farmers, fisherfolk, herders, trainees, heads of household, etc.

Where activities have issues or outcomes they are expecting to achieve related to specific gender groups (or other target groups), the indicators and expected results will clearly address this. Eg:

- number of new female seaweed cultivators or business owners instead of number of new businesses owners disaggregated by sex.

But, even where activities are not obviously directed at different groups, EE will attempt to look deeper to examine if there could be **disparate effects on gender** as a result. For example:

- Would improving availability of water change the lives of young girls more than young men? If so, how? And how measured?
- Would a change in income through seaweed cultivation affect the lives of women more than men? If so, how? And how measured?

- e. **Include a detailed budget with budget notes, a budget on the Implementing Entity management fee use, and an explanation and a breakdown of the execution costs.**

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
1. Baseline Survey Vulnerability Assessment of the identified villages in the three zones	--		65,43,600.00	This includes all the costs involved in survey, assessment, travel costs for conducting socio-economic surveys, ecological surveys, personnel and expert costs, purchasing lab and scientific equipments, procurement costs of experts/ consultants and other misc. costs etc.	GEER Foundation with involvement its researchers and external experts

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
2. Capacity building of communities for EbA & CbA					
ToB – CC resilience in agriculture (6), bhungroo (3), mangrove restoration (3), grassland restoration (6) and seaweed and poly culture (6)	24	40,000	9,60,000.00	This includes training material development cost, food for at least participants during training, Travel & logistics of trainers and any honorarium to be paid to trainers. Approximate number of participants in each ToB program is 25. The training may be for more than one day, and may include experience exchange visits also. Includes TA/DA for participants + extra incentive for women participants.	GEER Foundation through identified experts in the field
Open training- CC resilience in agriculture (6), bhungroo (3), mangrove restoration (3), grassland restoration (6) and seaweed and poly culture (6)	57	25,000	14,25,000.00	This includes travel for experts, stationeries and other training material expenses, food and refreshment expenses for approximately 50 participants for 1 day training.	GEER Foundation through identified experts in the field
Fee of Resource persons to be invited for all 32 villages	32	12000 per village	3,84,000.00	To lend expertise in training the communities	GEER Foundation through identified experts in the field

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
Annual workshop for the 3 stakeholders once in a year for 3 yrs	9	1,00,000	9,00,000.00	Annual stakeholders workshop to ensure smooth functioning of all the interventions in all villages	GEER Foundation
Exposure Visits	Lumpsum		8,00,000.00	Exposing the communities taking up the interventions to areas where it is successful	GEER Foundation
Inter-departmental workshop of officers	3	1,00,000	3,00,000.00	One inter-departmental meeting inviting all concerned line dept. each year to ensure coordination and replication	GEER Foundation
Audio-visual documentaries	5	4,00,000	20,00,000.00	To document the project activities in creative audio-visual media for outreach & communication	GEER Foundation by involving govt. empaneled agencies
Community mobilization	Lumpsum		10,80,000.00	To involve and mobilise the community towards the project activities through involvement activities and local advertisements	GEER Foundation by involving govt. empaneled agencies
Publication of resource material and project reports	Lumpsum		8,00,000.00	Reports and project success stories etc will be published for communication and value added dissemination	GEER Foundation
SUB-TOTAL Component-2			INR 1,06,59,000.00		

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
3. Climate Change Adaptation Interventions in the identified talukas					
Construction of at least 30 bhungroo on agricultural zone and at least 2 in coastal land.	32	5,62,500	1,80,00,000.00	This cost includes Installation of bhungroo, at least 30 in agricultural zone and 2 in coastal zone (includes recce assessment, geophysical testings of subsoil up to a depth of 1000 ft for each acre of lands for total 25 acres of lands, geophysical log data collection, Log data analysis, Bhungroo designing, Bhungroo drilling, Bhungroo casing sourcing, casing transportation, casing.	GEER Foundation will oversee the work. Technical work will be done by a firm appointed by GEER Foundation.
Drip irrigation integrated with solar pumps	800 ha 100 solar pumps	33,989.00	2,71,91,200.00	This includes cost of laying drip pipes, expert cost, transportation cost personal costs and providing 100 solar water pumps	GEER Foundation with help of concerned department
Fodder kits	800 units	10,000.00	80,00,000.00	This includes cost of each fodder kit, expert charges, transportation charges and other expert charges	GEER Foundation with help of concerned department

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
Bio-char application & hands-on training	200 units of bio-char producing bio-energy system	10,000 per unit + training cost	21,00,000.00	Will be provided to marginal farmers for naturally improving their farm's soil health, fertility, water retention with a co-benefit to emission reduction	GEER Foundation with support of agency appointed
Farmers PO for dairy management in 10 agri villages	Lumpsum		20,00,000	Includes cost of farmer's PO formation and supporting activities of milk collection, storage, value added product processing and marketing etc.	GEER Foundation with support of agency appointed
Mangrove restoration	500 ha	36,000.0	1,80,00,000.00	This includes costs for mangrove restoration charges as per KPT	Concerned department and agency appointed.
Seaweed cultivation	150 units	1,56,250.00	2,34,37,500.00	This includes cost of seaweed farm, bamboo rafts, fish nets, anchors, braider rope etc.	Appointed agency
Polyculture	50 units	2,12,250.00	1,06,12,500.00	This includes establishing polyculture farms, bamboo frames, nets, floating materials, catwalk materials, fish nets, rope etc.	Appointed agency
Automatic Weather Stations	10	5,00,000.00	50,00,000.00	To be deployed at appropriate locations in the coastal areas to gather baseline data and early warning system	GEER Foundation

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
Restoration of existing open wells/ percolation or surface ponds in each of the coastal and pastoral villages/ wandhs identifies to improve water recharge capacity	22 Feasibility studies and 3 units to be restores in each of the 20 villages	6000 per feasibility study 15,00,000 per village	3,01,32,000.00	Includes feasibility study in all the coastal and pastoral villages identified and doing restoration measures to enhance water recharge and storage capacity of the existing water recharging structures thereby ensuring villager's water security	GEER Foundation with help of appointed agency
Grassland restoration	500 ha Restoration, 100 ha seed-bank	54,883.00	3,29,30,000.00	This includes establishing seed banks and watchman costs.	Forest Department and appointed agency
Women Artisan's PO for skill development and handicraft promotion interventions in Banni	10 SHGs of women artisans 15 skill enhancement training and 15 exposure visits	10,00,000 per SHG formation and seed money 1,00,00 for skill enhancement trainings and exposure visits	40,00,000.00	Includes cost of women SHG formation & seed money and skill enhancement of women artisans and their exposure visits to handicraft exhibitions and fairs.	GEER Foundation with support of agency appointed
Expert and consultancy charges for efficient and scientific implementation of the planned interventions	Lumpsum @ 1.5% of the total intervention cost		27,21,048.00	This will be for the expert agencies appointed for carrying out the interventions to meet their expert and transportation costs over and above the intervention cost	Respective expert agency
Sub Total (component-3)			INR 16,41,24,248.00		

Project/ Programme Components	Units	Unit wise cost	Total cost (in Rs.)	Budget note	Responsible institution
5. Project/ Programme Execution cost (3%)			60,39,805.00		GEER Foundation
6. Total Project/ Programme cost:			20,73,66,653.00		
NIE fee (3%)			62,21,000.00		NABARD
GRAND TOTAL			21,35,87,653.00		

f. Include a disbursement schedule with time-bound milestones at the component level

S. No.	ACTIVITY	Year 1				Year 2				Year 3				Year 4			
		3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
1 a.	Baseline Survey – climatic and socio-economic parameters and Scenario building – for sample sites																
1.b	Vulnerability and Impact Assessment for sample sites																
2.	Capacity building for EbA & CbA																
3.	Climate Change Adaptation Interventions (as per 2a(ii) above) in each sample Cluster (of FIVE villages) in the identified Talukas/ Districts																
4.	Knowledge management and mainstreaming																

Annexure 1: Table for Presenting the Result Framework- Tentative

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
Component 1a: Baseline Survey – climatic and socio-economic parameters and Scenario building – for project locations					
Outcome 1.1: Climatic and socio-economic information of key natural resource dependent communities from the identified villages from agriculture, pastoral and coastal regions.	Contribution to the existing body of knowledge base for the project area and sectors.	No Existing literature specifically on climate change adaptation on the identified 20 villages and 12 wands.	Identified 10 agricultural villages in Khadir bet, 10 coastal villages and 12 wands in Banni region (pastoral zone).	Report on Baseline-Survey.	Assumptions: Primary data collection is possible for each of the regions on all the parameters for baseline assessment. Risks: Lack / non-availability of data of the past at Taluka/ village level.
<u>Output 1.1.1:</u> Baseline assessment report including scenarios based on tier-II data.	Approved report on baseline for the 10 villages from agricultural region, 10 from coastal region and villages from 3 clusters in Banni region.	No report or assessment available to the knowledge specifically on the villages identified under the NAFCC project.	10 villages from agricultural region, 10 from coastal region and 12 wands (hamlets) from Banni region.	Survey reports; Interviews with key researchers, field notes, associated spreadsheets, associated tier-II data.	Assumption: Primary data collection is possible for each of the regions on all the parameters on baseline assessment. Risks: There could be dearth of baseline information in many of the villages in Banni region, including on demographic and other socio-economic data over long historic time period chosen for developing a historical

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
					baseline.
Component 1b: Climate Vulnerability and Impact Assessment for sample sites					
Outcome 1.2: Scientific assessment of risks, vulnerability and impacts of climatic changes on socio-economic settings of the key natural resource dependent communities in identified cluster of villages/ talukas.	Contribution to the existing body of knowledge for the project area and sectors.	No report or assessment available to the knowledge specifically on the villages identified under the NAFCC project.	10 villages from agricultural region, 10 from coastal region and 12 wands (hamlets) from Banni region.	Report on impacts and vulnerability assessment.	Assumptions: Primary data collection is possible for each of the regions on all the parameters on baseline assessment. Risks: Lack / non-availability of data of the past at Taluka/ village level.
Output 1.2.1: Village perceptions on climate change impacts, existing coping/adaptation strategies and capacities to adapt to climate change analysed and understood	Researchers of the EE and line department staff understand farmer's, fisherfolk's and herder's knowledge on climate change and their existing coping and adaptation practices, Knowledge of	A detailed assessment on vulnerability or a perception of people on changes in climate and how it affects their lives has not been undertaken.	Vulnerability Assessment conducted for 10 villages from agricultural and coastal region and villages within 12 wands in the Banni region.	Vulnerability Assessment report	Assumptions: Stakeholders understand concepts of vulnerability and resilience after sensitization workshops. Risks: Lack of data on localised meteorological data.

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
	farm, coastal and pastoral household typologies based on adaptive capacities integrated into development of adaptation strategies by researchers and line department staff.				
Component 2: Enhancing capacities for implementing Climate Change Adaptation (both EbA & CbA)					
Outcome 2.1: Enhanced capacity of affected communities in terms of knowledge, skills, infrastructure and systems to cope up with climate change	Community know-how, knowledge and skill enhancement	Community is not well aware of techniques to be resilient to vagaries of climate change.	In total 4,020 community members spread across three zones will be trained on various aspects.	24 ToBs and 57 open trainings will be conducted. Training and capacity building means, methods and materials can be used for verification (eg: agenda, attendance sheet, photographs, training report etc.)	<p>Assumptions: Community members understand the subject and will adapt the climate change measures.</p> <p>Risks: Medium of training is English, which everyone might not comprehend.</p> <p>Mitigation option: As much as possible, training will be conducted in</p>

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
					<p>Gujarati and Hindi. Technical jargons will be translated as much as possible.</p> <p>Risk: Possibility of more stakeholders desiring ToB/skill enhancing workshops.</p> <p>Mitigation option: In such instances, more members will be accommodated as much as possible. More trainings can be organised where it is possible through government programmes.</p> <p>Risk: Low participation of women in ToB/workshops in cases where travelling is involved.</p> <p>Mitigation option: To avert the risk, subject material in Gujarati will be provided to each of the attendees of such training to be distributed among peers in their respective village.</p>

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
<p><u>Outcome 2.1:</u> Stakeholders aware of the climate change impacts in the target region of 10 villages each from agriculture and coastal community and villages from 3 clusters in the Banni region of Kachchh district in Gujarat.</p>	<p>Target communities understand and agree to implement the best practices on climate change adaptation in vulnerable locations.</p>	<p>No evidence of understanding and agreement on climate change impacts and vulnerable locations/groups. Currently, about only a few stakeholders have an understanding of climate change impacts and climate change adaptation practices in agriculture, coastal or pastoral sectors.</p>	<p>At least,</p> <ul style="list-style-type: none"> a) 1230 families in 10 agricultural villages will be aware of the current climate change challenge in agriculture sector and agree to implement best climate resilient practices in agriculture sector. b) 700 households in 10 coastal villages will be aware of the current climate change challenge in coastal region, and agree to adopt climate resilient practices to adapt to climate change. c) 240 households from Banni landscape agree on grassland restoration measures and 	<p>Training reports</p>	<p>Assumptions: Farmers agree to implement the informed best practices and adaptation intervention in all the three groups.</p> <p>Risks: Activities for which people are trained might not lead to the desired output in one season, which might lead to discouragement amongst the stakeholders. This is especially identified to be a risk in water conservation through Bhungroo and seaweed farming.</p>

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
			sustainable fodder management practices. d) 4020 households from all the three zones to be benefitted in open skill development and climate resilient practices and techniques.		
Component 3: Implementing Climate Change adaptation interventions					
Outcome 3.1: Livelihood, water and food security of the natural resource dependent communities in 10 villages in Khadir bet in Bhachua taluk the agricultural zone.	Improved resilience, minimise loss in income, improved state of water, livelihood, food security.	There are no bhungroos installed in the agricultural zone selected under the project.	Selective interventions in 10 selected villages from agricultural region in Kachchh district.	Field visit observations, project implementation reports.	Assumptions: rains, even though erratic will occur. Risks: failure in market linkage, complete failure of rains.
<u>Output 3.1.1:</u> 30 units of Bhungroo are installed in 10 agricultural villages in Khadir bet in such a way that there are at least two units in one village. At least 2 units of bhungroo will	Water availability to irrigate farm lands, decreased salinity of water in the farmlands, potable water in agricultural and coastal zones.	Loss of crop due to flash-floods and water scarcity, saline water for irrigation and drinking	30 farmers(preferably women groups - each group consisting 5-7 small and marginal women farmers) in 10 agricultural villages in Khadir betof Kachchh district.	Completion certificates from the installing partner, periodic field observations, periodic field tests conducted by GEER Foundation on soil nutrients and SOC	Assumptions: Rains will occur, and geologically there is no problem in the selected villages to install Bhungroo. Risks: Complete failure of rain will result in no recharge of water. Further,

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
be installed in the coastal region also.					there is risk that after the geological survey, it is found that bhungroo is not suitable for the Khadir Bet region or coastal zone. In both these instances, the EE has the responsibility to evaluate the risk after every year, based on the performance of installed units of bhungroo.
<u>Output 3.1.2:</u> Drip irrigation facility is installed and operational in 800 hectares spread across 10 selected villages in the Khadir bet region.	New mode of Irrigation to conserve water in demand side adopted in 10 villages	No drip irrigation in any of the villages in Khadir bet.	800 ha of land under drip irrigation in such a way that all small and marginal farmers are covered. Among medium and large farmers, 1 ha will be covered under drip irrigation after all land of small and marginal farmers are covered. A total of 360 households are expected to be covered under this.	Implementation report, field observations.	Assumptions: Rains will occur, and geologically there is no problem in the selected villages to take up drip irrigation and share the facility among everyone in the village. Risks: Complete failure of rain will result in no recharge of water.
<u>Output 3.1.3:</u> Government bodies give 90% subsidy for installing solar water	Access to water for irrigation, equity in pumping water by	No solar water pumps installed in Khadir Bet.	Community will be encouraged to form beneficiary groups in such a way that solar	Installation certificate by the solar water pump agency, subsidy	

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
pumps. However even the 10% seed money forms financial barrier. Under NAFCC 100 solar water pumps will be installed in the 10 villages in Khadir Bet by providing 10% of the seedmoney, rest of the 90% coming as subsidies.	eliminating the need for diesel powered pumps, reliance in pumping water as solar energy is renewable, and the life of such pumps is at least 25 years.		water pumps can be shared. So the optimistic target is covering all the farmers of Khadir Bet. The base target is 100 beneficiaries.	disbursement details by the electricity distribution entity, and field observations.	
Output 3.1.4: Fodder seed kits	Self-sustenance in fodder, decreased purchase of fodder from outside	Fodder is not grown, is purchased from outside during lean season.	800 households in agricultural zone and coastal zone.	Fodder seed kit distribution report.	Assumptions: People will be willing to take up fodder cropping also, given the availability of water. Risks: Fodder crop failure, low number of participants to take up this intervention.
Outcome 3.2: Livelihood, health, water, environmental security of the natural resource dependent communities in 10 villages of Abdasa taluk in the coastal zone of Kachchh	Improved resilience, minimise loss in income, improved state of potable water, livelihood, security.	No seaweed cultivation, polyculture practiced. No massive mangrove restoration work.	700 households from 10 selected villages in Abdasa taluk in Kachchh district.	Field visit observations, project implementation reports.	Assumptions: Proper market linkage will be available for seaweed farming and poly-culture. Risks: Failure to develop appropriate market linkages.

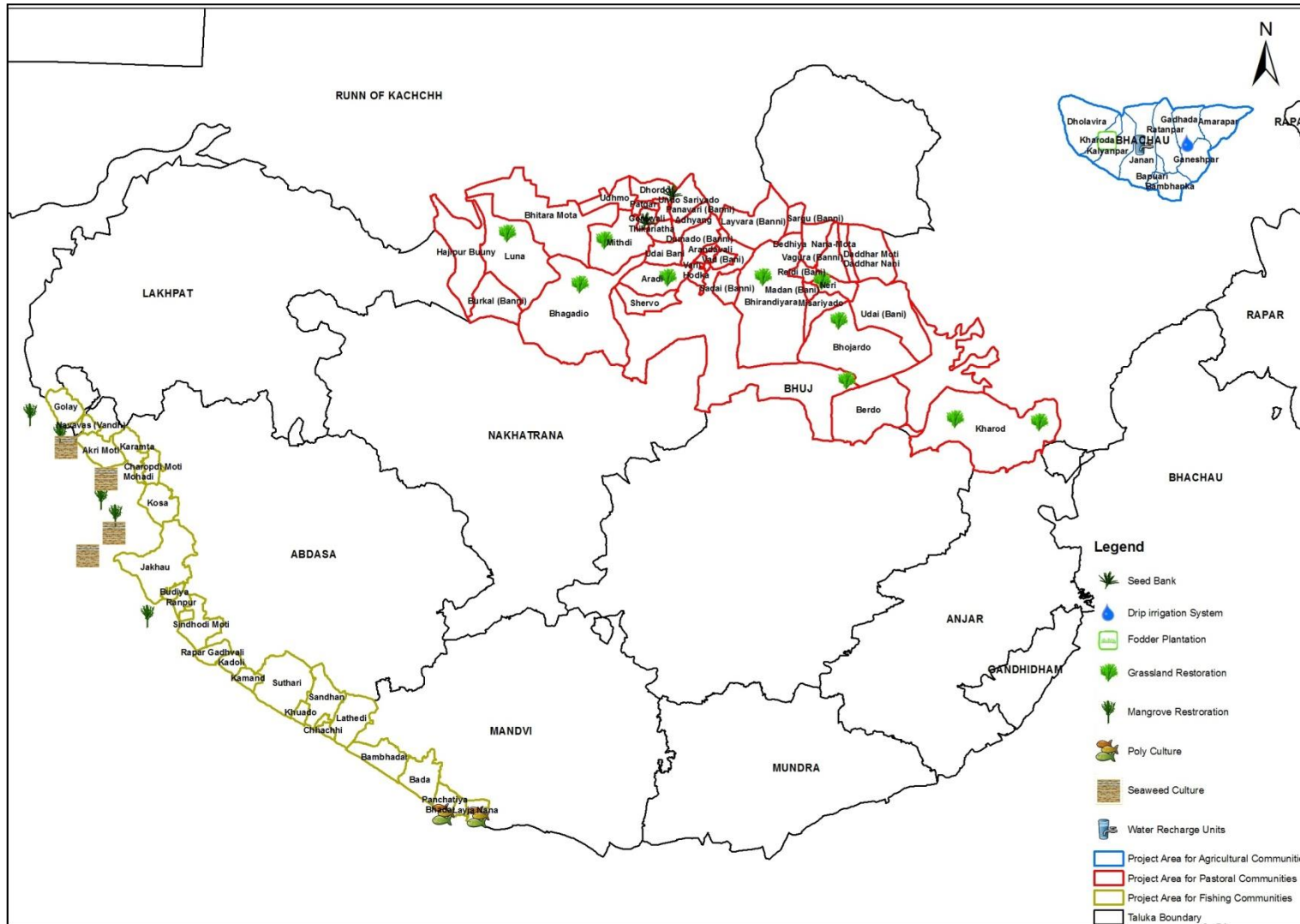
Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
district					
<u>Output 3.2.1:</u> Mangrove restoration in 500 ha in 3 clusters in Kachchh district	Mangroves in the 500 ha has been classified as medium to high dense mangrove forests	Sparsely / low dense mangrove forests	500 ha of sparsely dense mangrove in 3 clusters from identified in Kachchh district	Mangrove restoration report, if available, geo-spatial data can be used for analysis, FSI data (ISFR reports) also can be used for verification.	Assumptions: Community will be interested in conserving mangroves. Risks: Not allowing any harvesting of mangroves leaves as fodder, which might result in decrease of enthusiasm among community to conserve mangroves. Incursions of sea before start of the restoration activity can hamper the final results.
<u>Output 3.2.2:</u> 150 families take up seaweed farming in 10 coastal villages in Kachchh district	Resilience in livelihood through alternative source of income.	Dependency on fish catch, no seaweed cultivation.	150 households from 10 villages from the coastal zone.	Training and implementation reports	Assumptions: Proper market linkage and appropriate revenue will be garnered. Risks: Drop in prices, inadequate market linkage, abandoning the technique in high yield seasons. These risks are abated through phased awareness campaigns, targeting most vulnerable sections of the coastal community and

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
					handholding by technical lead (GUIDE). Fisheries department will also be instrumental in forging an industry linkage.
<u>Output 3.2.3:</u> 50 families take up polyculture in 10 coastal villages in Kachchh district	Resilience in livelihood through alternative source of income.	Dependency on fish catch, no polyculture.	50 households from 10 villages from the coastal region.	Training and implementation reports	Same as above for seaweed farming.
Outcome 3.2: Participatory ecological restoration of grassland in Banni region and sustainable livestock management.	Improved resilience, minimise loss in income of people residing in the Banni region. Better ecosystem services from the grassland.	Loss of grasses in Banni region	600 ha of grassland which will be managed by 12 wands in the Banni region. Of these, 500 ha is earmarked only for grassland conservation and 100 ha will also function as a salinity resistant grass seedbank.	Field visit observations, project implementation reports.	Assumptions: Good working relationship between the people and forest department in Banni region. Acceptance of grassland restoration measures. Risks: Cultural barriers in cattle grazing practices.
<u>Output 3.3.1:</u> Participatory restoration of grassland in 500 ha	Fodder availability for cattle from grassland	Fodder is not available for livestock after the monsoons	200 households spread in 10 wands; each wand will be responsible for maintaining the health of 50 ha of grassland.	Field visit observations, project implementation reports.	Assumptions: People will be willing to manage cattle so that they do not wander off and hamper grass restoration efforts. Risks: Voluntary manpower for maintenance and conservation of

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
					grassland may not be as easy, intensive coordination between many stakeholders is required
<u>Output 3.3.2:</u> Grass seedbank creation in 100 ha	At least 20 local species of grass is conserved in the 100 ha area.	No such seedbank for grass in Banni region.	40 households in 2 wands, each wand will be responsible for maintaining the health of 50 ha of grassland	Field visit observations, project implementation reports.	<p>Assumptions: Seeds of all variety of grass will be available as of date. Other assumptions are same as the one in the above output.</p> <p>Risks: Same as above.</p>
Component 4: Knowledge management and mainstreaming					
Outcome 4.1: Traditional Knowledge Documentation and identification of specific need-based strategies for adapting to climate change and its impacts	Record of knowledge base of different ways communities adapt their lifestyle / practices to harsh climate, development of knowledge products and value added dissemination for scale-up	No repository of local knowledge, experience exchange on climate change resilience.	Identified villages/ clusters mentioned in the sections above, government officers and scientists.	Annual meeting reports, 1 knowledge product that will be published, reports of experience exchange visits.	<p>Assumptions: Traditional knowledge collection will be possible in an unobtrusive manner.</p> <p>Risks: Compilation and recording of traditional knowledge is a laborious task, and there is possibility of some traditional solutions not figuring in the final report/knowledge product. To offset this, a mechanism will be devised to make all such information available</p>

Outcome/ Output	Indicator	Baseline	Target	Source of Verification	Risks and Assumptions
					through a digital medium at a later stage, for which GEER Foundation will raise funds through another project.

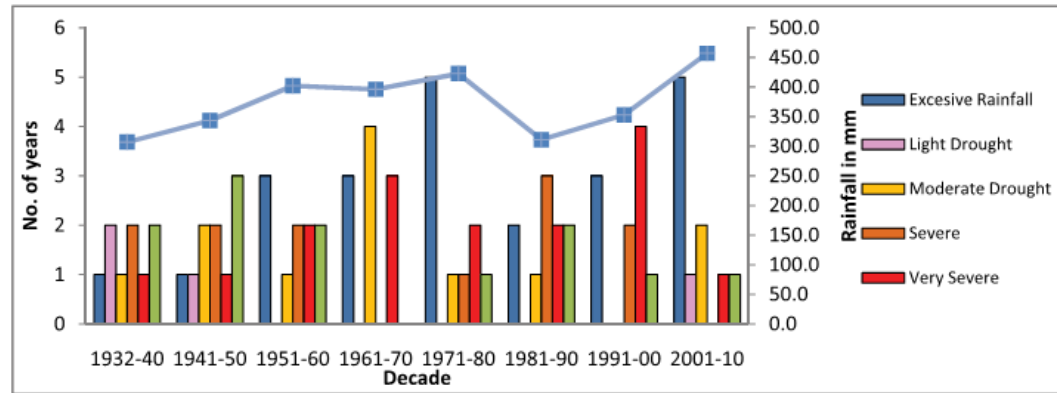
Annexure 2: Map of the Proposed Project Locations



Note: The Location of activity legends is tentative, and based only on primary assessment, the actual project intervention locations may vary according to the vulnerability and impact assessment, baseline survey and field conditions.

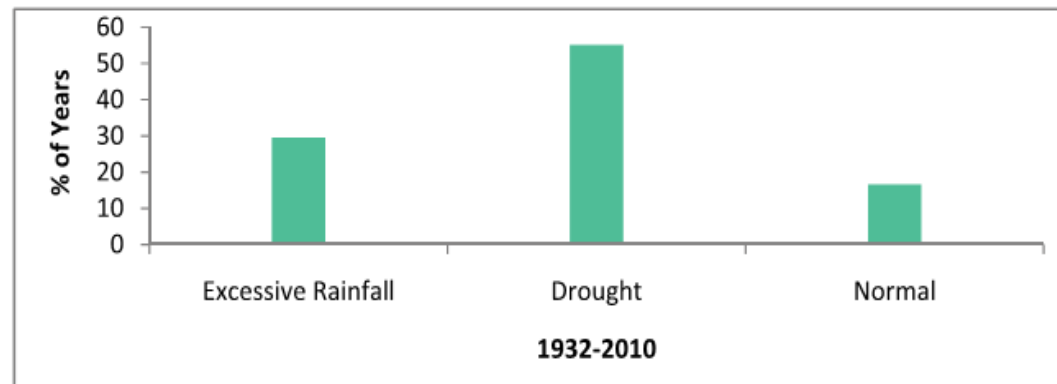
Annexure-3: Some Important trends in Climate and Natural resource productivity in Kachchh District

Decadal occurrences of Meteorological Drought³³



Source: IMD and GSDMA

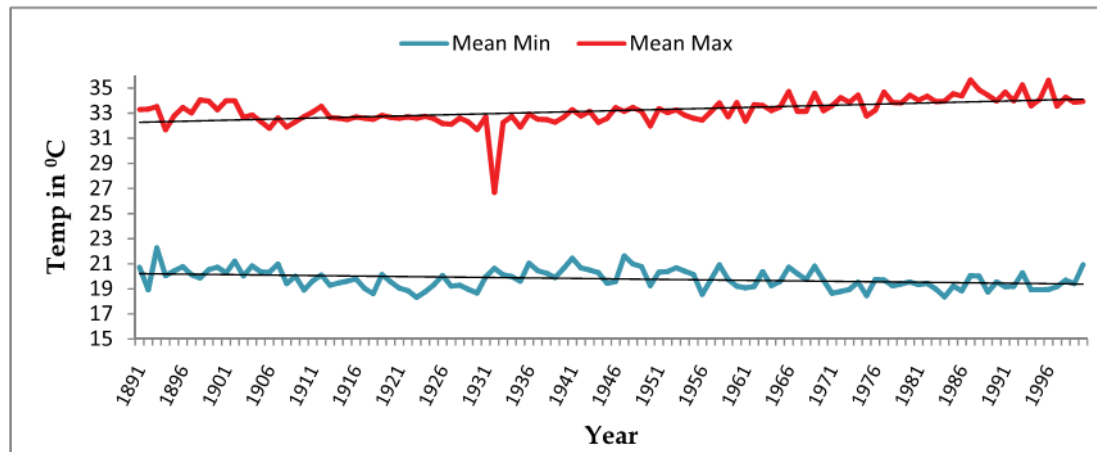
The occurrence of drought, excessive rain and normal years in Kachchh (1932-2010)



Source: IMD and GSDMA

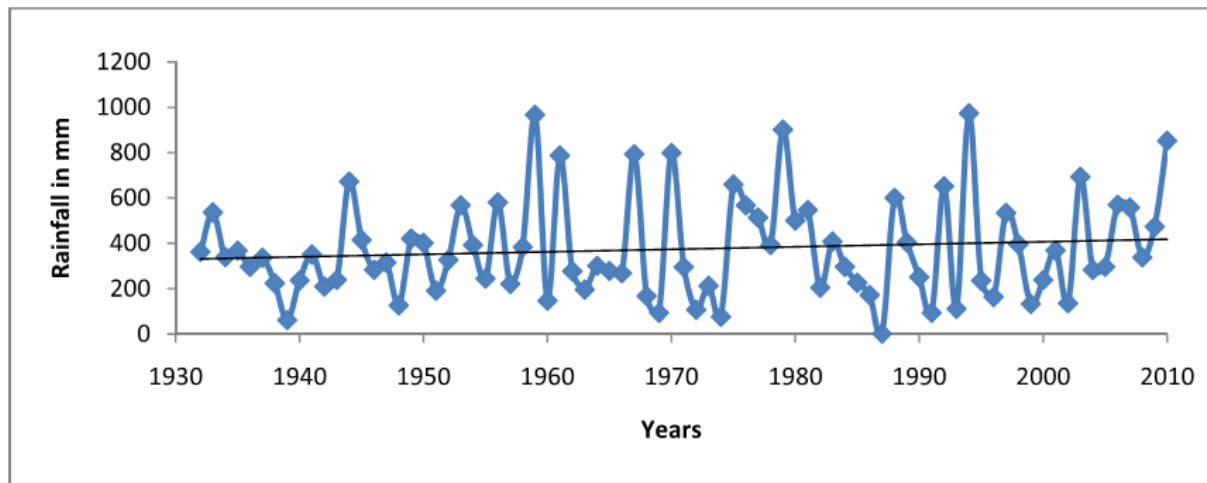
³³ Source of these Graphs: Gavali, D., Lakhmapurkar, J., Vasava, H., & Deshkar, S. (2011). *Trends of Changing Climate and Effects on Eco-Environment of Kachchh District, Gujarat*. Gandhinagar: GEC.

Yearly Mean Max & Min temperature trend for Kachchh (1891-2000)



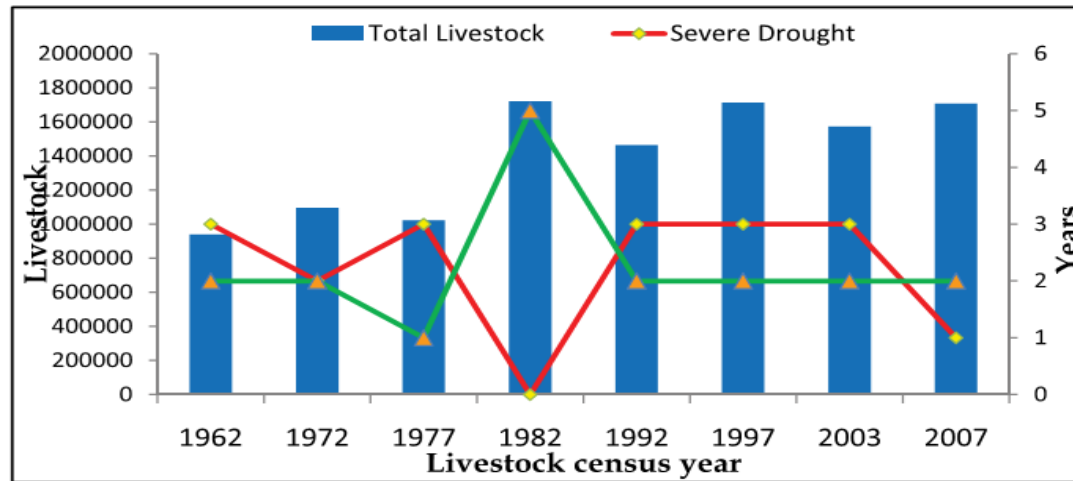
Source: IMD

Annual average rainfall for Kachchh 1930-2010



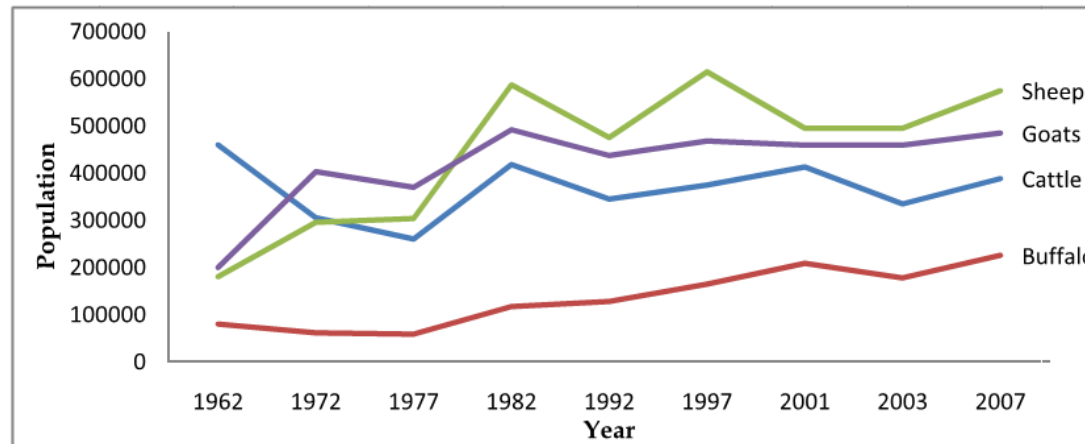
Source: IMD and GSDMA

Trends in Livestock population in Kachchh vs Rainfall



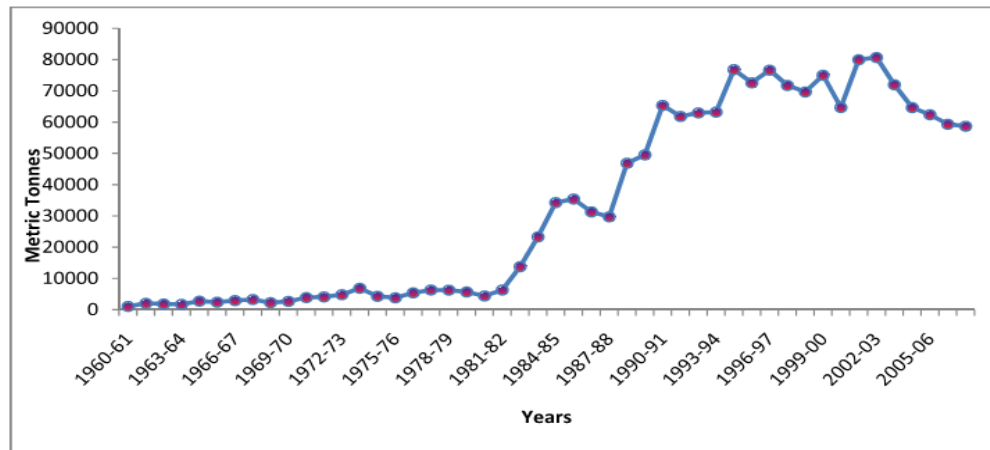
Source: Directorate of Livestock census; 1961, 1972, 1977, 1982, 1992, 1997, 2003, 2007

Major livestock composition over the years (1962-2007)



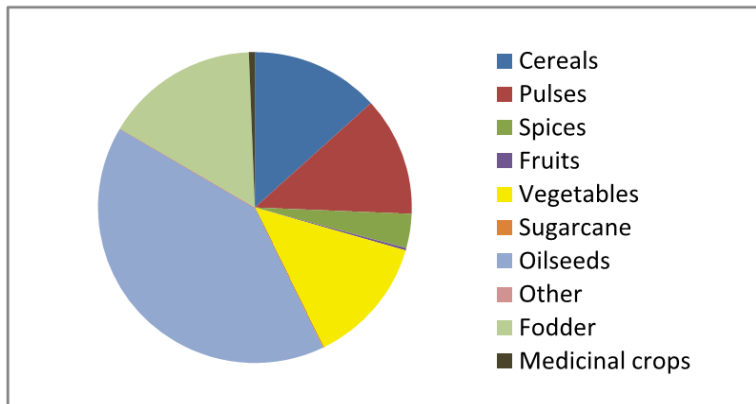
Source: Directorate of Livestock census; 1961, 1972, 1977, 1982, 1992, 1997, 2003, 2007

Marine Fish Production from Kachchh (1960-2007)



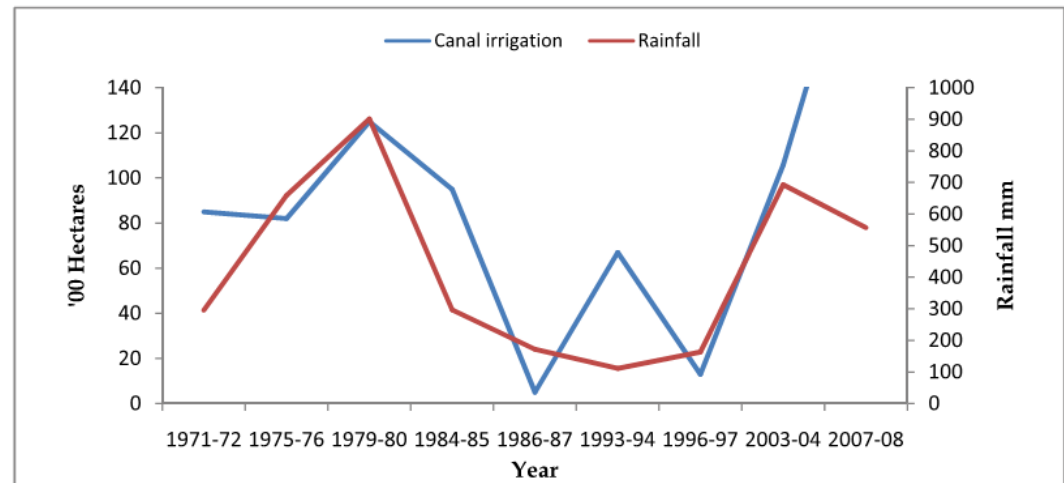
(Source: Commissioner of Fisheries, Govt. of Gujarat; 1960-61 to 2007-08)

Various crops grown in Kachchh District during 2009



Source: District Agriculture Department, Bhuj

Canal irrigation vs rainfall between 1971-72



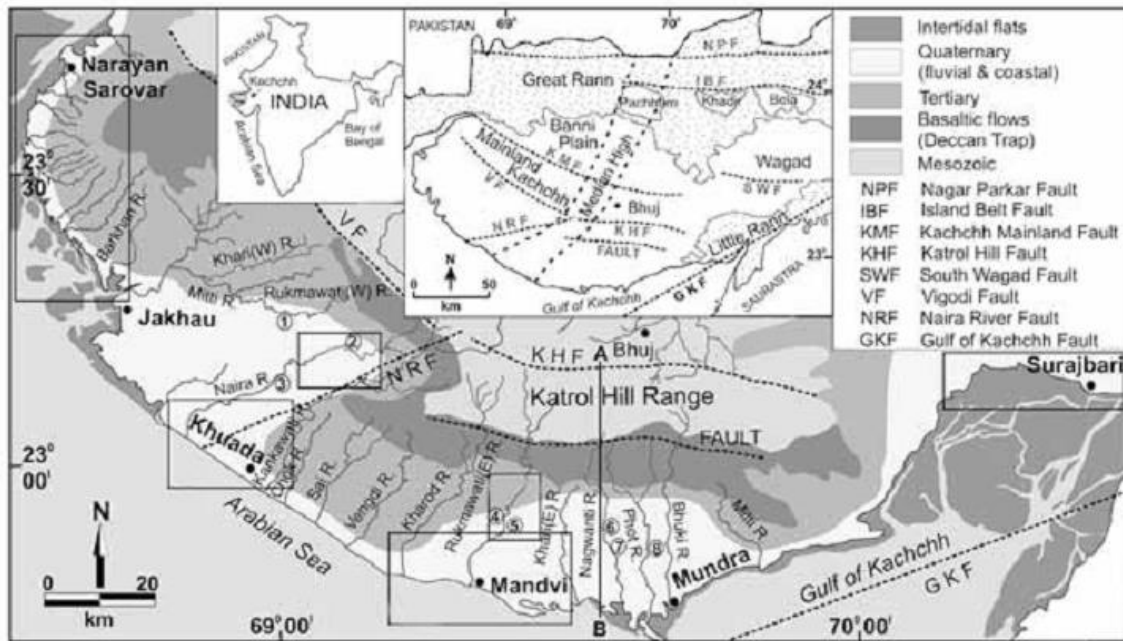
Source: District Statistical Department, Bhuj

Annexure-4: Demographic details of Kachchh District and the Talukas Highlighted under which the Project locations are proposed

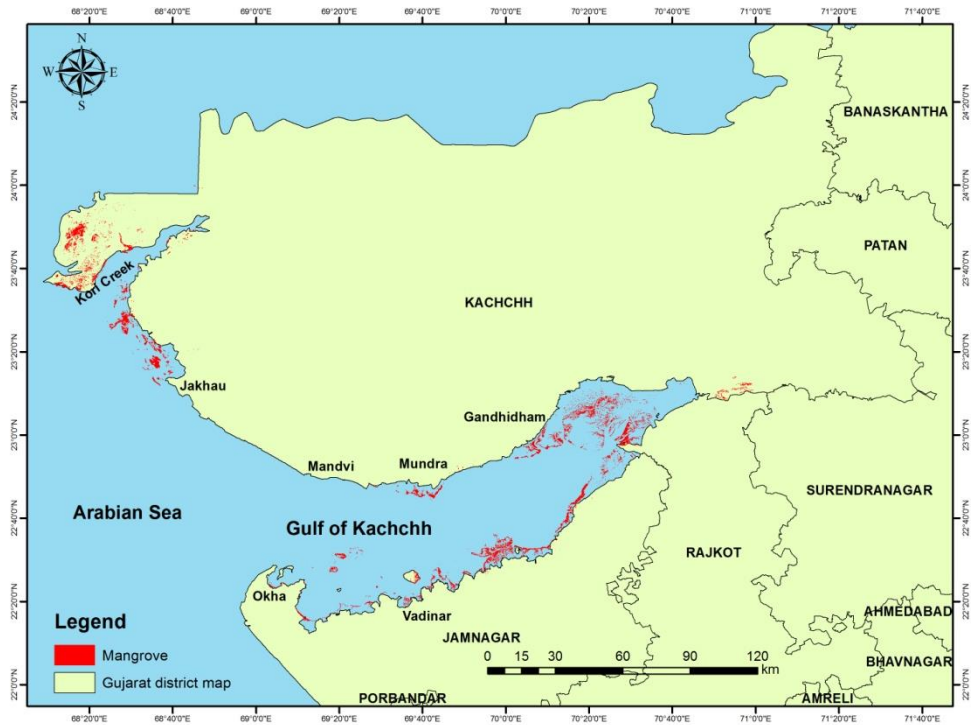
Taluka	Total Area		N_HH	TOT_M	TOT_F	Total Population	Sex ratio (F/1 000 M)	Main Worker Population					Marginal Worker Population				Total Working Population	
	Area (in Sq. Km)							Cultivators	Agri Labourer	HH Industry workers	Other Workers	Total main workers	Cultivators	Agri Labourer	HH Industry workers	Other Workers		Total marginal workers
Lakhpat	Rural	1945	12,155	32,274	30,278	62,552	30.2	3,228	6,908	102	8,719	18,957	234	1,406	54	785	2,479	21,436
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1945	12155	32274	30278	62552	30.2	3228	6908	102	8719	18957	234	1406	54	785	2479	21436
Rapar	Rural	2972	36,630	96,677	92,231	1,88,908	92.2	22,101	20,036	294	11,110	53,541	1,756	12,846	110	2,147	16,859	70,400
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2972	36630	96677	92231	188908	92.2	22101	20036	294	11110	53541	1756	12846	110	2147	16859	70400
Bhachau	Rural	1893	32,746	76,236	70,267	1,46,503	70.2	13,453	13,682	393	19,806	47,334	731	2,954	63	1,444	5,192	52,526
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1893	32746	76236	70267	146503	70.2	13453	13682	393	19806	47334	731	2954	63	1444	5192	52526
Anjar	Rural	1102	33,032	78,229	70,125	1,48,354	70.1	8,903	9,886	632	29,693	49,114	286	1,642	129	1,786	3,843	52,957
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1102	33032	78229	70125	148354	70.1	8903	9886	632	29693	49114	286	1642	129	1786	3843	52957
Bhuj	Rural	2372	48,568	1,16,990	1,12,765	2,29,755	112.7	13,058	22,790	1173	33,580	70,601	678	5,355	397	3,947	10,377	80,978
	Urban	69.9	15928	35232	34996	70,228	35.00	2249	1951	435	18558	23,193	54	769	147	1285	2,255	25,448
	Total	2442	64496	152222	147761	299983	147.7	15307	24741	1608	52138	93794	732	6124	544	5232	12632	106426
Nakhtrana	Rural	1985	28,608	74,380	71,987	1,46,367	71.9	7,662	20,098	390	18,988	47,138	307	4,632	126	1,535	6,600	53,738
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Total	1985	28608	74380	71987	146367	71.9	7662	20098	390	18988	47138	307	4632	126	1535	6600	53738
Abdasa	Rural	2398	24,070	61,387	56,151	1,17,538	56.1	8,226	15,929	230	14,883	39,268	583	4,971	64	1,248	6,866	46,134
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2398	24070	61387	56151	117538	56.1	8226	15929	230	14883	39268	583	4971	64	1248	6866	46134
Mandvi	Rural	1391	31,508	77,908	74,089	1,51,997	74.1	10,603	17,241	673	23,940	52,457	1,027	6,097	379	3,514	11,017	63,474
	Urban	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1391	31508	77908	74089	151997	74.0	10603	17241	673	23940	52457	1027	6097	379	3514	11017	63474
Mundra	Rural	867.4	30,454	78,986	53,895	1,32,881	53.9	6,489	7,560	640	42,857	57,546	363	1,709	195	2,447	4,714	62,260
	Urban	20.75	4,738	10,885	9,453	20,338	9.45	66	102	56	6,792	7,016	2	22	38	265	327	7,343
	Total	888.2	35192	89871	63348	153219	63.3	6555	7662	696	49649	64562	365	1731	233	2712	5041	69603
Gandhidham	Rural	124.4	8,230	20,457	18,524	38,981	18.52	571	345	196	11,105	12,217	79	131	32	506	748	12,965
	Urban	20.4	8652	22402	17791	40,193	17.8	82	138	72	13726	14,018	15	30	15	785	845	14,863
	Total	144.8	16882	42859	36315	79174	36.3	653	483	268	24831	26235	94	161	47	1291	1593	27828
Kachchh TOTAL	G_TOTAL	1716	315319	782043	712552	1494595	712.5	96691	136666	5286	253757	492400	6115	42564	1749	21694	72122	564522

Annexure-5: Tectonic Map of Kachchh District



Annexure-6: Potential Mangrove Restoration Sites at Kachchh District



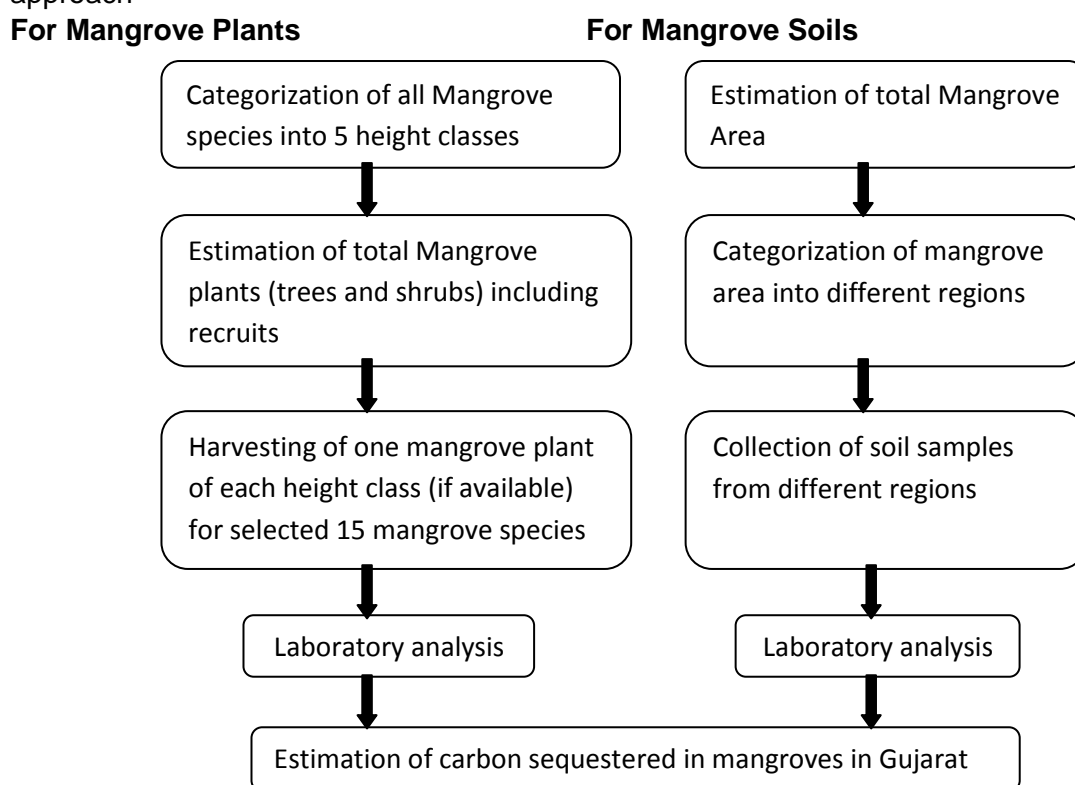
**Annexure-7: List of attendees of interdepartmental stakeholder consultation in
Gandhi Nagar**

National Adaptation fund on Climate Change (NAFCC)					
Department Meeting (GoG) on 11th and 12th January 2017					
Project /title: Climate Change Adaptation for Natural Resource Dependent Communities of Kachchh, Gujarat					
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Annexure-8: Carbon sequestration potential of mangroves

Gujarat hosts the second largest mangrove cover (1,058 sq km) of the country (FSI, 2011). GEER has estimated the cover and carbon sequestered by mangrove forests of the state. The mangroves are distributed over 4 regions namely Kachchh district, Gulf of Kachchh, Saurashtra and south Gujarat. Among these regions Kachchh district has maximum mangrove forests (61%) followed by Gulf of Kachchh (19%). The carbon sequestration by mangrove species in the four regions has been calculated by multiplying the values obtained for carbon sequestration by different height classes of species in the region under consideration. Subsequently summing of carbon sequestration by all mangrove species reported from that region was done. The carbon content of mangrove plants and soil has been estimated by following approach



The harvesting method has been used for biomass estimation which was subsequently used to estimate the carbon sequestered by mangrove plants (including recruits). The total mangrove cover of Kachchh region is 56,004 ha which is distributed in the dense (25,798 ha), moderate (14,370 ha), and sparse (15,839 ha) areas. The dense mangrove forests have been found to sequester 1.180 million tons of carbon. Similarly 0.34 million ton and 0.22 million tons of carbon have been sequestered by moderate and sparse mangrove forest. A total of 1.74 million ton of carbon has been found to be sequestered by mangrove species in Kachchh. It also holds 86% of its mangrove trees and about 49% of the total recruits have been reported. The biomass per unit area was reported 65.82 tons per ha.

Two mangrove species have been reported i.e. *A. marina* and *C. tagal*. The dense mangrove forests have been found to sequester 1.180 million tons of carbon of which 1.177 million tons have been sequestered by *A. marina* and 0.003 million tons by *C.*

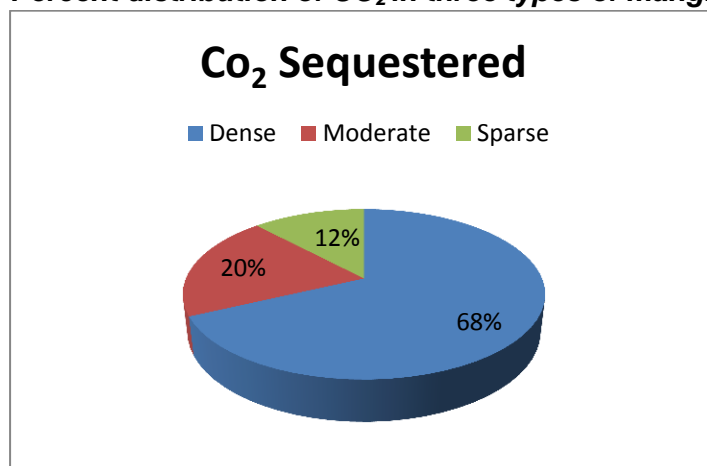
tagal. Similarly, 0.34 million ton and 0.22 million tons of carbon have been found to be sequestered by moderate and sparse mangroves forests of Kachchh.

Species wise details about carbon sequestered (million ton) in mangroves of Kachchh

Species/ height classes	1-150 cm	151-300 cm	301-400 cm	401-500 cm	>500 cm	Total
Dense						
<i>A. marina</i>	0.111	0.447	0.418	0.201	0.000	1.177
<i>C. tagal</i>	0.003	0.000	0.000	0.000	0.000	0.003
Total	0.114	0.447	0.418	0.201	0.000	1.180
Moderate						
<i>A. marina</i>	0.04	0.14	0.16	0.00	0.00	0.34
Sparse						
<i>A. marina</i>	0.02	0.09	0.10	0.00	0.00	0.22
<i>C. tagal</i>	0.000	0.001	0.000	0.00	0.000	0.001
Total	0.02	0.10	0.10	0.00	0.00	0.22
Total of all density classes						
<i>A. marina</i>	0.17	0.68	0.68	0.20	0.00	1.74
<i>C. tagal</i>	0.003	0.001	0.000	0.00	0.00	0.00
Total	0.18	0.68	0.68	0.20	0.00	1.74

In Kachchh, 0.40 million ton, 0.165 million ton and 0.176 million ton of carbon (Soil organic carbon- in the upper layer of soil; 1-15 cm) has been sequestered in the dense, moderate and sparse mangrove forest respectively. And 1.31 million ton of carbon (SOC) has been sequestered in the lower layer (16-30 cm).The carbon dioxide sequestration in mangrove soils have been reported 7.51 million ton.

Percent distribution of CO₂ in three types of mangrove forests of Kachchh



Carbon sequestration (in million tons) in Kachchh

Carbon Sequestration	Dense	Moderate	Sparse
SOC(1-15cm)- by soil	0.400	0.165	0.176
BY trees	1.180	0.34	0.22

A total of 2.24 million ton of carbon has been sequestered collectively by the mangrove of Gujarat out of this, 78% has been sequestered by the mangroves of Kachchh.

Annexure-9: Stakeholder consultations



Grassland restoration: Officers from forest department, scientists from GEER Foundation and GUIDE near Gorevali village, Banni region.



Focus group discussions with the pastoral communities of Gorevali village, Banni



Grassland degradation in Banni region



Prosopis juliflora germination from cattle droppings in Banni: cattle are one major reason for dispersal of *P. juliflora* and its easy germination



Group discussions with the Mutva and Jatt pastoral communities at Dhrobana Village



Focus group discussions with 'pagadiya' & small boat fishermen community at Tuna Port temporary settlement



Women of the fisherman community have a prime role in sorting and drying of fish and selling it in the market. Seaweed farming and polyculture will involve active participation of women.



Focus group discussions with the community members including fisherman at Bhadreswar Village



Understanding water conservation and recharge techniques at Khadir bet (Agricultural zone)



Inspecting issues of ground water level, salinity ingress and irrigation system for agriculture at Khadir bet



Focus group discussions with farmer communities of Khadir bet



Inter-departmental consultation at Bhuj

Annexure-10: Attendance sheets of stakeholder consultations

Dt: 07/02/2017

National Adaptation fund on Climate Change (NAFCC)
Department Meeting (GoG) on 7th February 2017, Kachchh-Bhuj
Project /title: Climate Change Adaptation for Natural Resource Dependent Communities of Kachchh, Gujarat

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23					
24					
25					

Date: 8/2/2017 Place: Gorewali, Banni Time: Community: Pastoral

S. No.	Name of Member	Village	Block	Sown Area/ no. Of livestock/ fishing nets	Mobile
1	...			17	...
2	...			10	...
3	...			80-	...
4	...			51-	...
5	...			121-	...
6	...			31-	...
7	...			21-	...
8	...			71-	...
9	...			51-	...
10	...			30 of 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000	...
11	...			21-	...
12	...			351-	...
13	...			21-	...
14	...			21-	...
15	...			21-	...
16	...			21-	...
17	...			21-	...
18	...			21-	...
19	...			21-	...
20	...			21-	...
21	...			21-	...
22	...			21-	...

Date: 10/2/2017 Place: Khadir Bet Time: Community: Agricultural

S. No.	Name of Member	Village	Block	Sown Area/ no. Of livestock/ fishing nets	Mobile
	KHADIR VISIT & MEETING			10/2/2017	
1
2
3
4
5
6
7
8
9
10
11
12

Date: 9/2/2017 Place: Tuna port bandar Time: Community: Fisherman

S. No.	Name of Member	Village	Block	Sown Area/ no. Of livestock/ fishing nets	Mobile
1	4-5	9925050728
2	...	"	"	20	
3	...	"	"	3	
4	...	"	"	-	9727327670
5	...	"	"	5	
6	...	"	"	3	9979662004
7	...	"	"	3	
8	...	"	"	4	
9	...	"	"	2	
10	...	"	"	5	
11	...	"	"	2	
12	...	"	"	2	
13	...	"	"	3	

Date: 9/2/2017 Place: Bhadracharya Time: Community: Fisherman

S. No.	Name of Member	Village	Block	Sown Area/ no. Of livestock/ fishing nets/pots	Mobile
1	Munda	3/1 pagadia	
2	...	"	"	3/ pagadia	
3	...	"	"	4/2 fish	
4	3/3 fish	
5	pagadia	
6	...	"	"	3/3 fish	
7	...	"	"	pagadia	