# Bamboo Value Chain Study and Feasibility Report

The Bamboo Value Chain Study and Feasibiltiy of establishing a facility centre report

Submitted to
Aga Khan Agency for Habitat India
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By
Centre for Indian Bamboo Resource and Technology
New Delhi.

# A Key Note

Assignment for preparation of this Bamboo Value Chain Study in Gir Sasan has been awarded to "Centre for Indian Bamboo Resource and Technology (CIBART)", a bamboo development organization. CIBART is a Sec.8 not-for-profit Company (earlier as Sec.25 non-profit) having Head Office in New Delhi and project offices in five Indian States and project operations in twelve States since December 2002.

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# Acknowledgment

At the outset, CIBART would like to thank Aga Khan Agency for Habitat (India) for the work order and CIBART expresses gratitude for this opportunity to conduct this work assignment and quality research. We express our thanks to the AKAHI staff members and representatives for sharing information and support in meaningful discussions.

I highly appreciate the guidance, technical inputs and support given by the Board of Directors of CIBART to the team conducting the field validation and analysis. This assignment was successfully completed by the team consisting of Ms. K Rathna, Dr. Kshitij Malhotra, Mr. Sanjay Singh, Mr. Kalpesh Dhodia and the field team members and their continued support. I thank the Forest Department officials, Junagadh, Gujarat, for their time to explain the practices, the research associates for their extensive secondary research, and the farmers who spared their time and information formed the primary research.

(S T S Lepcha)

Chair Person

CIBART

# Glossary

**Clump-** The group of Culms making a Clump of Bamboo.

**Culms-** The woody ringed stems, known as culms, are typically hollow between the rings (nodes) and grow in branching clusters from a thick rhizome (underground stem). Bamboo culms can attain heights ranging from 10 to 15 cm (about 4 to 6 inches) in the smallest species to more than 40 meters (about 130 feet) in the largest.

**Wildlife Sanctuary-** Wildlife sanctuary is an area set aside to protect animals and plants that are threatened or endangered.

**Protected Area-** Protected areas are those in which human occupation or at least the exploitation of resources is limited. It Includes National Park, Wildlife Sanctuary, Conservation Reserves, and Community Reserves.

**Reserved Forests:** Reserve forests are the most restricted forests and are constituted by the State Government on any forest land or wasteland which is the property of the Government.

In reserved forests, local people are prohibited, unless specifically allowed by a Forest Officer in the course of the settlement.

**Protected Forests:** The State Government is empowered to constitute any land other than reserved forests as protected forests over which the Government has proprietary rights and the power to issue rules regarding the use of such forests.

This power has been used to establish State control over trees, whose timber, fruit or other non-wood products have revenue-raising potential.

**Village forest:** Village forests are the one in which the State Government may assign to 'any village community the rights of Government to or over any land which has been constituted a reserved forest'

**Slats-** Bamboo slats are made by slicing a bamboo pole and sanding and shaping it to produce one flat side. This decorative construction material is easy to install, remarkably durable and amazingly versatile. They are ideal for indoor applications that need a tropical theme.

**De-skinning-** It is a process of removal of the outer green skin of Bamboo.

**Slivering-** It is a process of making thin bamboo strips with help oa f sharp knife.

# Acronym

AKAHI- Aga Khan Agency for Habitat India

Bamboo CFC- Bamboo Common Facility Centre

BPC- Bamboo Processing Centre

CCB – Copper Chrome Boron

CIBART- Centre for Indian Bamboo Resource and Technology

cm- Centimetre

DFO- Divisional Forest Officer

FGDs- Focus Group Discussions

GI sheets- Galvanised Iron sheets

GoI- Government of India

HH- House Hold

IAY- Indira Awas Yojana

INBAR – International Bamboo and Rattan Organization

JAU- Junagadh Agriculture University

m- Metre

MoEFCC - Ministry of Environment, Forests and Climate Change

NGO- Non-Governmental Organization

PA- Protected Area

PC-Performance Criteria

PPEs- Personal Protective Equipment's

SDGs- Sustainable Development Goals

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# 1. INTRODUCTION

## 1.1. BACKGROUND

The Centre for Indian Bamboo Resource and Technology (CIBART) was established in December 2002 and is a Non-Governmental Organization (NGO) registered as a not-for-profit public company limited by shares under Section 8 of the Indian Companies Act, 2013 (earlier as Section 25 of the Companies Act, 1956) (Registration no. U20239DL2118053 dated 16 December 2002). CIBART focuses on bamboo resource development and management, bamboo product design and development, project implementation, research, enterprise development, community skills development, technology development and transfer, monitoring and evaluation systems, marketing, and policy development. CIBART's mandate is livelihood development, ecological security and sustainable use of bamboo. CIBART serves as a catalyst to the bamboo industry in India undertaking various collaborative livelihood development projects.

CIBART's efforts are based on the unique potential of bamboo to reach out to the rural poor and smallholders, and enable them to participate in and benefit from the market of wood products, with integrated approaches to build sustainable livelihoods and sustainable environments, from bamboo resources to processing, from processing to market. CIBART's action research/ project sites, within short periods of time, have generated substantial economic and social value to the communities they are involved with, and a number of innovative technologies and products have been developed and localized.

Over the past 20 years, CIBART has developed in-house expertise in: large scale bamboo plantation, bamboo enterprise development in several product segments (craft, furniture, paneling, construction, boats, among others); new technologies for creation of rural jobs; introduction of higher value-added stages in production and sales of bamboo products; promotion of inclusive social enterprises; technical assistance; impact assessment and networking. CIBART is indeed, committed to create movements of individuals and has done that by, in one case, transitioning a landless tribal artisan community who struggled hard for subsistence into a community with enhanced artisanal capacities, sustainable livelihoods and whose people led dignified lives. CIBART's institutional framework enables economic sustainability, replication, knowledge and skills building,scaleing-up thorough proficient design, input, backstopping and mentoring.

In this proposed study, CIBART is partnered with M/s Aga Khan Agency for Habitat (India), to explore the Scope and Feasibility of a Value Chain Alliance for use of bamboo in the building and construction sector. The study has divided in to two parts (i) results of a bamboo resource mapping exercise and scope in introducing suitable species (ii) examine the infrastructure needs for training, processing and production of construction components.

## 1.2. BAMBOO BENEFITS

Bamboo, a grass, is among the fastest growing species of flora on the earth, and absorbs carbon dioxide approximately 17 Tonne per Hectors[1] from species like Bambusa *tulda* and Dendrocalamus *longispathus* species from around 100 to 400 Tonnes per Hectare by other species[2], which also depends upon its age of maturity. Bambusa *bamboos* the dry matter accumulation at the age of 4, 6 and 8 has been reported to be 122, 225 and 286 Tonne per Hectare, respectively and it is on par with the 10 year old fast growing Causarina *equisetifolia* (292.68 Tonne per Hectare) or Eucalyptus *tereticornis* plantation (254.97 Tonne per Hectare)[3].

[1] *doi: https://doi.org/10.1038/nindia.2021.46*
[2] https://www.inbar.int/understanding-bamboos-climate-change-potential/
[3] https://www.researchgate.net/publication/215475397_Bamboo_plantations_An_approach_to_Carbon_sequestration
K.K., Seethalakshmi & Cm, Jijeesh & M., Balagopalan. (2009). Bamboo plantations: An approach to Carbon sequestration.

Bamboo can produce oxygen 27.38 Metric Tonne per year[4] during its growth period. Bamboo support to nearly 2.5 billion people worldwide, most of whom are tribals. In India, about 2 million traditional artisans depend on harvesting, processing, value addition and selling of bamboo products, majorly baskets and handicrafts, etc.[5] Bamboo plant grows to its full maturity for harvesting in four years. Bamboo farming can arrest soil erosion, and bring the green cover to barren areas and at the same time bamboo-based products can substantially replace materials like steel, aluminium, glass, plastics, forest timber, etc in the making of utility products, crafts, furniture and in buildings.

Across the world, bamboo is used industrially for a range of applications: construction and structural applications, wood substitutes and composites, bamboo-based fibers and fabrics, food products and charcoal. The presence of value addition in near-source in the modern value chain implies that the Bamboo sector has excellent potential in terms of pro-poor impact in poverty alleviation from industrial component point of view. Despite having a large bamboo cover across the Country, due to challenges in its procurement, lack of technical knowledge, insufficient market demand, lack of innovations, regulatory barriers, variety of issues in the value chain and for other reasons, the domestic bamboo industry's growth is not impressive. Mostly, bamboo in India remains a material for personal usage and most of the products produced by the number of firms lack in quality and have limited value addition and the use of bamboo for large building construction is slowly taking off due to barriers in the growth of domestic bamboo industry.

In Asia, the major bamboo producing countries are India (almost 11.4 million hectares) and China (over 5.4 million hectares)[6], both contribute about half of whole world bamboo resources in 2005. India is the world's second-largest cultivator of bamboo after China[7]. According to FSI Report 2021, Bamboo bearing area is recorded as 14.94 million hectares[5]. It can create employment of 516-million-man days per annum[8]. Bamboo is used in rural construction and for temporary structures. The construction of sustainable bamboo-based buildings is attracting interest and bamboo in structural applications has been proven to be a successful experiment in international geographies. Like Renzo Piano, 1998 Laureates of the Pritzker Architecture Prize uses bamboo in Jean-Marie-Cultural-Center[9].

[4] https://www.currentscience.ac.in/Volumes/122/07/0850.pdf
[5] https://fsi.nic.in/isfr-2021/chapter-8.pdf
[6] https://www.fao.org/3/a1243e/a1243e.pdf
[7] https://www.downtoearth.org.in/blog/agriculture/the-story-of-national-bamboo-mission-61016
[8] Swamy C. 2011. Employment Generation by Bamboo Resource Development and its impact on Rural Communities, Int J Rural Stud. 18 (1): 1-6
[9] https://www.re-thinkingthefuture.com/wp-content/uploads/2020/10/A1832-Jean-Marie-Cultural-Center-by-Renzo-Piano-Image-7.jpg
https://www.re-thinkingthefuture.com/wp-content/uploads/2020/10/A1832-Jean-Marie-Cultural-Center-by-Renzo-Piano-Image-10.jpg
https://www.re-thinkingthefuture.com/wp-content/uploads/2020/10/A1832-Jean-Marie-Cultural-Center-by-Renzo-Piano-Image-11.jpg

**Jean-Marie-Cultural-Center at New Caledonia**

**Bamboo Restaurant at Gir Somnath**

### 1.2.1. Bamboo in Construction

Bamboo has been labeled as a suitable replacement of wood due to its adaptability and its short maturity period. Bamboo is a durable, affordable, sustainable and attractive building material. Unlike standard building materials such as concrete and steel that emit tonnes of carbon in their manufacturing process, bamboo continues storing much of its carbon even when it has been turned into buildings, bridges, and furniture. The World Bank forecasts that the world's urban population will rise by 150% by 2045. The demand for housing will rise proportionately[10]. Many countries with fast-growing urban populations are encouraging the use of sustainable bio-based materials, such as bamboo, in construction. If managed well, bamboo has the potential to help satisfy some of the demand for affordable, decent housing and, if grown and harvested sustainably, also contribute towards Net-zero targets. Several studies have indicated that bamboo could be used for more than just housing construction. In addition to the high quality life of the end-used, a rise in construction volumes will bring increased awareness related to the environmental benefits.

## 1.3 SCOPE OF WORK

This study of bamboo resource mapping in Gir Sasan area of Gujarat State is making an assessment of the quantity and availability of bamboo species, the species specificity and the supply feasibility in farm areas and with farmers. The scope is included

i) The potential usage within the project area and recommended species for the construction industry.
ii) To determine the scope for establishment of a facility for community/ artisans to engage in production activities and
iii) A proposal on establishing a facility with machines and other needed equipments for production of construction components as a way forward.

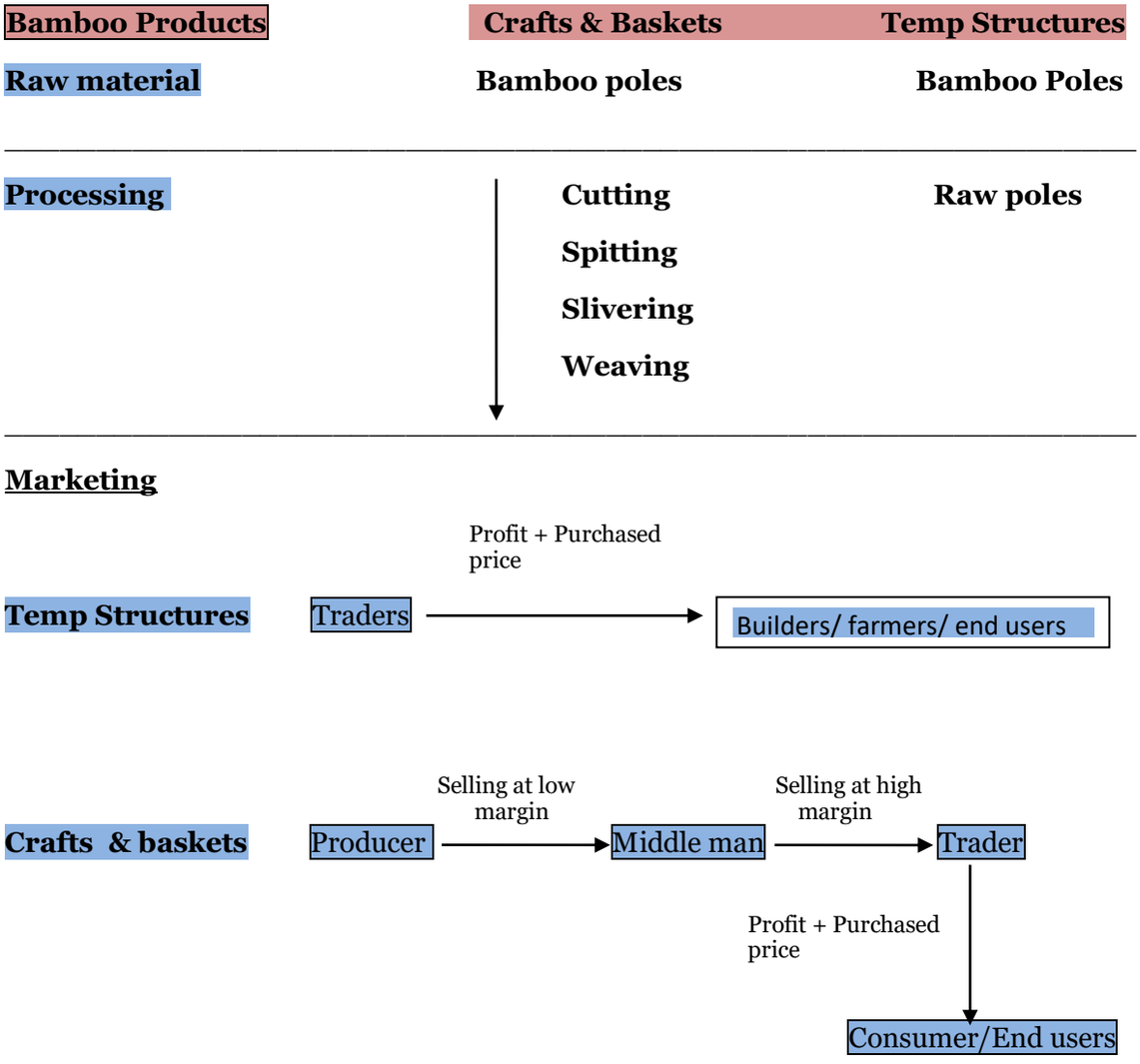
## 1.4. NEED FOR BAMBOO VALUE CHAIN

Bamboo value chain consists of bamboo resource producers (institutions, promoting bamboo plantation activities in forest as well as in non-forests area and farmers, in non-forest area), traders, processing enterprises, and end-users. The bamboo value chain found in the study area for (1) bamboo poles (2) bamboo craft products (3) construction support material (scaffolding) and (4) traditional and temporary structures. In each value chain, there is limited number of actors, i.e. bamboo poles producers, bamboo traders and bamboo artisans. There is scope on making bamboo panels, boards and composites for houses. Using bamboo in place of timber will alleviate the burden on timber, which is in the depleting state and new value chain focuses on bamboo panel production, bamboo structural components production, bamboo furniture production, bamboo fencing works and bamboo structures making.

Traditional skill sets exist and there is a practice of including bamboo in bamboo structures like Hut, Bamboo fencing, Temporary fish shop making. Bamboo poles split into two portions, used as plant supporting in farm fields. Due to limited resources and limited institutions in promoting bamboo activities, the value chain is not well developed in study area. Most common bamboo products seen are scaffolding material, temporary shelter making material, traditional baskets and fencing material.

[10] Climate action platform; weforum.org

### 1.4.1. Traditional Value Chain




**Bamboo crafts**: There are a few households that produce bamboo handicrafts as per the demand from the local market. During the survey, the study team undertook visits to local markets where bamboo products are sold and it was observed that seasonal demand the traditional basket products and floral baskets.

**Bamboo poles:** Limited bamboo resources found in the study area. Need of the hour is to develop the supply chain with small land holder farmers for them to generate additional income by planting bamboo. There is no pulp and paper industry or processing facility exists in the area. Demand for bamboo poles by such industries only encourages the farmers to grow more bamboo and manage the resources. Bamboo poles are used by farmers in their mango farms, by the traders to make temporary shops such as in Fish Market, by the community in making Chauppals, temporary pooja mantaps etc.

**Bamboo Poles as agri support at Gir Gidhada Beach**

**Bamboo Temporary Shop at Mangrol**

**Bamboo scaffolding for construction:** Currently, bamboo is used as a construction material, especially in scaffolding. A scaffold is a temporary structure used to support people and materials under construction of a building. It represents an essential part in construction and it offers a safer and more comfortable work arrangement than working from ladders. For scaffolding, matured bamboo poles are used and from the study findings, the traders sell bamboo poles primarily for scaffolding works. Traditional or rural houses used bamboo in roofing, columns and for fencing. However, use of bamboo as a modern construction material is not picked up due to lack of technology, limited skilled manpower and treatment methods.

**Bamboo Scaffolding for Construction**

**Bamboo Restaurant at UNA**

**Bamboo Craft Shop at Junagadh**

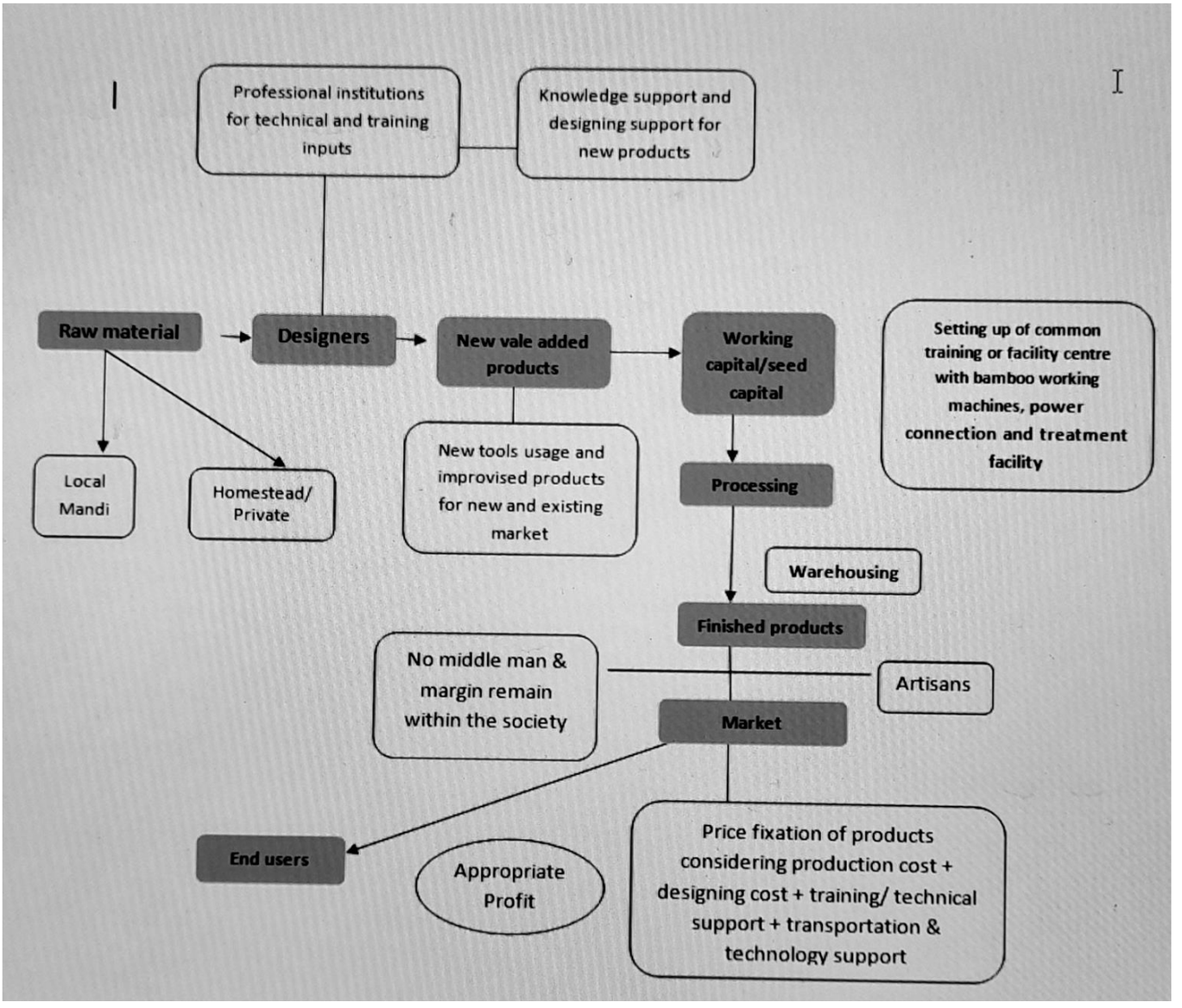
### 1.4.2. New Value Chain

**Availability / Purchase of Raw Material:** Raw material is not available in abundant quantity in homesteads or with farmers. For the new products, the procurement will be initially done from the traders. Currently, the artisans purchase bamboo from local traders and these are not treated and products developed without any design inputs. In the new value chain the products viz. bamboo huts, houses, fencing, furniture, structural components, panels etc. would be developed with the technical inputs from professional institutions. Training the farmers in growing, training the artisans in processing steps of bamboo for several products. There would be machineries and tools for the processing to make different products with good finishing.

**Bamboo Hut**

**Bamboo Fencing**

A varied product linein the new value chain as described in the matrix:




**Bamboo Furniture in Restaurants**

# 2. APPROACH & DATA

## 2.1. METHODOLOGY AND RESULTS

### 2.1.1. Estimation of Bamboo Resources in Forest Area

To estimate bamboo resources in forest areas all data were collected from secondary sources either from Forest working plan or from government websites. The unique features of the State of Gujarat are the climatic and geomorphologic conditions such as the largest coastline in the Country, the saline deserts of Rann, grasslands, wetlands, etc. These factors have bestowed the State with rich floral and fauna diversity. The Asiatic lion and Wild Ass have their last reserve in the forests of Gir and the Great Rann of Kutch, respectively.

The working plan is prescribed for the entire Junagadh and Gir Somnath districts and Kutiyana Taluka of Porbandar district. The data covers the total forest areas of Junagadh division except for the area of Girnar Wildlife Sanctuary. The data that exists with the Forest Department for the Junagadh division mentioned that harvesting of any type of timber or bamboo is not allowed in the protected area. Only dead, dying and diseased trees are harvested.

**Growing stock of bamboo**: Bamboo is scarcely found in the studied forest area. Study on analysis of growing stock of bamboo has not been done sofar.[11] However, as per FSI report 2021, in whole Gujarat bamboo-bearing area is reported as 3547 sq km. Out of 136 species, only two species Dendrocalamus *strictus* (Manvel) and Bambusa *bamboos* (katas) are industrially most important species found naturally in the forests. Bamboo is also cultivated by farmers mainly on the periphery of their farmlands. Bamboo is found in 15 Districts of the state and they are spread over South Gujarat, Central Gujarat, North Gujarat and parts of Western Gujarat. Gregarious flowering of bamboo has been reported in Narmada, Dangs, and parts of Tapi, Surat and Valsad districts of South Gujarat in Past few years[12]. During the primary survey, flowering also recorded in Gir Arboretum and Birding Point, Gir Sasan.

**Flowering In Bamboo**

[11] Chapter 6, page no. 97-98;
[12] https://forests.gujarat.gov.in/writereaddata/images/pdf/concept-note-for-bamboo.pdf

**New plantations of Bamboo**: Three years back in 2019, the Forest department planted Bambusa *balcooa* in 25 hectares in a reserved forest area in Junagadh. Further, the study team found Dendrocalamus *strictus* and Bambusa *vulgaris* (yellow) planted by the forest department in the forest area of Junagadh. The periphery of the Gir DFO office was planted with Dendrocalamus *strictus* and about 60 clumps were found here with an average of 20 culms in each. Both these plantations are of two years of age.

**Harvesting of bamboo**: Harvesting of any bamboo is not done in this working plan due to scattered and less bamboo resources. Therefore, the recorded removal of bamboo is zero.

Therefore, in the present study, primary data was collected from non-forest areas and from farmers' fields.

### 2.1.2. Estimation of Bamboo Resources in Non-Forest Area

Gir Sasan area is not having substantial bamboo resources at present and its distribution is not uniform across the blocks. There is a scarcity of large bamboo plantations. Some bamboo does grow on boundaries of farmer lands and in unmanaged clumps. Bamboo plantations and products have the potential to create sustainable livelihoods and through community ownership, management, and land resource use.

To assess the bamboo resources, that exist in the study area, a survey was conducted where a total number of 110 farmers were interviewed from December 2022 - February 2023, to substantiate data available and provide an accurate assessment on the bamboo sector in all three districts. The survey was conducted in 42 villages in 23 blocks of all three districts.


Bamboo plantations occurred under farm forestry schemes in Dangs, Navasari and Valsad districts in such a manner that agro-forestry in these districts turns into the main economic activity of the farmers, integrating cultivation of herbal plants with agro-forestry systems to enhance economic returns to the farmers. But such type of activities was not observed in the vicinity of the current study area.

### 2.1.3. Methodology used to Estimate Bamboo Resources in Non-Forest Area

This study is based on primary and secondary research.

The study was conducted by a team of 6 core staff and four interns. This study focused on FGDs (focus group discussions) and personal interviews with bamboo farmers, bamboo traders, and bamboo artisans. The field study included 24 field days and a desk review of 6 days. Structured questionnaire was used to collect

information about bamboo resources, the agricultural crops, the income sources and the willingness to grow bamboo. The FGDs led by a researcher to discuss issues and explore subjective matters. The structured questionnaire application is a quantitative research method and the aim is to ensure to get views, comparisons, and answers for the same questions in same order.

The survey was conducted in 42 villages in 23 blocks of all three districts.

• Structured questionnaire was administered for the data collection at household (HH) level and discussion with the farmer to assess the bamboo resources.

• There are 3 districts and 26 blocks in the study area. All 3 districts and 23 blocks have been covered during the field survey.

• Out of the 3 districts, bamboo is available in every district & in every block either in homestead or in farm areas, however, the species may be different.

• In every block in every district, approximately 1-5 households have been selected randomly and this structured questionnaire has been administered. All 23 blocks were thus covered and data from 110 HH had been collected.

• Information on available bamboo species, number of clumps per HH, species-wise total number of poles, and dry poles, sale of bamboo poles in last year were collected.

• Information of the price of bamboo per pole was collected from local timber merchants.

• Species-wise quality measurements were done in each block for the diameter of bamboo after measuring one pole of each available species.

• Data on the total number of households is taken from the Census 2011 report and government websites of the respective district.

• Questionnaire format administered is attached as Annexure I of the report.

### 2.1.4. Details of District-wise blocks covered in the primary survey

During the whole study, one hundred-ten data samples were collected from 42 villages of 23 Blocks, i.e. 9 Blocks from Amreli, 5 Blocks from Gir Somnath, and 9 Blocks from Junagadh, except for Jafrabad & Khambha blocks of Amreli and Patan-Veraval block of Gir Somnath district.

**Table 1: District-wise blocks covered for the primary survey**

| Name of Block | District wise Data collected | | | Grand Total |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| Amreli | 5 | | | 5 |
| Babra | 4 | | | 4 |
| Bagasara | 7 | | | 7 |
| Bhesan | | | 5 | 5 |
| Dhari | 5 | | | 5 |
| Gir Gadhada | | 3 | | 3 |
| Junagadh | | | 6 | 6 |
| Keshod | | | 9 | 9 |
| Kodinar | | 1 | | 1 |
| Kukavav-vadia | 6 | | | 6 |
| Lathi | 5 | | | 5 |
| Lillia | 5 | | | 5 |

| | | | | |
|---|---|---|---|---|
| Maliya | | | 5 | 5 |
| Manavadar | | | 5 | 5 |
| Mendarada | | | 5 | 5 |
| Mendarda | | | 2 | 2 |
| Rajula | 5 | | | 5 |
| Saverkundla | 3 | | | 3 |
| Sutrapada | | 1 | | 1 |
| Talala | | 7 | | 7 |
| Una | | 3 | | 3 |
| Vanthali | | | 6 | 6 |
| Vishavadar | | | 7 | 7 |
| **Grand Total** | **45** | **15** | **50** | **110** |

## 2.2. STUDY AREA

### 2.2.1. Location and demographic features

Junagadh district is located in western Gujarat and is surrounded by Arabian sea and forest area. It is located at a longitude of 20.47 N to 21.45 N and a latitude of 70.15 E to 70.55 and 271.89 feet above mean sea level. The Area is 5093.36 sq km.

District Junagadh is surrounded by district Porbandar in the North-west, district Rajkot in the North, district Amerli in the East and district Gir Somnath in the South west. Further, it is surrounded by Sea coast in South and South west side. Junagadh city has two rivers, the Sonrakh and the Kalwo. The city has several lakes: Narsinh Mehta Sarovar, Damodarji, Sudarshan Lake, etc. Willingdon Dam, Hasnapur Dam, and Anandpur Weir are the main water sources for the city.[13] The district consists of five sub-division (Tehsil) namely Junagadh, Vanthali, Keshod, Visavadar, and Mendarda and 9 Blocks viz. Junagadh, Vanthali, Manavadar, Keshod, Mangrol, Visavadar, Bhesan, Mendarda, Maliya Hatina. There are 492 No. of Gram Panchayats and 5 revenue divisions. The district is famous for Gir mountain area namely Girnar, also known as Girinagar or Revatak Parvata[14].

Gir Somnath district was formulated on 15th August, 2013 from Junagadh district[15]. This district is famous for Asiatic Lions and Somnath temple. It is famous for Gir National Sanctuary. The Land is Famous for Its Spiritual and Cultural Heritage for ages. It is situated between 20° 54′ 21.1896” North latitudes and east longitude of 70° 23′ 15.0180”. The area of Gir somnath District is 3755 sq. k.m.

[13] https://en.wikipedia.org/wiki/Junagadh
[14] https://junagadh.nic.in/documents/
[15] https://www.indiatoday.in/india/west/story/modi-gujarat-announces-seven-new-districts-keeps-poll-promise-173747-2013-08-13

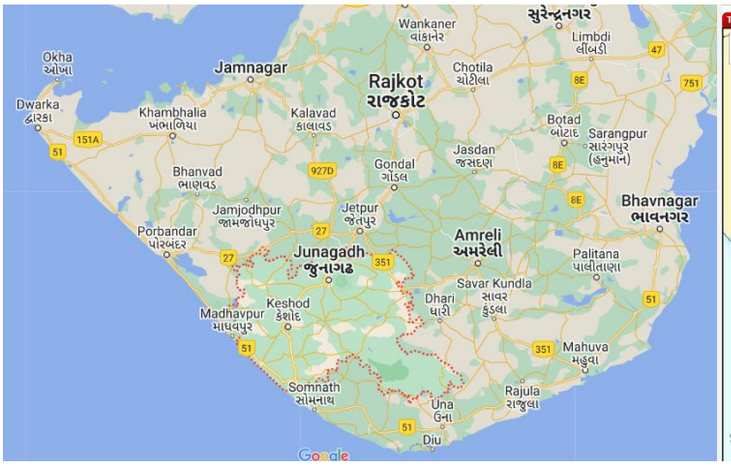
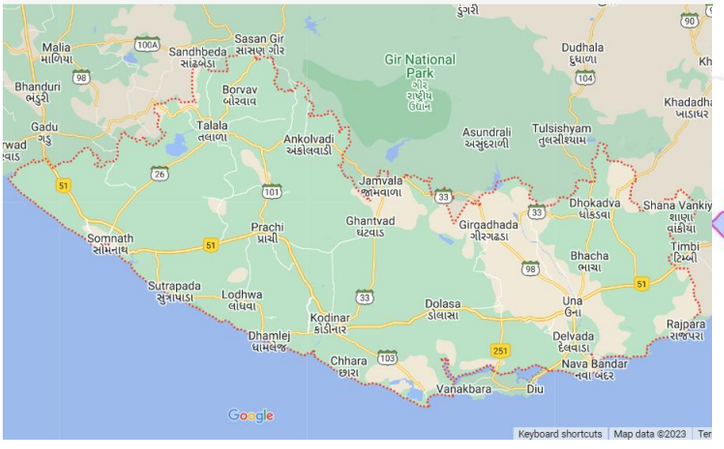




**Figure 1: District map of Junagadh**

**Figure 2: Tehsil map of Junagadh**



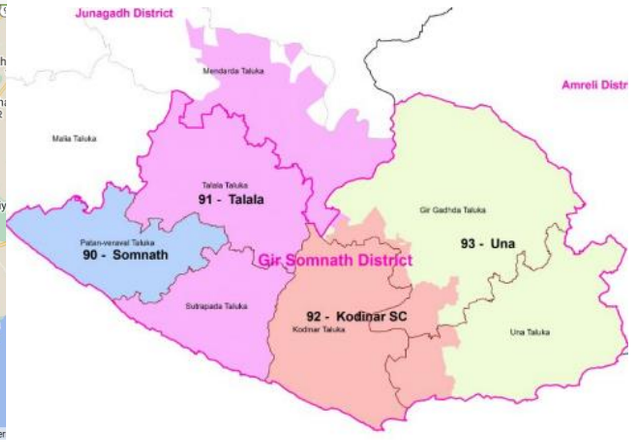




**Figure 3: District map of Gir Somnath**

**Figure 4: Tehsil map of Gir Somnath**

According to 2011 census, the total population (old) of the Junagadh district is 1527329 (2743082) out which male & females are 1404356 and 1338726, respectively. The population density is 845 (310). The female population is 945 (955) per thousand males. The average literacy percentage of the district is 78.55% (88%). Male & female literacy percentage is 92.46 and 83.38 percent, respectively. There are 492 no. of grampanchayats operational in the district in 547 (1681) villages. Junagadh is well connected to Rajkot, Ahmedabad, and Veraval by National Highway 8D (NH8D).

Presently, Gir Somnath district has 946790 size of population and 969 sex ratios. The average literacy percentage of the district is 76.49%. There are 300 no. of gram panchayats and 2 revenue divisions.

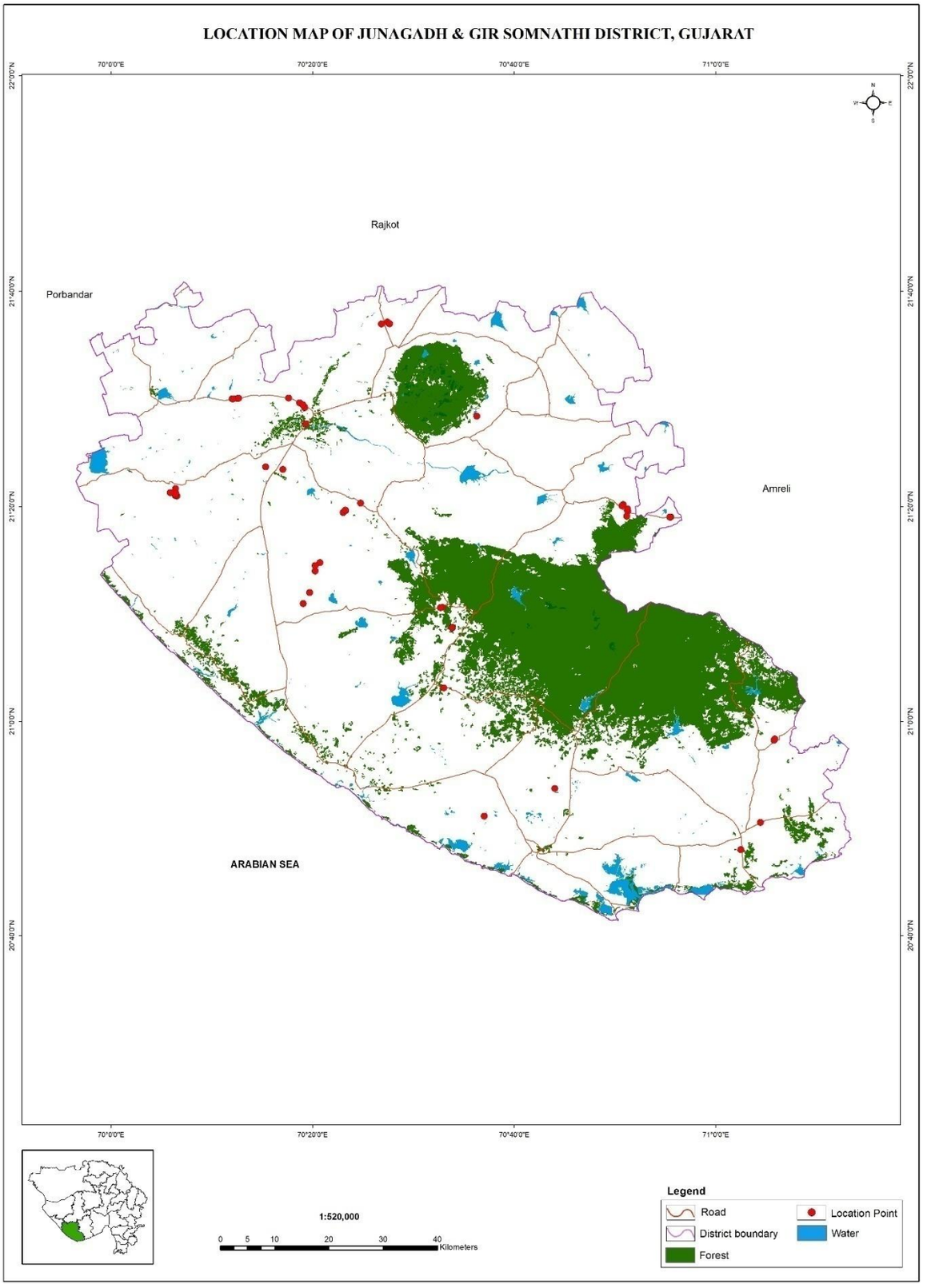



**Figure 5: Location Map of Junagadh and Gir Somanth Districts for Data collection also showing Forest and Road Infrastructure.**

**Table 2: Demographic details of Gir Sasan Area**

| Demographic Label | Junagadh | Gir Somnath | Amerli |
|---|---|---|---|
| Area | 5093 (12,805) Sq Km | 3775 Sq Km | 7431 Sq Km |
| Forest area | | | 568.99 Sq Km |
| Block | 10 | 6 | 11 |
| No. of Revenue Divisions | 5 | 2 | 5 |
| No. of Villages | 547 (1681) | 345 | 618 |
| No. of Gram Panchayats | 492 | 300 | 590 |
| No. of Municipalities | 7 | 5 | 9 |
| Total Population (Census-2011) | 1527329 | 946790 | 1514190 |
| Sex Ratio | 945 | 969 | 964 |
| Literacy Rate (%) | 78.55 | 76.49 | 74.25 |
| Main Crops | Groundnut, Bajri, Jowar, Cotton, Sugarcane | Groundnut, Bajri, Jowar, Cotton | Groundnut, Bajri, Jowar, Cotton, Sugarcane |

**Source: Census, 2011**

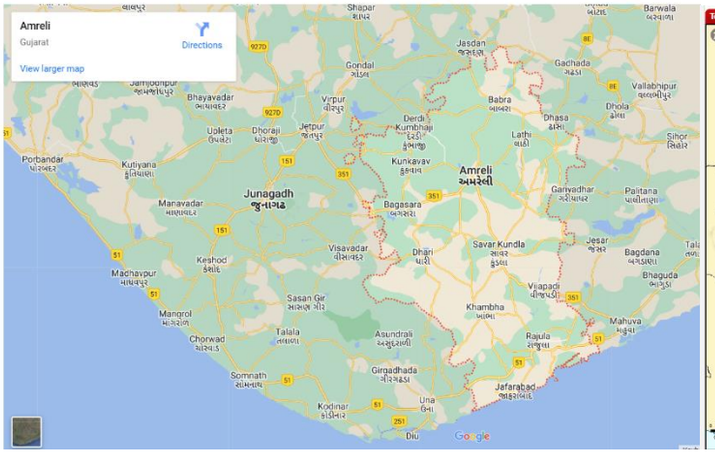



**Figure 6: District map of Amreli**


**Figure 7: Tehsil map of Amreli**

Amreli district covers 7431.24 sq. km. of area, out of that 568.99 sq. km area comes under forest. It has 11 blocks and 5 revenue divisions. Savarkundla (1179.56 sq.km.) block cover 15.87% of the area which is the highest area cover in compare to other block of district. Vice versa Bagasara (35.56 sq.km.) block cover 4.72% area of district which is comparatively less than other blocks of Amreli district. There are 618 villages and 590 no. of gram panchayats. As per Census 2011, 1514190 people are living in the district. Jafarabad has highest density that is 255 while Dhari has lowest density of 132, because of forest area that taluka cover. The female population is 964 per thousand males. The average literacy percentage of the district is 74.25% and Male Literacy is 82.21% and Female Literacy is 66.09%[16].

[16] https://amreli.nic.in/

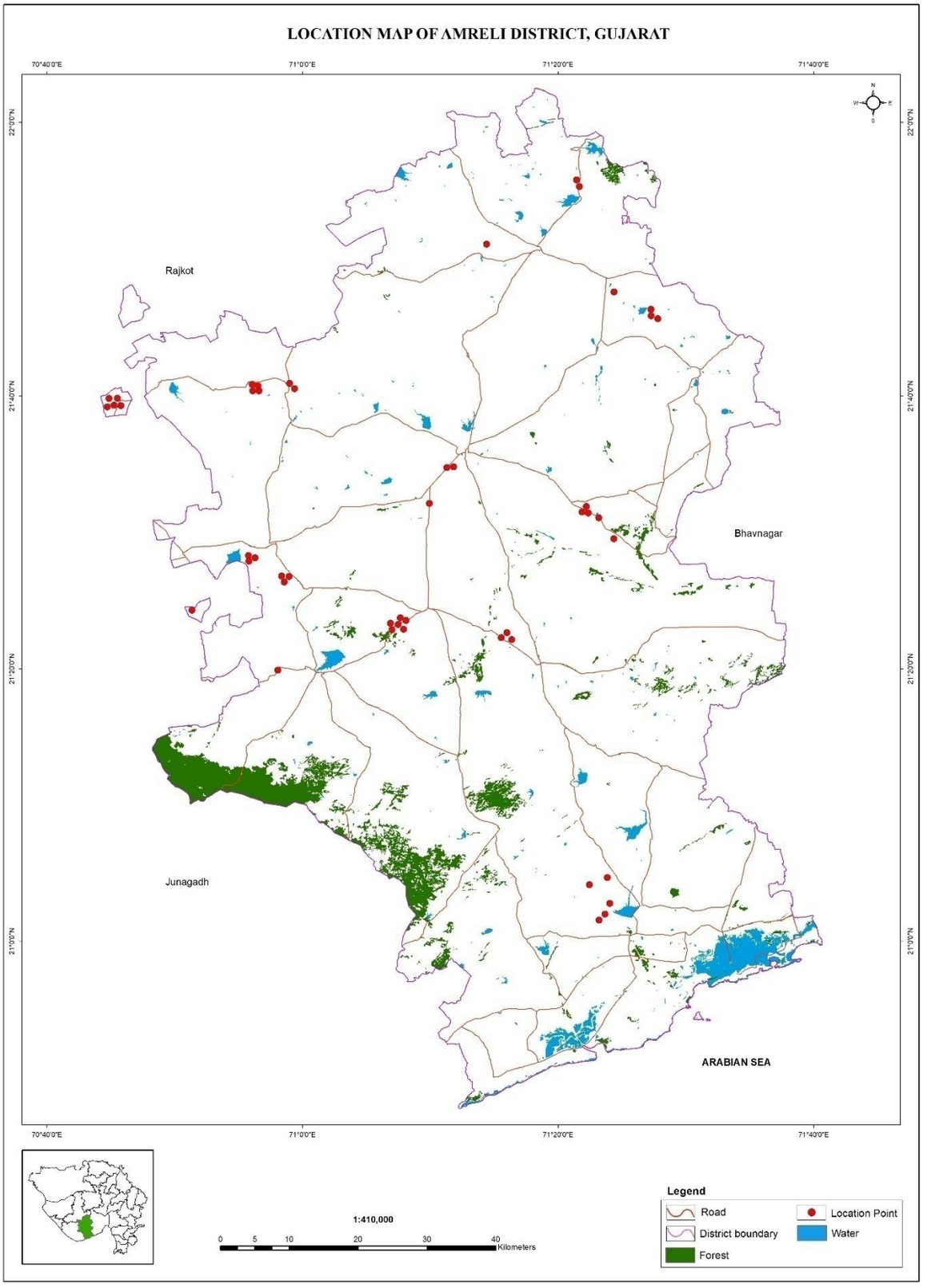



**Figure 8: Location Map of Amreli District for Data collection also showing Forest and Road Infrastructure.**

### 2.2.2. Topography

The topography of Junagadh is comprise deep- to medium-black coastal alluvium, due to its proximity to the sea, long shoreline, and nearby mountain ridge. It lies in a Seismic Zone III region, which means earthquakes up to magnitude 6.5 on the Richter-scale may be expected.

### 2.2.3. Climate and rainfall

The climate of the district may be treated as normal pleasant whether remains throughout the year. It has a tropical wet and dry climate (Aw) bordering on a hot semi-arid climate (BSh), Usually rainy season from June to September and winter or dry season from October to May. The district lies in the Agroclimatic zone of South Saurashtra Zone (GJ.7) as per (NARP)[17]. The close proximity of the Arabian Sea and the Gulf of Cambay affect the climate. In the summer months, temperatures range from 28 to 38 °C (82 to 100 °F). In the winter, they range from 10 to 25 °C (50 to 77 °F). From June to September the city is drained by the southwest monsoon. Rainfall averages 800 to 1,200 millimetres (31 to 47 in) annually. The greatest rainfall in a calendar year—2,800 millimetres (110 in)—was recorded in 1983.

### 2.2.4. Forests

The Government of Gujarat has declared an area of 1412.1 sq km as Protected Area (PA) which comprises 258.7 sq km as National Park and 1153.4 sq km as Sanctuary. Besides this 470.5 sq km of forest area forms a buffer Zone as reserve, protected and unclassified forest. Thus, a total area of 1882.6 sq km makes up the Gir forest. Whereas, Amreli district has 568.99 Sq Km forest area[18].

### 2.2.5. Soil

The district is formed from sedimentary rocks and partly from volcanic rocks. They are generally calcareous, rich in potassium content but comparatively deficient in nitrogen and humus. The soil of the region has Major Soils types, Medium to shallow black soils spread in an Area of 619000 ha, Mixed red and black soils in 132000 ha and Coastal alluvial soils in 125000 ha which consist of 70 percent, 15 percent and 14 percent, respectively.

The black soil is found in parts of Vanthali, Manavadar and Keshod blocks except the Gir Gidha areas. Most of the villages of Junagadh, Bhesan, Una, Kodinar, Talala, Malia and Vishavadar blocks have medium black soil. The alluvial soil is found in the low-lying areas popularly known as “Ghed” in parts of Keshod and Mangrol talukas, these areas remain inundated during monsoon. Though the soil of this tract is fertile, water logging conditions prevent effective utilization of the land. In parts of Mangrol, Veraval and Sutrepada blocks the soil is alluvial and calcareous. The brackish soils are mostly found near the coastal belt of Mangrol, Maliya, Veraval, Sutrapada, Kodinar and Una blocks are represent the generation of the coastal alluvial soil due to ingress of the seawater. The area popularly known as “Lili Nagher” is the tract of fertile soil extending from Veraval – Patan to Una[19].

## 2.3. BAMBOO SPECIES EXIST

Dendrocalamus *strictus* (manvel) and Bambusa *bamboos* (katas) are industrially the most important species found naturally in forests as well in farm lands in the study area. Dendrocalamus *strictus* is cultivated by farmers on the periphery of their farmlands and Katas, the thorny variety was not preferred. The unmanaged clumps of Bambusa *bamboos* pose difficulty in harvesting however it is one of the species suitable for construction and traditional houses are built by using the locally available bamboo. Bamboos are found in 15 districts of the Gujarat state however limited stock is found in the study area viz. Junagadh and Gir Somnath.

[17] https://agricoop.nic.in/sites/default/files/GUJ%204-Bhavnagar%2030.04.2011.pdf
[18] https://junagadh.nic.in/tourist-place/sasan-gir/
[19] Nair, B. 2014. https://cgwb.gov.in/District_Profile/Gujarat/Junagadh.pdf

### 2.3.1. District and blocks wise Income per acre from cropping

Farmers of Bagasara, Lillia & Saverkundla blocks of Amreli, Una block of Gir Somnath, and Maliya & Vanthali blocks of Junagadh district have less than Rs 25 thousand income per acre from various crops. Whereas, farmers at Gir Gidhada, Kodinar blocks of Gir Somnath, and Mendarda blocks of Junagadh earn more than Rs 40 thousand in income from their farmland in a growing season (Annexure-II).

**Table 3: District wise Income per Acre from cropping**

| Name of Block | District-wise Income (in Rs) | | |
|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh |
| **Average** | **26928** | **36985** | **26577** |

### 2.3.2. District and Crop-wise Average Income per Acre

In the study area, farmers grew 12 types of crops in their farmlands and earned Rs 13,000 to 55,000 per acre per crop selected for cultivation. In the Gir Somnath district, farmers earn an average of Rs 10,000 higher (i.e. 37,000) compared to Amreli and Junagadh districts (i.e. 27,000). Cotton, Cumin, and Sesame, crops are providing more than Rs 40000 per acre per crop returns.

**Table 4: District and Crop-wise Average Income per Acre**

| Crop Name | District-wise Income (in Rs) | | | Grand Avg. |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| Bajra | | 28000 | | 28000 |
| Castor | 28500 | | 29833 | 29591 |
| Chickpea | 21875 | 53000 | 28900 | 32583 |
| Coriander | 15333 | | 22633 | 19505 |
| Cotton | 41100 | 48000 | 40343 | 41129 |
| Cumin | 35000 | | 55000 | 41667 |
| Groundnut | 21816 | 29500 | 19556 | 21241 |
| Onion | 38500 | 20000 | 39167 | 36889 |
| Pigeon pea | | | 25000 | 25000 |
| Sesame | | 52500 | 38000 | 45250 |
| Soyabean | 12667 | 45000 | 34000 | 23400 |
| Wheat | 19250 | 32188 | 25536 | 24289 |
| **Grand Avg.** | **26928** | **36985** | **26577** | **27774** |

### 2.3.3. District and Season-wise Average Income per Acre

Annually, farmers generate income Rs 50-90 thousand per acre from two-three seasons of cropping pattern. Farmers of Amreli District generate less as compared to Junagadh and Gir Somnath Districts. In a season, the average income of farmers in the Gir Sasan area was recorded upto 36 thousand.

**Table 5: District and Season-wise Average Income per Acre**

| Crop Seasons | District-wise Income (in Rs) | | | Grand Avg. |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| 1 | 30261 | 32500 | 25436 | 28107 |

| | | | | |
|---|---|---|---|---|
| 2 | 21060 | 40625 | 27431 | 26139 |
| 2/3 | | 39375 | 33375 | 36375 |
| **Grand Total** | **51321** | **112500** | **86242** | **90621** |

### 2.3.4. Details of Tree Crops growing in the Studied Area

Mango, Coconut, and Guava are the main tree crops growing in the studied region. Apart from this Mahogany, Sandal, Eucalyptus, and *Tectona grandis* also introducing into the farmland by outstation living farmers. As reported by JAU, 16900 ha of land is covered under mango cultivation and 6500 ha of land is covered under coconut cultivation.

### 2.3.5. Details of Bamboo growing in the Studied Area

In farm boundaries, a range of 1-8 Clumps are found and bamboo planted in riverside to check for landslide and landscaping purposes. Five species of Bamboo were recorded in the three studied districts of the Gir Sasan area, *namely* Bambusa *balcooa,* Bambusa *bamboos,* Bambusa *tulda,* Bambusa *vulgaris* and Dendrocalamus *strictus*. All five Bamboo species are recorded in the Junagadh district while Bambusa *balcooa,* Bambusa *bamboos,* Bambusa *vulgaris* and Dendrocalamus *strictus* found in Gir Somnath and Bambusa *bamboos,* Bambusa *tulda*, Bambusa *vulgaris* and Dendrocalamus *strictus* found in Amreli district. There were nineteen clumps of Dendrocalamus *strictus* and two clumps of Bambusa *bamboos* found in the plantation site in Junagadh Agricultural University in Junagadh. Out of the species found in the study area, Bambusa *balcooa,* Bambusa *bamboos* are suitable for construction and Bambusa *tulda* is a multi-purpose bamboo variety.

**Table 6: Bamboo growing in the Studied Area**

| Name of Bamboo | Local Name | District-wise Bamboo Distribution (# of farmers' sites) | | | Number of Sites |
|---|---|---|---|---|---|
| | | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | Baambu | | 1 | 1 | 2 |
| *B. bamboos* | Katas | 4 | 1 | 16 | 21 |
| *B. tulda* | Bans | 1 | | 4 | 5 |
| *B. vulgaris* | Vans | 1 | 4 | 3 | 7 |
| *D. strictus* | Nakur Bans | 19 | 6 | 18 | 43 |
| Farmers not having bamboo stock | | 21 | 8 | 11 | 40 |
| **Grand Total** | | **46** | **20** | **53** | **119** |

In more than 50 percent of locations bamboo was present. Mostly only one clump with 15 to 40 poles in number was observed in farm boundaries and farmers cultivate it for their personal use only, not for commercial purposes. In the past three to five years, 1-2 farmers planted bamboo on a commercial scale in each district. Mr. Jana Bhai of village Bediya, Block Gir Gidhada, District Gir Somnath planted an intensive 450 bamboo plants in 1 Acre of land in block plantation in 2021 and Mr. Karim Bhai Ajeet Jariya of village Sangodra, Block Talala, District Gir Somnath planted 600 bamboos in 1 Acre of land in block plantation in 2019. Mr Rasik Bhai village of Bandhala, block & District Junagadh planted 1700 bamboo in 5 Acre of land in boundary plantation in 2021. There is no big industry exists, which is limiting the scope for farmers in earning from bamboo by selling and this reason is limiting the scope of plantation activity in a full-fledged manner. Farmers interviewed utilized some poles for personal uses either as support to their agriculture crops or constructing temporary huts or as roofing support and no selling reported.

### 2.3.6. Details of Bamboo culms (poles)/ clump 1-2 cm diameter

More than three thousand culms were recorded in 1-2 cm diameter class in the study area. Maximum culms of 1007 were counted of Bambusa *balcooa* species in Gir Somnath and minimum 8 culms were counted of Bambusa *tulda* in Amerli district.

**Table 7: Bamboo culms (poles)/ clump 1-2 cm diameter**

| Name of Bamboo | District-wise Bamboo Distribution | | | Number of culms |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | | 1007 | 300 | 1307 |
| *B. bamboos* | 55 | 90 | 564 | 609 |
| *B. tulda* | 8 | | 34 | 42 |
| *B. vulgaris* | 25 | 15 | 118 | 158 |
| *D. strictus* | 254 | 37 | 591 | 882 |
| **Grand Total** | **342** | **1149** | **1607** | **3088** |

### 2.3.7. Details of Bamboo culms (poles)/ clump 3-5 cm diameter

More than 6700 culms were recorded in 3-5 cm diameter class in the study area. Maximum culms of 2370 were counted of Bambusa *balcooa* species in Gir Somnath and minimum culms of 9 were counted of Bambusa *tulda* in Amerli district.

**Table 8: Bamboo culms (poles)/ clump 3-5 cm diameter**

| Name of Bamboo | District-wise Bamboo Distribution | | | Number of culms |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | | 2370 | 1200 | 3570 |
| *B. bamboos* | 69 | 67 | 338 | 474 |
| *B. tulda* | 9 | | 69 | 78 |
| *B. vulgaris* | 10 | 205 | 430 | 645 |
| *D. strictus* | 306 | 15 | 1644 | 1965 |
| **Grand Total** | **394** | **2657** | **3681** | **6732** |

### 2.3.8. Details of Bamboo culms (poles)/ clump 5-8 cm diameter

More than four thousand culms were recorded in 5-8 cm diameter category in the study area. Maximum culms were counted as 2601 of Bambusa *balcooa* species in Gir Somnath and minimum culms of 4 were counted of Bambusa *tulda* in Amerli district.

**Table 9: Bamboo culms (poles)/ clump 5-8 cm diameter**

| Name of Bamboo | District-wise Bamboo Distribution | | | Number of culms |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | | 2601 | 300 | 2901 |
| *B. bamboos* | 25 | 54 | 59 | 138 |
| *B. tulda* | 4 | | 13 | 17 |
| *B. vulgaris* | 10 | 50 | 114 | 174 |
| *D. strictus* | 88 | 75 | 726 | 889 |
| **Grand Total** | **127** | **2780** | **1212** | **4119** |

### 2.3.9. Details of Bamboo culms (poles)/ clump >8 cm diameter

Total 77 culms were counted in >8 cm diameter class in the study area. Maximum culms were counted as 20 of Bambusa *vulgaris (yellow) and* Dendrocalamus *strictus* species in Junagadh and minimum 10 culms were counted of Bambusa *bamboos* in the Gir Somnath and Junagadh districts.

**Table 10: Bamboo culms (poles)/ clump >8 cm diameter**

| Name of Bamboo | District-wise Bamboo Distribution | | | Number of culms |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | 0 | 17 | 0 | 17 |
| *B. bamboos* | 0 | 10 | 10 | 20 |
| *B. tulda* | 0 | 0 | 0 | 0 |
| *B. vulgaris* | 0 | 0 | 20 | 20 |
| *D. strictus* | 0 | 0 | 20 | 20 |
| **Grand Total** | **0** | **27** | **50** | 77 |

### 2.3.10. Details of Bamboo culms (poles)/clumps in various diameter

Maximum 6600 number of culms are found in Gir Somnath district thereafter 6500 number of culms in Junagadh districts and 900 number of culms in Amreli in various sizes ranges from 1 cm to >8 cm. As far as species is concerned Bambusa *balcooa* followed by Dendrocalamus *strictus*, Bambusa *bamboos* and Bambusa *vulgaris* represented maximum number of culms in all districts in various sizes.

**Table 11: Bamboo culms (poles)/clumps in various diameter**

| Name of Bamboo | District-wise Bamboo Distribution | | | Number of culms |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | 0 | 5995 | 1800 | 7795 |
| *B. bamboos* | 149 | 221 | 971 | 1241 |
| *B. tulda* | 21 | 0 | 116 | 137 |
| *B. vulgaris* | 45 | 270 | 682 | 997 |
| *D. strictus* | 648 | 127 | 2981 | 3756 |
| **Grand Total** | **863** | **6613** | **6550** | **14016** |

### 2.3.11. Details of Dry Bamboo culms (poles)/ clumps in various diameter

Studies on dry bamboo showing that there is no dryness observed in Bambusa *bamboos,* Bambusa *vulgaris and* Dendrocalamus *strictus* in Gir Somanath, however, few culms were showing dryness in Gir Gidhada block of Bambusa *balcooa*. Bambusa *balcooa* also shows dryness problems in Bandhala village of Junagadh block of Junagadh district.

**Table 12: Dry Bamboo culms (poles)/ clumps in various diameter**

| Name of Bamboo | District-wise Bamboo Distribution | | | Number of culms |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| *B. balcooa* | | 15 | 450 | 465 |
| *B. bamboos* | 23 | | 96 | 119 |
| *B. tulda* | 3 | | | 3 |
| *B. vulgaris* | | | 69 | 69 |
| *D. strictus* | 90 | | 696 | 786 |
| **Grand Total** | **116** | **15** | **1311** | **1442** |

## 2.4. BAMBOO SPECIES SUITABLE FOR CONSTRUCTION

From the experiences of CIBART, the best suited varieties of bamboo for construction in India are Bambusa *balcooa,* Bambusa *bamboos,* Bambusa *tulda* and Bambusa *nutans*. While Bambusa *bamboos* is indigenous to the study area, Bambusa *balcooa* is also growing well in the study area and many parts of the Country. The other two species mostly grow in North-East India as well as in West Bengal and Bihar.

In one of its earlier projects on "**Prefab bamboo structures**", CIBART worked on design development and prototyping and testing of structural arrangements using the Bambusa *balcooa,* Bambusa *tulda* and Bambusa *nutans* and the results were found to be satisfactory. Further, in Tripura, CIBART built a structure by using Bambusa *balcooa* and Thyrosostachys *oliverii*, where it was proved and accepted that bamboo being the

mainstream construction material. For structures and furniture production, the raw material 'bamboo' need to be treated well for the enhanced life of the structure. In Bahraich district of Uttar Pradesh, CIBART built a structure in July 2017, by using locally available Bambusa *bamboos* for proceesing activities and training the artisans.

Bambusa *bamboos and* Bambusa *balcooa* species are used in housing construction in Gujarat due to its strength. Bamboo has good tensile strength quality and used as an excellent structural material in earthquake resistant architechtures. Case study of Baghel, A and Thakkar, A 2017: "Bamboo: A Resilient Material for Mass Housing in Earthquake Prone Zones of Gujarat"[20] given the properties and strength qualities of bamboo in earthquake-resistant low-cost buildings.

## 2.5. BAMBOO LIVELIHOODS AND RURAL IMPACT

Bamboo, a versatile and renewable grass, has gained importance in recent times, since it is an ecologically, socially, economically and culturally sustainable material, offers solutions to sustainability-related issues, such as global warming, climate change, poverty, food security and job security. Bamboo is a wonder plant and given bamboo's resilience and the speed at which it grows, large parts of degraded, waste and boundaries of farmlands can be utilized for developing bamboo resources.

It is imperative to build the bamboo resources due to limited and the non-availability of sufficient quantities of high-quality age-graded bamboo in the study area. This is also a main constraint to bamboo-based production activities or establishing micro-enterprises or large-scale industries. To provide livelihoods to the poorest of the poor through enterprise models. -

**Rural Impact:** The quality bamboos needed for the construction industry are not at present available in the study area and this bamboo to be sourced at a premium price from the traders. If the interested farmers grow the construction suitable species, that not only helps these rural families but also is encouraging them to plant more bamboo clumps and take care of them with good management since they realize that producing quality bamboo means higher income and higher livelihood. Bamboo makes farming households resilient with such income being independent of the vagaries of climate that can affect common agricultural crops. In a study by Swamy in 2011 it showed that it can create employment of 516 million man days per annum[21].

## 2.6. MANAGEMENT OF BAMBOO GROWN IN FARMS BASED ON TRADITIONAL KNOWLEDGE

Bamboo grown in farmer fields has been managed as per the traditional knowledge of the local people. There are some strengths and weaknesses in the traditional knowledge-based system adopted by the villagers. In the process of utilization of bamboo, farmers maintain several bamboo species in their home gardens to meet their basic needs. Bamboo contractors purchase bamboo from bamboo growers and sell it for scaffolding, to the paper industry and to big traders.

### 2.6.1. Key Tips in Bamboo Management and Harvesting

Harvesting of culms from a newly developed clump begins only after it exceeds five years of age, and keeps the younger clumps undisturbed.

For new plants, vegetative propagation be practiced through the offset method in which 1-2-year-old culms are cut at 1.5-2 m height and excavated alongwith a portion of rhizome with its root system and planted in the rainy season.

[20] https://www.researchgate.net/publication/332697132_(referred in Preferred by Nature)
[21] Swamy C. 2011. Employment Generation by Bamboo Resource Development and its impact on Rural Communities, Int J Rural Stud. 18 (1): 1-6

Selective felling system is preferred over the clear-felling system.

Mounding of soil to the bamboo clump prior to the rainy season will keep the newly emerged shoot healthier and reduces the mortality rate.

Leaf litter and farmyard manure around the clump every year for fulfilling the nutrient requirements of the growing culms.

Bamboo plantations can be taken up on the land of any interested right holder. Awareness should be created among right holders to motivate them to create bamboo plantations on their land. These farmers/ beneficiaries could be provided with technical and financial support for undertaking bamboo plantations on the allotted land for commercial bamboo plantations.

## 2.7. LEGAL PROCURMENT REQUIREMENT FOR BAMBOO, APPLICABLE STATE LAW

Ministry of Environment, Forests and Climate Change (MoEFCC), Government of India on 5th January 2018 has amended the Indian Forest Act, 1927 and introduced the Indian Forest (Amendment) Act, 2017. The act amends section 2, clause (7) of the Indian Forest Act, 1927 by omitting the word 'bamboos' (belonging to grass family Poaceae) from the earlier definition of trees which included palms, stumps, bamboos, brush-wood and canes, thereby dispensing with the requirement of felling/ transit permit for its economic use by farmers in non-forest areas. This amendment will help to encourage bamboo plantation and domestic production among farmers which will eventually contribute to enhanced economic growth, and increased green cover as well as bring reforms in the bamboo sector. It has also stated that bamboo grown in forest areas shall continue to be governed by the provisions of the Indian Forest Act, 1927. The major objective behind the amendment is to promote the cultivation of bamboo in non-forest areas to achieve twin objectives of increasing the income of farmers and also increasing the green cover of the country. The act consolidates the laws relating to forests, transportation of forest produce and the duty to be imposed on them.

### 2.7.1. Legal Rights for Non-Forest Bamboo Growing Areas

Legal ownership rights for bamboo grown on private farms rests with the farm owners. They are free to sell the bamboo grown on their land after receiving a certificate from the Gram Panchayat. An ownership right for bamboo grown on village land rests with the Gram Panchayat. Bamboo grown on village land can be sold after obtaining permission from the Gram Panchayat. There is no restriction on the trade of bamboo products inside the state.

Non-forest private land is owned by an individual/ family and managed by the individual/ community.

Growing: Allowed.

Harvesting: Permission for the felling of bamboo is not required. Gram Sabha will regulate the felling and transit of trees/ timber grown.

Transport: Gram sabha is authorised to certify the origin of timber felled in private non-forest lands. The Forest Department will issue permits based on the certificate of origin issued by Gram Sabha for movement across districts or states. A vehicle carrying bamboo needs to hold a valid carrying license or get a one-time transit permit by paying the requisite fee for carrying private/ forest grown bamboo.

Trading: Allowed. Typically, local agents (collectors) collect the bamboo from villagers and take it to the local district market. Traders registered with the Forest Department are allowed to transport further and sell.

### 2.7.2. Forest Land Legal Rights

a) Forest public land is owned by the Forest Department and left unmanaged without harvesting unless permitted by the Forest Department (Reserve Forest)

Growing: Not allowed except by Forest Department. Normally, reserve forests are left wild.
Harvesting: Not allowed
Transport: Not allowed
Trading: Not allowed

b) Forest public land is owned by the forest department and managed by the Forest Department (Protected Forest).

Growing: Not allowed except by the Forest Department or forest dwellers.

Harvesting: Allowed on permission of the State Forest Department. A permit is needed for the collection of all forest produce as well as for timber which requires a valid transit permit.

Transport: Allowed on the issue of a permit for transporting of forest produce as well as timber. The Transit permit will be valid for the destination for which it is granted.

Trading: Not allowed.

## 2.8. BAMBOO TRADERS

The following data was collected through a primary survey of bamboo traders in the study area, where plywood merchant sells bamboo poles for scaffolding activities to construction agencies. One of the traders M/s Asha Pura Saw Mill sells poles for an artisan family in Junagadh and one in Talala and one Sawmill in Junagadh sells bamboo poles for the construction industry. There were two shops selling bamboo articles in Junagadh and the demand is seasonal. The trader details are:

| | |
|---|---|
| 1 | M/s Durga Plywoods, Talala |
| 2 | M/s Shah Tulsidass Nemchand & Sons, Junagadh |
| 3 | M/s Asha Pura Saw Mill, Junagadh |


**Bamboo Merchant, M/S Durga Plywoods, Talala**


**Bamboo Trader, M/s Tulsidass Nemchand & Sons, Junagadh**

**Bamboo Merchant, M/s Asha Pura Saw Mill, Junagadh**

Bamboo traders procure bamboo poles from Siliguri, West Bengal and sell primarily to construction agnecies for scaffolding activities. The demand for bamboo poles of 2-3 inches wall thickness is growing and the Proprietor, M/s Asha Pura Saw Mill buying at an average of 2 trucks of bamboo poles every month. Each truck carries around 1100 poles of 20 ft. size.

## 2.9. TREATMENT AND PROCESSING FACILITY

Bamboo has acquired a unique place in construction and establishing a natural habitat. Early decaying of bamboo has become the greatest problem, when non-treated bamboo used in construction. Bamboo treatment has become a necessity for the structure, keeping in mind the non-treated bamboo's short durability, the costs involved in the intermittent replacement of the components and the cost of the material and labour time. Bamboo is treated and used to avoid the attack of borers and pests for making construction components and furniture products. Seasoning and chemical treatments of bamboo and bamboo products are given high priority, especially for construction-related activities. The study team visited the proposed locations in Talala, Gir Somnath and Junagadh in order to establish a treatment and processing facility. CIBART had established three common facility centres in South Gujarat, Two in Tapi district and one in Navasari district. Traditional treatment methods are used in treating small bambo products and craft products. Going with the experience, for bamboo furniture and bamboo structures, it is necessary to have the bamboo poles treated by using chemical treatment. The use of treated bamboo poles enhances the business opportunities and also the rural employment opportunities. CIBART, thus, proposes for a compact type vaccum/ pressure impregnation bamboo treatment plant to treat the bamboo poles, especially for furniture and structural components.

Bamboo treatment and preservation can be classified into two (2) categories, namely, traditional or non-chemical techniques and modern or chemical techniques.

### 2.9.1. Traditional Methods for Treating Bamboo[22]

There are ancient methods to treat bamboo using non-chemical or smoke, which have been practiced in areas where bamboo grows. Since bamboo resources are plenty, the untreaed bamboo or traditionally treated bamboos are replaced regularly in those areas that have abundant bamboo. They are simple and cost-effective methods without the use of chemicals or supporting equipment. However, these methods are in general not appropriate for long-term protection of bamboo. This method can be performed by various techniques; however, five major techniques are as follows:

**A) Smoking and heating**: Smoking bamboo poles reduces the moisture content in freshly harvested bamboo and extrudes out the sugars that are in the pole. In this method, the consistency of the heat and smoke quality should be maintained and poles will be rotated to get them treated uniformly. Burning large amount of material to create smoke has its own environmental challenges. This is an effective method, as the chemical compounds found in smoke are absorbed by the bamboo tissues and help to protect them from insects. Smoke causes a blackening of the culm and reduction of its moisture content thereby restricting biological degradation. The houses that are traditionally built by using bamboo poles in roofing in Gir Somnath area have been regularly exposed to smoke treatment. The heating process kills off existing pest infiltrations whilst partially plasticizing the lignin in the bamboo and hence increasing its durability.

**Bamboo Poles in Smoke Treatment[22]**

**Bamboo Roofing after Smoke Treatment**

**B) Water-leaching**: This is one of the simplest techniques for preserving bamboo. In this method, bamboo poles are submerged in flowing, clean water for a certain period (4-8 months). The water-soluble substances present in the bamboo, will be washed away slowly. Though this method is not completely resistant to insect attacks, poles treated through this method are less attractive to insects. In the case of stagnation, change the water once every week to avoid bacterial growth, staining and smell.

[22] https://bamboou.com/traditional-methods-for-treating-bamboo/

**Water tank for leaching**

**Treatment of bamboo mats**

**Treated mats sun-dried**

**C) Fermentation:** In this method, the bamboo poles are immersed within mud and tree leaves for a few months (3-4 months), to get the microorganisms and bacteria in the compost to convert the starches and sugars into acid thus lowering the likelihood of insect prediction. However, this is not a full-proof method and is not reliable to get a long-time protection.

**D) Salt water/ Sea water immersion:** In this method, bamboo poles are immersed in salt water or sea-water for about 1 to 3 months, to allow the poles to absorb the salt solution and release the sugary sap. For thick-walled bamboo, holes are drilled from the outside skin close to each internode, to allow the maximum penetration of salts into the bamboo. There are issues observed in this method, as the steel bolts used in joining get rusted due to the presence of the highly corrosive content i.e. chlorine in the salt water/ sea water.

**E) Lime Washing**: Bamboo culms and bamboo mats for housing are washed with slaked lime. Besides the ornamental effect of the white color, the process is expected to prolong the service life of the bamboo. The surface becomes alkaline, which delays fungal attacks. Lime washing of bamboo may not inhibit fungal growth[23].

### 2.9.2. Chemical Treatment Methods[24]

In Chemical treatment methods, preservatives (borax and boric acid) are used to protect bamboo products from degradation. This is a well-established method providing long life and good protection even in adverse conditions like few exposers of sun light or rain, etc. While doing permanent structures, using the borax and boric acid treatments are the most reliable treatment methods. Borax and boric acid-based treatments are not harmful to the environment and they are relatively accessible and affordable. Poles treated by using this method are durable for the construction industry. By using chemical treatment, the durability of bamboo can be extended upto 3 to 5 times. Treatment with chemicals for bamboo preservation is more effective than any non-chemical method and ensures a longer life. Different methods of bamboo treatment exist.

**A) Soaking/ washing (boron-based treatment)**: An open-tank treatment by soaking fresh culms, dried culms and splits is a rather simple method that leads to a protective effect. This method involves soaking the bamboo in a bath of the chemical (i.e., sodium borate, sodium tetraborate, or disodium tetraborate). The materials are prepared to size, and soaked in a solution of 7% boron or 10% XM5. The treatment time takes about 2–3 days for splits and 7–9 days for the culm parts. For culm parts with skin, the solution penetrates by diffusion mainly into the ends, partly at the nodes and to a small extent

[23] Kaur, Perminder & Satya, Santosh & Pant, Kamal & Naik, Satya. (2016). Eco-Friendly Preservation of Bamboo species: Traditional to Modern Techniques. Bioresources. 11. 10.15376/biores.11.4.Kaur.

[24] https://www.inbar.int/wp-content/uploads/2023/01/2022_Post-Harvest-Bamboo-Treatment-Preservation-and-Storage-Practices.pdf

through the outer culm wall. Culm parts without skin as well as splits can be treated easier than round bamboo. Split bamboo may require only a week, whereas round culms need 10–14 days. The chemical can be heated to speed up the process (Kartal et al., 2008). This requires fresh or almost fresh culms (up to seven days since harvesting) otherwise the cell walls will start to close. Bamboo should be stored upright for a minimum of one week after treatment to allow the boron to diffuse throughout the culm, followed by a further period of one to two weeks to partly season the bamboo. The bath liquid can be reused multiple times.

After many studies by bamboo builders throughout Bali, a treatment solution made up of borax and boric acid mixed with water has been proven to provide the treatment that bamboo needs. The recipe for the solution looks like this: 6% Borax, 4% Boric Acid and 90% Water[25].

**B) Butt-end treatment:** In this method, green culms are placed vertically in the preservative solution such as boric acid: borax as 1:1.4 (or CCB –Copper Chrome Boron) in a container or cement tank. The bamboo poles cut into 2 m length, remove foliage, pace sections in the solution. Depending on the length, bamboo to be kept immersed in the solution for 7-14 days. The time for treatment will depend upon the moisture content and length of the culm. Stir the solution in between to prevent sedimentation and invert the sections midway, when the drops of solution appear at the nodes as the solution progresses upward. Once treated, the culms dried under shade. Butt-end treatment is suitable for freshly harvested green bamboo only.

**C) Boucherie treatment:** Through Boucherie method, freshly harvested green bamboo can be treated. In this method, one end of the bamboo is connected to the reservoir containing the treatment media through a coupling unit. The hydraulic pressure pushes the treatment media through the wall of fresh bamboo and thereby the sap is drained out and replaced the chemical. The process is completed when all the sap has been replaced by the preservative. Readymade CCB will be used to prepare the media, i.e., 8% CCB in 20 litres of water. Boucherie method is well suited for on-site application, low environmental impact, a simple, less time (3-5 hours) consuming process. The equipment can be fabricated locally and boucherie equipments available in the market inexpensive and affordable.


**Demonstration of Boucherie method**

[25] https://www.homesteadinhawaii.com/bamboo-construction-harvest-and-treat-to-last-years/

**D) Pressure vacuum treatment**: The pressure method is mainly used for the treatment of dried bamboo. The principle behind the process is to force the preservative solution into the bamboo tissue. This can be done by a vacuum and/or by increasing the pressure upon the preservative in the treatment cylinder. The pressure method is mainly applied for bamboo culm parts and splits for making furniture and housing. Culm parts and splits are treated with 7% boron or 8% XM5 with a pressure of 7 kg/cm2 for 2–3 hours. This schedule is mostly applied to all bamboo species. While using the pressure vacuum treatment plant, the manufacturer's safety procedures should be followed strictly.

**Pressure Vacuum Treatment Cylinder**

## 2.10. TRAINING/ SKILLS IMPROVEMENT

Through intensive field action and state-of-the-art technology in bamboo and bamboo products developed and successfully field tested in its own processing facilities, CIBART proposes to improve the livelihoods of the targeted population, through skills building to enhance their income and provide them a sustained wage or self-employment. While income is needed for sustenance and living, employment provides social status and prestige and gives the person a sense of well-being. There would be multiple actions at the beneficiaries' end along the value chain from resource production through processing to marketing. Time duration for developing skills in treating methods, furniture production and for the structures making is for 3 weeks, 2 months and 3 months respectively. To operate the treatment plant a team of four/ six young community members needed on full time basis and about 50 members need to be trained in the production of bamboo furniture and bamboo structural components making for a successful business operations.

**Skilled Manpower: Removing Knots in Bamboo Pole**

**Bamboo Treatment Plant Operation**

**Bamboo Woring Machine Operation**

## 2.11. POTENTIAL TO USE DEGRADED LAND FOR GROWING BAMBOO FOR COMMERCIAL PURPOSES

There are limited bamboo sources available in the study area and for executing bamboo construction orders, bamboo resources need to be developed. Farmers in the study area shown interest in growing bamboo species other than the Bambusa *bamboos,* which is indigenous to the area. Instead of comprising the agricultural land, degraded land can be used for planting bamboo which is usually available with gram panchayats on a lease basis for a minimum of ten years. While traditional species mature at 5 years, tissue culture species mature at 3 years and nine months. There would be high costs of reclamation initially however the demand for raw materials could be met through this strategy. One of the construction suitable "Bambusa *balcooa*" tissue cultured plantlets can be grown in degraded lands and waste lands. In Gujarat, Bambusa *balcooa* grown in mining areas in Raj Pipala and CIBART developed a plantation of 20 acres.

## 2.12 POTENTIAL FOR USING WASTELAND EXISTS IN THE STUDY AREA

In total 54.34 Sq Km of cultivable wasteland is available in the three districts of state/ study area. Other land details are also given in Annexure III. Maximum 34.23 sq Km land cultivable wasteland is available in Gir Somnath district among all studied districts. Thus, it is the potential for utilization of wastelands for resource generation in carrying out bamboo plantation with species suitable for construction purposes.

## 2.13 POTENTIAL SOURCES FROM FARMS AND FROM GROWERS

Bamboo farming is promoted with the support of the National Bamboo Mission in five districts of Gujarat. Bamboo farming has gone beyond homestead or boundary plantings into farm plantations since farmers have become commercial suppliers to traders and industry. Considering the spread and scale of growing bamboo in other parts of the State, the need for tending selective species and selective cutting of bamboo poles of the desired age, as well as the current low density of cultivation, there is a large potential for enhancing bamboo supply. For the new value chain, some suggested steps are:

- Bamboo may be sourced from farmers who have ownership rights. They may also purchase from contractors who have established linkages with farmers.
- Bamboo may be sourced from all 3 districts.
- The farming communities encourage for bamboo planting and this offers the possibility to intensify bamboo production.

- Promote and establish bamboo plantations with suitable species with technical assistance and training in leased, waste and degraded lands
- Additional supplies into the market could come from the large number of farming HHs that have considerable bamboo resources but are currently not supplying to markets. This would entail quick scaling up of production since each HH already has at least one bamboo clump.
- Contract growing by the agency. This depends on individual farming HHs agreeing to grow bamboo against a buyback contract that is guaranteed by the agency.
- The Gram Panchayat – a third tier of elected governance, is a revenue village with several small villages and hamlets under it – could also make available its common property land/ waste land for planting against a long-term buying contract or bring individual farming households together.
- Evaluate the use of bamboo in composite system with other building materials, such as wood and steel components

# 3. LIMITATIONS

Gir area is not having a substantial bamboo resource base at present, and its distribution is not uniform across the blocks that were studied. Because of the scarcity of bamboo resources, there were not many product lines developed. There is limited or no interest among farmers towards bamboo resource development due to no awareness or understanding of different species and their use. Further, the existing traditional cropping practices are limiting them to experiments especially with bamboo.

Bamboo is not grown as a farm crop and the farmers have one or two clumps of Dendrocalamus *strictus* or Bambusa *bamboos*. This study is limited to visits such farmers having bamboo clumps as per the local information received.

Information on bamboo cultivation and processing is very limited with the agencies or institutions that promote bamboo development activities in the study area. If any such institutions exist, did not cover in this study, except The Junagadh Agricultural University.

There are three blocks *viz*. Jafrabad, Khambha of Amreli and Patan-Veravel block in Gir Somnath district, were not covered due to the distance and other disturbances in The Gir Sasan area. In Amreli distirct, having found no bamboo in many farmers fields, the study team did not explore the above three blocks referred.

People live near to seashore and they are mainly growing coconut trees and conversion from coconut cultivation to bamboo cultivation is a big challenge as compared to seasonal crop grows like wheat, groundnut and cumin. The Study team observed from the farmers that there are reluctant to add a new crop like bamboo and even though some of them have one or two clumps did not show interest for new species or more plantation. As far as soil is concerned, bamboo can be grown in all types of soil except a sodic soil. Sodic soils have a low infiltration rate, they are poorly aerated and difficult to cultivate.

# 4. BUSINESS ENVIRONMENT OF THE PROPOSED LOCATION AND ECOSYSTEM

Gir Somnath is located in an ideal place of attraction for tourism in the state of Gujarat and this is one of the important spiritual centers for Hindus and the first Jyothilingam temple situated. Due to the good number of tourists visiting both Gir Sasan and Gir Somnath, all around the year, it is an ideal place to have iconic bamboo structures developed, which attract the public. The machinery and other resources of the facility center can be used for design development and diversification and making a different range of products for construction as well as for interiors.

This proposed location has a good network of national and state highways for the transportation of bamboo/ processed components and hence large-scale supply/ transportation of processed material to other parts of the state, where assembling works can be done. Further, combined efforts of working with the farmers to grow and utilized bamboo resources, local bamboo economy is kickstarted.

## 4.1. GEOGRAPHY AND PROPOSED LOCATION OF BPC

CIBART proposes to establish one Processing and Treatment facility in Gir Somnath district as it is well connected by road and rail. There is an open area of around 2500 sq.ft. could be converted as a processing facility. For installing a treatment plant and to keep raw bamboo poles and storing the bamboo treated bamboos, the available space is inadequate. It is however better to have both Treatment facility and Processing facility in one location, adjacent to each other. For this location, the nearest airport is Rajkot, approximately 100 kms from Gir Somnath. Bamboo growing is limited in the Gir Sasan area and for the continuation operation of a business vertical, raw bamboo poles supply is necessary. Farmers are interested in Gir Somnath district to grow new species which are suitable for construction activities. Hence there are opportunities for establishing commercial bamboo plantations with suitable bamboo species in Gir Somnath with interested farmers. For the initial period, bamboo could be procured from the traders and from other bamboo-growing districts of Gujarat/ Maharashtra, till the local resources are developed in this study area.

## 4.2. BAMBOO MARKETING OPPORTUNITIES FOR FARMERS

All farmers consume bamboo for their personal usage and not for sale either due to no market available nearby or timber traders not accepting the quality of bamboo produced by farmers. They are growing bamboo on their own land. Farmers have no skills of value addition in raw bamboo and do not know where they can sell their bamboo in the market.

As per responses received during the survey, mostly farmers have no awareness, no market, no buyers, no regular agriculture of bamboo resources and showing concern about difficulty in cutting the Bambusa *bamboos*. At present, mostly they are not willing to plant bamboo in their farmland in Amreli and Junagadh district but in Gir Somnath district farmers are willing to plant bamboo in their farmland if proper knowledge of cultivation and market will be provided to them.

## 4.3. BAMBOO PLANTATION WILLINGNESS/INCLINATION

Few Farmers aware about the bamboo is consumed in Tourism Industry or Construction Industry in Gir Somnath district and overall, approximately 25 percent of farmers are showing willingness for bamboo plantation with new species in overall districts but majorly in Gir Somnath. A detailed list of farmers collected

by the study team and bamboo plantation activities could be initiated from Gir Somnath district. Here, no bamboo treatment facility is available in the Gir Sasan area and only raw bamboo poles procured by timber trader in Talala being used by artisans. Structures are of temporary nature and Bambusa *balcooa or* Bambusa *tulda* poles from Assam are used in making such structures. The fish market structure is one such example;

**800 meters lengthy single storey temporary structure for fish trade**

**Table 13: Bamboo Plantation Willingness/ Inclination**

| Responses | District-wise Bamboo plantation willingness | | | Total Number |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| **No** | 40 | 4 | 37 | 81 |
| **Yes** | 5 | 11 | 14 | 30 |
| **Grand Total** | **45** | **15** | **51** | **111** |

## 4.4. RATIONALE AND BUSINESS VERTICLE

The bamboo sector also needs support to undergo restructuring through technology up gradation and modernization in order to improve productivity, quality, cost-effectiveness and consumer satisfaction in order to survive and remain competitive. It is of prime importance that the products are produced by using treated bamboo poles. In the absence of a Bamboo Treatment Plant and Processing facility, the business opportunities are not optimally exploited. There are possible avenues to begin community-based livelihood generation opportunities through bamboo plantation and production.

There is a definite need to introduce vocational options to the youth of this region, especially those that incorporate alternate, sustainable Non Timber Forest Produce, since timber is a rapidly diminishing raw material and thereby an unsustainable vocation as well. Bamboo can play a very important role in providing a natural resource, and a viable livelihood option to the people of this region. It would cater to the daily needs of the people: providing a renewable and sustainable source of income and a viable timber replacement material. The facility centre would function as a Business incubator for small-scale entrepreneurs, who could use its facilities to explore and develop new techniques, technologies, products, etc. at a highly subsidized cost.

Apart from using the treated poles for its own use and for structuring activities, the processing facility could supply treated poles and supply of processed components and products for long life, and the charges/ remuneration would go towards the operational costs of the facility center.

The following activities are suggested for the Treatment and Processing Facility:

1. Bamboo Pressure Vacuum Treatment plant may be established at Gir Somnath in a suitable location

2. Bamboo working machines and alternative power supply should be installed in the center
3. Training and skills building of the local youth on bamboo furniture production and construction components may be provided
4. Training should be focused on improving and maintaining the quality of production
5. Ensuring cost-competitive production through the process flow
6. Processed and semi-processed components, raw materials should be available to artisans/ institutions
7. Centre may focus on the development and promotion of bamboo fabrication, preservation, design and production of low/high-value structures

# 5. WAY FORWORD AND PROPOSED BAMBOO VALUE CHAIN

As a way forward, new bamboo value chain will focus on the product line of bamboo construction components, bamboo structures, bamboo furniture and bamboo roofing sheets. The value chain maintains a pro-poor focus and seek to develop bamboo-based economic opportunities in rural areas through upstream bamboo-based economic activities, technology induction, and market linkages. The project interventions carried out initially in one district viz. Gir Somnath and subsequently replicate it in other districts.

The project targets quality social and civil infrastructure and sustainable employment in the areas that can help enhance the income and more importantly, resilience, of every farmer engaged in or every artisan associated with it. There would be multiple actions at the beneficiaries' end, along with each of the value chains from resource production through processing to marketing. The project would therefore span bamboo nurseries, micro-plantations on farm boundary or block plantations, bamboo plantation management and harvesting for quality produce, enhancement of productivity, depots establishment and bamboo collection and preservation treatment, componentizing/commoditizing, assembly and finishing of bamboo products.

The project ensures economic sustainability, replication through dissemination and building up of knowledge and skills, and scaling up of the production capacity, backstopping and mentoring the field actions. Indicative finances are provided for the establishment of nurseries, model plots establishment, processing facility establishment, the machineries, the treatment facility establishment, the necessary skill building programmes and enterprises establishment.

## 5.1. SUPPLY CHAIN ESTABLISHMENT

The bamboo poles (culms) needed for the Bamboo Processing Centre (BPC or Bamboo CFC) would be collected from within a 15 to 30 km radius of the BPC. The 15-30 km radius has been chosen since this allows for a pickup truck to travel up and down within the same day, including stoppages for the collection of bamboo, and return back to the CFC by the evening. The next day the truck would do a similar round of an area not covered, which would continue so that by the end of the month, all or most of the resource "catchment" are of the BPC is covered, after which the cycle will repeat. The project would need to first utilize and work with existing bamboo while the results of better clump and pole management, debudding, and agronomic practices, show their results or the bamboo available with the traders or at the trading points. It is expected that the percentage of quality, straight poles, would be from 10-20% of the available poles. Buy-back guarantee to the bamboo growers that would not only meet the growing needs of the BPC but also add to the permanent green cover of the district and state.

If possible, the plantation and new plantings will also be done in the 15-30 km radius area around the BPC. While new plantings of the desired species and in the required quantity would be carried out from the start of the programme, the new bamboo plants would take time to grow to maturity. Therefore, at least some part of the plantings would be given the needed agronomic inputs to enable rapid growth while the rest catch up in time. Interplanting bamboo with other crops would also be promoted in the first year. Another strategy would be to do homestead planting and farm boundary planting and as this comes into production. Households will be encouraged to plant on farm boundaries and other land unusable by agriculture with an aim to plant a minimum of 15-25 plants and above clumps of bamboo that would greatly enhance their resilience and bring them above the poverty line. While farmers would be free to do block planting of bamboo on their own accord, the focus for plantations will be of construction suitable species on farm boundaries, degraded and wastelands not used for agriculture land. That bamboo can rehabilitate degraded and wastelands has already been proven in Allahabad district[26]. The important action is to see that bamboo clumps are planted along contour bunds that

[26] Won the $1 million Alcan Prize for Sustanable Development in 2007; an INBAR project.

help in preventing water run-off and enhance percolation time. Income would get generated from the sale of bamboo poles or made into products in demand, which is targeted at the youth.

## 5.2. CONSTRAINTS IN THE CURRENT BAMBOO BASED LIVELIHOOD MECHANISM

The rural artisans are involved in bamboo craftsmanship for decades and despite the promising market opportunity and large-scale benefits that bamboo now offers, there are several constraints noted that influence the rural communities from existing and growing market demand for eco-friendly bamboo products. In the study area, there were a few artisans engaged in bamboo crafts activities. There are constraints too in the current bamboo-based livelihoods as described below:

- Inadequate quantity and inconsistent quality of bamboo resources owing to poor or no management of bamboo resources, lack of proper harvesting, age of bamboo and location classification of culms/poles
- Absence of a strategic direction/ guidance/ policy for bamboo propagation and small farmer-focused planting that would enable better care and production of quality poles for establishing bamboo enterprises
- Lack of appropriate technology, tools, and machinery adaptation and development, with limited or no access to basic infrastructure
- Low risk-taking capacities of the rural farmers to innovate on the traditional product ranges despite the demand in an upper end market
- Absence of treatment facilities and lack of production of quality dimensioned intermediary commoditized products to ensure quality final products, so that reproduction and replacement are possible and the material becomes standard in nature
- Inadequate production systems which result in an inability to produce in volume with quality
- Regulatory and policy constraints, including lack of conversion of policy opportunities for market development and price support
- Linkage to institutional markets remains limited
- Inequitable supply chains linking rural producers to their markets, causing low value share realization and poor product quality
- No enabling and dependable institutional arrangements that deliver community services and technical support locally.

In summary, the informal nature of the bamboo sector could do much better if it was to be organized with backward and forward linkages while being integrated well into each bamboo product value chain.

## 5.3. OVERALL OBJECTIVE OF BPC

Overall objective of a bamboo CFC or a BPC in Gir Sasan is to make it an economically self-sustaining, with the rapid enhancement of the bamboo density and canopy for their sustainability, contributing to the overall industrialization, economic growth, and environmental security. Bamboo CFC is focusing to create environmentally sensitive habitats, popularize bamboo buildings/ houses and take this initiative to a sustainable scale where it can make a significant impact in the lives of rural communities.

Specific objectives of the Project

1. Develop a Bamboo Processing Centre (BPC or Bamboo CFC) and bamboo depots (collection points) within a radius of 15-30 km from the BPC.
2. Develop a strong cadre of knowledgeable production team and skilled personnel through the on-the-job bamboo skill enhancement trainings
3. Develop robust markets for bamboo poles, bamboo commodities, and products. Work with government departments/ private/ donors to ensure regular orders for bamboo construction activities, social housing and tourist constructions.

4. Promote bamboo growing while providing intermediate income streams: Augment bamboo resource availability by promoting highly productive and commercial species of bamboo, and upgrading bamboo agronomy and management.
5. Establish backward linkages and promote bamboo growing by households, small farmers, while also establishing plantings in degraded lands, wastelands and abandoned farmland. Back up planting with a buy-back agreement with an MSP.

## 5.4. BAMBOO VALUE CHAIN

Model commercial enterprises will set up production of various products in demand in an area around the BPC campus in independent or condominium-style worksheds/ bamboo structures/ bamboo buildings. Marketing linkages and production systems will be designed with an emphasis on quality, quantity, delivery schedule, and price. The following bamboo value chains would be taken up in the BPC, subject to funding specific to the enterprise, and linkage to institutional markets wherever possible; one product line will be focused but the value chains would be built up depending on demand. For ex. Furniture production, roofing sheets, crafts, gift articles etc. Investment in plant and machinery would be planned accordingly.

The products thus introduced in the BPC are:

**A. Construction: Bamboo-based construction is earthquake resistant and is self-insulating.**

- IAY housing, tourist huts, health centers, bus shelters, school buildings, etc.
- Equipment required in BPC: cross cutting, splitting, preservation treatment
- Set up enterprises that produce components and stock-related inputs
- Trained construction team, people who can build with bamboo

**B. Furniture: Bamboo furniture can be produced depending on demand.**

i. Equipment required in BPC: cross cutting, splitting, preservation treatment, knot removing machine, lathe machine, paint brush booth
ii. Set up enterprises that produce components or establish village intermediary centres
**iii.** Trained team members who can produce bamboo furniture for office, hotels, guest houses, schools etc.

**C. Bamboo Roofing:** Bamboo roofing looks aesthetic and there is no compromise on the strength of the structure and it is an effective, eco-friendly alternative to metal or concrete to a building. They adapt well to any season. Bamboo roofing sheets aer much more flexible adn durable than other sheets.

**D. Bamboo crafts/ gift products/ souvenirs**

## 5.5. SELECTION FOR CONSTRUCTION

For all projects, the supply of raw materials is the key issue and only a few bamboo species are suitable for bamboo structure and components making. Hence, the selection of species and identify the matured poles be the first step in bamboo structuring project. Bamboo wall thickness also plays an important role and generally, the lower portion of bamboo pole is used for structural purposes. There are hundreds of traditional systems and types, where bamboo is predominantly used for house construction, especially in North East India and these houses are withstanding normal weather and wind condition. Some basics for the bamboo selection for construction as given below:

- Bamboo having thick walls (8 mm to 10 mm or more)
- For column, beam and Truss – outer diameter 80 mm-100 mm or more
- For purlins – bamboos having thin walls (4 mm-8 mm) and outer diameter 50 mm-75 mm
- Strength is measured by inter nodal distance and less inter nodal distance bamboo is preferable
- Treated bamboo and it should be free from any defects

- If the outer skin is smooth, this can be retained.

**Bamboo Treatment in Pressure Vacuum Plant**

For centuries bamboo has contributed to the housing construction, its structural strength has been recognized and scientific tests have been carried out in many parts of the World. Bamboo is recognized as an engineered solution for construction purposes. This material is much more relevant for regions that have extensive bamboo resources and for other regions that have limited or no resources, bamboo pre-fabricated components are of a good option. Occupational standards may be as similar as for pre-fabricated housing components. Pre-fabrication of engineered bamboo components, such as, bamboo columns, bamboo beams, wall panels, etc. and erecting them at site, within a short span of time has been an option to be tried at large and it will be proved once again that bamboo, a suitable material for cost-effective structure.

To undertake the construction of superstructure using bamboo, Ministry of Rural Development (Rural Housing) developed the draft National Occupational Standards (NOSs). The draft NOSs recommended for bamboo structures by the Rural Housing Division of the Ministry are as given below:

The scope covers the following four elements:

- Erection of bamboo stilts sub-structure for simple rural shelters
- Selection and treatment of bamboo for use in construction
- Erection of bamboo and timber superstructure
- Construction of roofing systems with bamboo (understructure and trusses)

**Table 14: Performance Criteria with respect to the Scope**

| Element | Performance Criteria |
|---|---|
| **Erection of bamboo / timber stilt sub-structure for simple rural shelters** | To be competent, the user/individual on the job must be able to:<br>PC1. Read and interpret the sketches for sub-structure (foundation) works select required tools for the task and ensure they are in working condition<br>PC2. Select appropriate Personal Protective Equipment (P.P.E.s) for the task<br>PC3. Ensure work place is clear for undertaking the substructure work<br>PC4. Set out the layouts as per sketches/drawings<br>PC5. Ensure transfer of loading points as per the layouts checking all specs of construction like horizontality and vertical straightness using water level tubes, plum bobs and other methods required to check 90 degree.<br>PC6. Ensure proper protection of bamboo members at the foundation from moisture and chances of decay.<br>PC7. Ensure safety of the foundation before commencement of construction of superstructure.<br>PC8. Connect base of the bamboo member to a stone foundation or a concrete foundation making sure the protection of bamboo posts. |

| | |
|---|---|
| **Selection and treatment of bamboo for use in construction** | To be competent, the user/individual on the job must be able to:<br><br>PC1. Identify/ select bamboo for use in different parts of a structure<br>PC2. Or understand the logic of cutting bamboos and sourcing them.<br>PC3. Guide sorting as per their use and proper storage of cut bamboos.<br>PC4. Planning of Cost effective treatment of bamboo members before use<br>PC5. To prepare bamboo and bamboo splits for use in different parts of construction<br>PC6. Knowledge on locally available bamboo based wall construction components.<br>PC7. Source already available types of bamboo/ bamboo-based mats with proper quality check for use in superstructure construction. |
| **Erection of bamboo and timber superstructure** | To be competent, the user/individual on the job must be able to:<br><br>PC1. Read and interpret/ label components as specified.<br>PC2. Plan/organise construction of superstructure: Identify and sort different components and stack them as per use.<br>PC3. Check for damages post preparation of members and treatment.<br>PC4. Check for straightness of bamboo members or alternatively check for shrinkage post component production.<br>PC5. Different appropriate ways to tie, screw and hammer on bamboo members for a permanent construction.<br>PC6. Erection of simple bamboo mat walls to Ekra and Plastering with cement stabilised mud if needed.<br>PC7. Understand the need for constant inspection of mechanical joints. |
| **Construction of Roofs with Bamboo** | To be competent, the user/individual on the job must be able to:<br><br>PC1. Read and interpret/label components as specified.<br>PC2. Ensure stability of horizontal and vertical ties before the erection of bamboo trusses.<br>PC3. Fabricate trusses as per specifications as components.<br>PC4. Stack the truss components on the vertical posts or as per specifications.<br>PC5. Apply purlins step by step simultaneously as the trusses are erected to ensure the stability of the trusses in standing position.<br>PC6. Complete the roof framing work with all trusses and purlins complete.<br>PC7. Tie/ screw the purlins to the truss components.<br>PC8. Use J – Hooks to fix roofing sheets.<br>PC9. Check quality of roofing sheets, mostly GI sheets.<br>PC10. Application of roofing sheets as specified.<br>PC11. Provide ridge capping<br>PC12. Provide GI gutters at eaves end for collection of rainwater. |

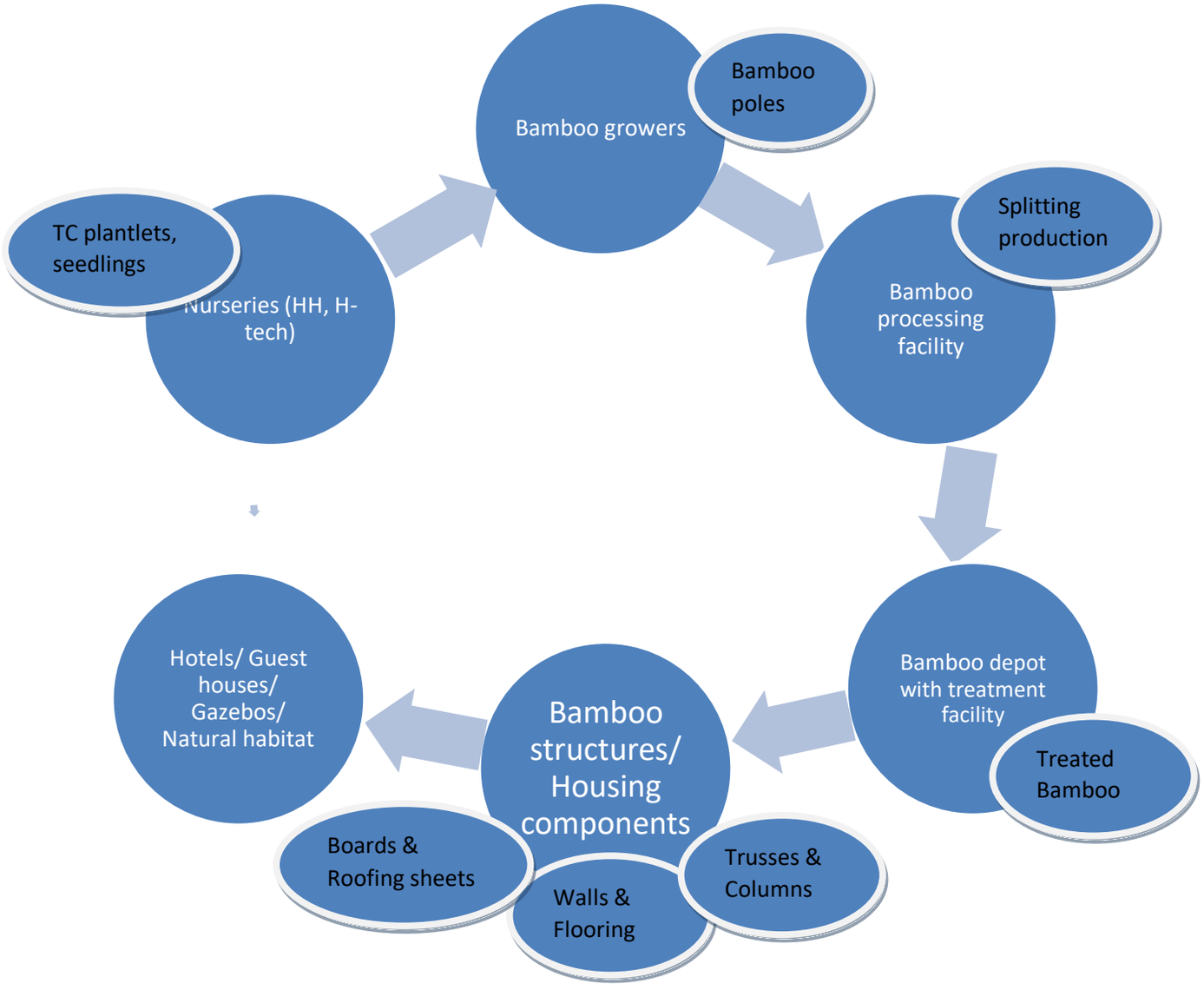
## 5.6. BAMBOO-BASED HOUSING FOR THE RURAL POOR PEOPLE

Bamboo has great potential for contributing to poverty reduction, environmental protection, and achievement of the SDGs in general, for over a billion poor and disadvantaged people in Africa, Asia and Latin America. In India, which is predominantly rural, the demand for rural housing is four times that of urban.

To address this massive housing need, the Government of India (GoI) through its various agencies, as well as state-level institutions, has implemented several rural housing programs, some fully subsidized and some partly. The Indira Awas Yojana (IAY) launched in 1985 is one of the major initiatives for rural housing. Started

as a fully subsidized housing scheme for the socially and (invariably) economically backward classes, it changed the eligibility criteria in 1993 to cover all rural poor people. In spite of these efforts and intentions, the housing situation in the country remains woefully inadequate.

### 5.6.1. Bamboo Housing Value Chain




### 5.6.2. Outcomes Envisaged

☐ Establish successful operations at BPC

☐ Design development of different product ranges under “construction segment” and “furniture segment”

☐ Performance under different weather conditions

☐ Process to be adopted for making products

☐ Market testing and positioning of the bamboo structural projects.

☐ Awareness generated on bamboo based products & increased use of bamboo for domestic consumption.

☐ Bamboo is positioned as an alternative to wood for commercial and industrial uses.

☐ Commercial bamboo plantations promoted with farmers for employment in producing alternative and environment-friendly crop which is resistant to erratic climatic changes.

## 5.7. RISK ANALYSIS

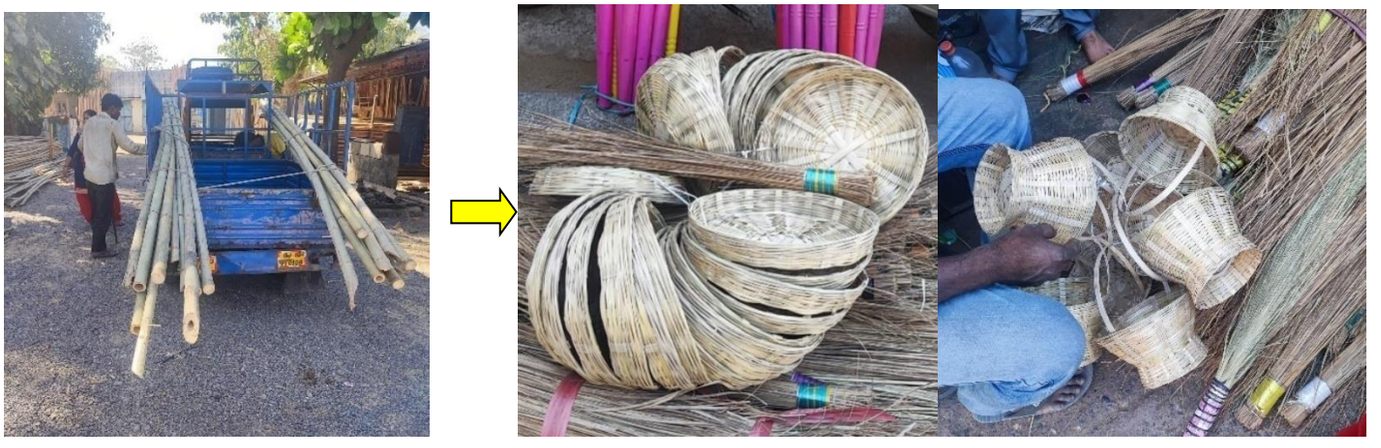
| Risks | Assumptions |
|---|---|
| **Supply Chain:**<br>a) Bamboo depots – Unavailability of the required amount of bamboo | a) Long term strategy of growing bamboo for self-sufficiency is obtained |
| b)Farmers' un-willingness to grow bamboo | b) *Regular meetings and awareness development alongwith technical support on growing<br>*Availability of suitable seedlings/ plantlets at their door steps<br>*Appropriate pricing for the produce<br>*Establishment of bamboo depots near to growing areas |
| **Market:**<br>Market Challenges by existing traders | The system will be built in for collaborations with the traders in the initial period and till adequate resources developed<br>Collaborating with the traders for poles of specific species not grown by farmers/ not existing in the project area |
| **Human Resources:**<br>Turnover of human resources and issues in retaining the talent | Training, sensitization, awareness building and incentives |
| **Quality:**<br>Products do not match current quality standards | Develop and improve quality standards and product designs |

Under the proposed intervention, the product range introduced will be bamboo constructions (green buildings, schools, tourist homes, hotels, houses, etc.) furniture (viz. chair, table, relaxing chair, dining furniture and eco-tourism products) crafts (for utility and tourists).

## 5.8. CONCEPTUAL FRAMEWORK/ PROJECT STRATEGY

At present, Cluster is having individual artisans skilled to make baskets, in Talala *namely* Sai Baba Sakhi Mandal and there is no association present. The study team met with individual artisans and around 20 artisans engaged in weave based products, lamp shades and utility products. Skill upgradation programs on suggested bamboo furniture and bamboo structural components production with quality aspects, treatment aspects, and market orientation to be undertaken.

**Products Prepared by artisans of Sai Baba Sakhi Mandal, Talala[27]**



**Raw Poles procurement and Products Prepared by artisan of Junagadh**

Within the three-year project period, a strong linkage between industries (including hotels/ private agencies/ government departments, etc.) will be developed and product quality ensured for external markets.

### 5.8.1. Sources of Tapping New Artisans to the Cluster

Regular camps will be organized in the villages to spread awareness among the people in the project district who are the target group and make them aware of the benefits of bamboo and how they could enhance their incomes from it.

[27] https://gujarati.news18.com/news/kutchh-saurastra/gir-somnath-women-create-innovative-products-from-bamboo-and-get-employmentgsbv-dr-local18-1233886.html

## 5.9. TRAINING CUM PRODUCTION INITIATION

Trainees will be selected based on existing basket weaving skills, commitment, family background, neediness, etc. Priority would be given to youngsters and women, who reside near to the BPC. Social animators will be placed to coordinate with the community members in the selection of potential trainees. Till the establishment of bamboo processing facilities, the training could be organized externally on the product ranges from furniture, construction components and structuring through any professional organization or with the technical support from an individual designer. Once established, the processing center functions as an on-job training center. Artisans and community members undertake a few months' training, usually 2-3 months for bamboo furniture and bamboo structuring. Artisans who engage in crafts product making, would be trained on making souvenirs and gift articles for catering to tousism segment. Emphasis will be laid to develop them with professional qualities which include time management, improvement of skills, communication, team building, interpersonal relationship, well being in all terms – socially, economically and spiritually.

### 5.9.1. Bamboo Processing Centre: A Training Cum Workshop Centre (Centre Of Excellence)

The production of products from bamboo requires that it is processed. Commonly this is slating, de-skinning and slivering. The slats are used for making small products like trays and the slivers are used for (bamboo weaving) woven products such as baskets and mats. Manual processing will take much time and machines will take lesser time. Once the basic materials prepared, there will be less time for producing the value-added products.

**De-skinning of Bamboo**

**Bamboo Slivers Preparation**

**Bamboo Slivers Drying in Sun Light**

**Weaving for Bamboo Mats, etc**

**Bamboo Slats**

**Slats assembling for small products**

**Value-added Bamboo Products made by rural artisans after Craft Training by CIBART**

**Round pole products**

**Furniture making**

The sizing of the slats, sticks and slivers when done manually is a time consuming process and product quality also suffers. Bamboo slats and slivers production by automated machines ensure the uniformity and quality. Bamboo is a is very variable due to manual production with the result the product quality also suffers. Further, bamboo is a vegetal material, and therefore like wood, it is susceptible to borer beetle attacks and microorganisms. Bamboo products thus deteriorate soon which undermines confidence in the material. All the above affect the value added in products since consumers are not prepared to pay higher prices. The Bamboo Processing Centre (BPC; or Bamboo CFC) will address all the above issues while enhancing the existing skills of artisans and instilling knowledge and practice of new ones, including the operation of simple and complex machines including the treatment plant that are needed. The result will be higher productivity, higher earnings, higher quality, enhanced market bandwidth, and other benefits.

There are several BPCs could be established and each BPC could be having a core product viz. for Furniture in Schools and domestic market, Incense sticks, Construction components, slat-based products including packaging materials, for social construction units, for tourism industries, earthquake-proof structures, fishing tools, for panels and flooring, for handicrafts-baskets, mats, and artifacts, for matchsticks, for toys, etc. depending on the demand and comparative locational and other advantages.

For this study, the BPC focusing on construction components production and structural activities proposed and the choice of the core product "bamboo construction". This BPC focuses on developing the core competencies of bamboo structure making and developing a set of expert trainers and artisans who are fully capable of producing and executing orders. Over time, this BPC might have more than one value chain, though some would be predominant relative to the market opportunity and production (quality and quantity). Trained artisans and expert trainers would be duly tested, evaluated and certified so that any organization wanting such services could hire them while having the confidence that the person they are getting has the needed knowledge, expertise and experience.

**Processing and Treatment Centre of CIBART inVyara, Tapi district**

**Bamboo Processing Centre with Machines installed**

A common facility or an entity that provides entrepreneurship, best practices, research, support and training to develop entrepreneurs for a product line or for several products according to the market demand. This line of thought and concept will be practiced in this facility for the promotion of the business. Approximately, 3000 sq.ft. area would be made available for establishing a Bamboo Processing cum Training Centre and recommended the location for Gir Somnath district.

## 5.10. TREATMENT SHED (STORAGE OF RAW MATERIAL)

In the present situation, artisans use non-treated bamboo for baskets production; however if the proposed intervention of the next product line that is “Construction” is introduced, production team needs treated bamboo for preparing construction components in the production unit. Further, the bamboo treated with appropriate technology like pressure treatment with chemicals, will be collected and stored in a place for easier

use and an approximate 2400 sq ft area would be required to be built or obtained for installing the treatment plant and storage of such treated raw material. This facility may be utilized by all artisans associated with the training cum production center and those interested to procure treated bamboo poles.


**Pressure Vacuum Treatment Plant installed in CIBART facility**

## 5.11. BAMBOO WORKING MACHINERIES REQUIREMENT

The facility center established with needed machinery like Bamboo treatment facility, bamboo cutting machines, splitting machines, external knot removal machines, grinders, cross cutters, jig saws, sander, turning machines, paint brush booth, CNC cutter, sanding and other types of machinery and working tables etc. and will become a full fledged processing cum treatment centre. This processing center will be established in a 3000 sq. ft. area (similar to the CFC center in Navasari of CIBART); this processing facility will have the following machines for final finishing and all near-final products.

**Table:15 – List of Machineries**

| Sr. No. | Name of Tools/ Machine | Estimated Cost per unit (in Rs.) | Qty required |
|---|---|---|---|
| 1 | Stand Drill Machine | 13570 | 1 |
| 2 | Bamboo Sander Machine | 66490 | 1 |
| 3 | Compressor with Stand | 88500 | 1 |
| 4 | Universal wood working Machine | 206500 | 1 |
| 5 | Table Saw Cutter Machine | 8850 | 2 |
| 6 | Knot Removing Machine | 53100 | 2 |
| 7 | Cross Cutter Machine | 11210 | 2 |
| 8 | Jigsaw Machine | 17110 | 2 |

| Sr. No. | Name of Tools/ Machine | Estimated Cost per unit (in Rs.) | Qty required |
|---|---|---|---|
| 9 | Drill Machine | 5310 | 2 |
| 10 | Grinder Machine | 4248 | 2 |
| 11 | Circular Saw | 43660 | 2 |
| 12 | Drill Bit Set (4 mm to 12 mm) | 5900 | 2 |
| 13 | Round bit set (20 mm to 45 mm) | 4720 | 2 |
| 14 | Sikanja set (4 ft to 7 ft) | 5310 | 10 |
| 15 | C Clamp (3" to 6" ) | 1180 | 10 |
| 16 | Measurement Tape | 180 | 10 |
| 17 | Scissor | 390 | 10 |
| 18 | File set (flate and half round) | 950 | 10 |
| 19 | Chaursi set | 625 | 10 |
| 20 | Light Board | 540 | 20 |
| 21 | Hexo Frame | 250 | 40 |
| 22 | Combination stone | 180 | 20 |
| 23 | Hammer (200 gram) | 310 | 20 |
| 24 | Gas Cylinder & Burner | 7500 | 2 |
| 25 | Knife (chaku) | 150 | 20 |
| 26 | Moulding Stand | 5000 | 4 |
| 27 | Preservation Unit | 1100000 | 1 |
| 28 | Preservation Chemical (m.ton) | 350000 | 2 |
| 29 | CNC engraving machine HT1325 | 834750 | 1 |
| 30 | Manual hard board cutter | 27000 | 1 |
| 31 | Table cutting machine | 84240 | 1 |
| 32 | Air flexi gun | 5104 | 6 |
| 33 | Frame master | 82836 | 1 |
| 34 | Paint brush booth | 419000 | 1 |
| 35 | Bosch power tools | 16500 | 50 |
| 36 | Manual tool sets | 1500 | 50 |
| 37 | Other Miscellaneous | 50000 | 1 |

In addition to the above types of machinery, there would be civil costs in the establishment of a processing and treatment facility, operations and maintenance expenses of machinery, electrification, recurring operational expenses, training/ skill building expenses, working capital for operations, and expenses towards marketing.

## 5.12. PROJECT COST AND MEANS OF FINANCE

The cost of the project include the cost of establishing the processing cum treatment centers, installation and electrification, training programmes, machinery, recurring costs for 1 year, working capital, and marketing costs; Following table shows the costs estimated for these:

**Table 16: Project Costs**

| Sr. No. | Particulars | Approximate Total (Rs. Lakhs) |
|---|---|---|
| **I. Project interventions** | | |
| A | Land costs | 18.00 |
| B | Building, land Development & other Civil Works | 46.00 |
| C | Plant and machinery & installation costs | 60.00 |
| D | Technology upgradation & training | 17.00 |
| E | Recurring operational costs for one year | 24.00 |
| F | Value addition/ processing/ production/ designing | 30.00 |
| F | Working capital | 44.00 |
| | **Total for Project Interventions** | **239.00** |

### 5.12.1. Operation And Maintenance Model

The unit will run on a Production basis: To make the facility more sustainable, 100% of the capacity will be utilized to make the construction components/ orders execution on a common brand basis, and does the direct marketing activities.

As per the business projections, the business will have Construction/ Structural components at 80% and a furniture segment at 20%.

The unit is expected to generate surplus revenue from the second year onwards.

### 5.12.2. Implementation Schedule

The civil construction is expected to be completed by end of the fourth quarter of the first year of the project implementation. Purchase and erection of machinery will be done by the last quarter of 1st year and the plant is expected to start its commercial operations by end of the first quarter of 2nd year. It is expected to reach breakeven in the second quarter of the second year.


**Few images of products developed by CIBART in bamboo construction value chain**


**Machineries Requirement in Treatment Unit/ Processing and Production Unit**

**Annexure-I**

BAMBOO for sustainable development

**CIBART**

Centre for Indian Bamboo Resource & Technology
(CIBART)
New Delhi –110065

## Bamboo Resource Mapping and Market Study

Questionnaire

| FARMER QUESTIONNAIRE | | | | |
|---|---|---|---|---|
| Interviewer Name: _____ | Date : dd/mm/23 | Interview Location _____ | Block _____ | Village _____ |

Dear Sir, Good day. I am visiting you on behalf of CIBART, New Delhi, a national-level bamboo research and development body. We are interested in procuring bamboo poles from this area and would first like to know some details about the different types of processes involved in procurement and selling of bamboo in this area

## SECTION ONE - DEMOGRAPHICS

| State | District | | Block | Village |
|---|---|---|---|---|
| Respondent Name | | | | |
| Respondent Gender (Pls tick) | Male ① | Female ② | Contact Number, if any | |

Q-ID01a Could you please tell me your age in the number of completed years?_____Yrs

| 25-30 Years ① | 31-35 Years ② | 36-40 Years ③ | 41-45 Years ④ | 46-50 ⑤ | More than 50 ⑥ |
|---|---|---|---|---|---|

| Q-ID03a Do you or your family own any farmland? | Yes ① | No ② |
|---|---|---|
| Q-ID03a How much farmland do you own? | _____ (all land in acre) | |

## SECTION TWO – CURRENT CROP PATTERN

Q-ID04a) How many crops do you grow in a year?_____

| Mainly which crops do you grow? | Average yield (per Acre) | Average amount Earn from it (per Acre) | On average what are the prices for these crops |
|---|---|---|---|
| First crop | | | |
| Second crop | | | |
| Third crop | | | |

Q-ID04b Do you also grow any Tree /Woodland/Permanent crop like (Mango) etc? Yes ① No ②

| Tree name | No. of trees in compact plantations | Average farm size | Average amount Earn from it (per Acre and after how long) | No. of scattered trees |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

Q-ID04c Do you also have any Bamboo Clump?

| Yes ① | No ② |
|---|---|

| Species Name bamboo (local name) | Number of clumps in homestead (1); in farm boundary (2), & in farm (3) | How many culms (poles)/ clump | On average how many Bamboo culms do you sale yearly | What is the price per Bamboo Culm sold to local buyer (1) | What is the price per Bamboo Culm sold to external buyer (2) | Who buys, their location, Phone No. |
|---|---|---|---|---|---|---|
| _____ | 1.<br>2.<br>3. | | | | | |
| 2 _____ | 1.<br>2.<br>3. | | | | | |
| 3 _____ | 1.<br>2.<br>3. | | | | | |

What is the legal status of the land on which bamboo is growing: ___
_____
_____

## SECTION THIRD – INCLINATION FOR BAMBOO PLANTATION

Q-ID06a what was the 3 main reasons for Planting (Yes=1)/Not Planting (No=2) Bamboo on Farm:

| | | |
|---|---|---|
| | | |

Q-ID06a If the above problem are resolved, would you plant more bamboo and in how much area?

| Yes ① | No ② |
|---|---|
| _____Acre | |

Q-ID06b Suppose a new national level company is planning to provide proper marketing channel and support, tools and equipment, and proper cost and sale of bamboo, how much would you be willing to grow Bamboo on farm?

On a scale of 10 where 1=Not appealing at all; 5=Neither appealing nor unappealing; 10=Very Appealing, please rate the appeal of the concept

| 1 | 2 | 3 | 4 | [redacted] | 6 | 7 | 8 | 9 | [redacted] |
|---|---|---|---|---|---|---|---|---|---|

Not Appealing at all  Neither Appealing nor Unappealing  Very Appealing

Why? _____

Would you be able to invest on bamboo plantation? _____

Q-ID06d Any additional facilities which you think should be provided

Q-ID06e Are you a member of any farmer organization? If Yes, Which?

| | |
|---|---|
| Yes ①_____ | No ②_____ |

Field Measurements:

a) Number of bamboo culms (poles): 1 year ____; 2 years_____; 3 years or more_____; dry culms_____; total culms_____

b) Culm circumference in cm_____; Culm thickness in mm_____and height of culm till which thickness is 12mm____(meters)

## SECTION FOUR – INCLINATION FOR BAMBOO MARKETING

Q-ID07a Which type of Industry is available in your district for bamboo like, Paper Industry, Timber Industry, Fashion Industry, Tourism Industry or Construction Industry with approx. numbers?

Q-ID07b Are You selling Bamboo in Paper Industry (a), Timber Industry (b), Fashion Industry (c), Tourism Industry (d) or in Construction Industry (e)? No, and Yes_____

Q-ID07c In Construction Industry, What type of Bamboo is being Used

(a) Raw (b) Treated

Q-ID07d In Construction Industry, Bamboo is either procured locally or imported from other states

(a) Locally (b) Imported and (c) Both

Q-ID07e In Construction Industry, Bamboo procured locally is available in sufficient quantity

(a) Yes and (b) No

Q-ID07e In Construction Industry, Bamboo procured locally is available in sufficient quantity

(a) Yes and (b) No

Thank you for your time and support

**Annexure-II**

**District and blocks wise Income per acre from cropping**

| Name of Block | District-wise Income (in Rs) | | |
|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh |
| Amreli | 35500 | | |
| Babra | 28750 | | |
| Bagasara | 19208 | | |
| Bhesan | | | 36168 |
| Dhari | 32429 | | |
| Gir Gidhada | | 43500 | |
| Junagadh | | | 26750 |
| Keshod | | | 28682 |
| Kodinar | | 48750 | |
| Kukavav-vadia | 24600 | | |
| Lathi | 25286 | | |
| Lillia | 22250 | | |
| Maliya | | | 18556 |
| Manavadar | | | 26063 |
| Mendarada | | | 25091 |
| Mendarda | | | 45667 |
| Rajula | 38333 | | |
| Saverkundla | 22600 | | |
| Sutrapada | | 29750 | |
| Talala | | 38321 | |
| Una | | 24333 | |
| Vanthali | | | 15800 |
| Vishavadar | | | 29571 |
| **Grand Total** | **26928** | **36985** | **26577** |

## Annexure-III

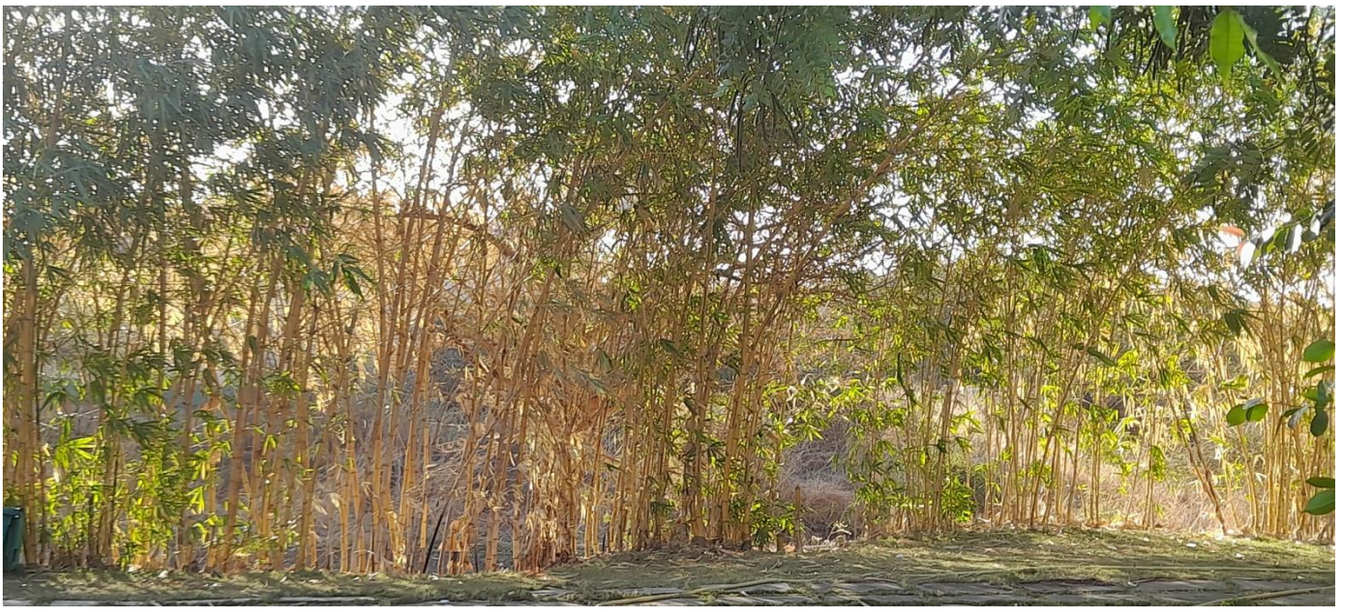
### District wise Land Available for Cultivation[28]

| Classification of Land | District-wise Land Area | | | Total Land Area (in hectares) |
|---|---|---|---|---|
| | Amreli | Gir Somnath | Junagadh | |
| Cultivable wasteland | 1166.93 | 3422.8 | 844.91 | 5434.64 |
| Degraded land | 9.73 | 38.53 | 25.42 | 73.68 |
| Rain fed land | 8321.2 | 6553.41 | 10855.23 | 25729.91 |
| Forest land | 45.83 | 0 | 194.91 | 240.74 |
| Other land | 884.31 | 2479.06 | 1166.96 | 4530.33 |
| **Grand Total** | **10428** | **12493.8** | **13087.43** | **36009.23** |

## Annexure –IV

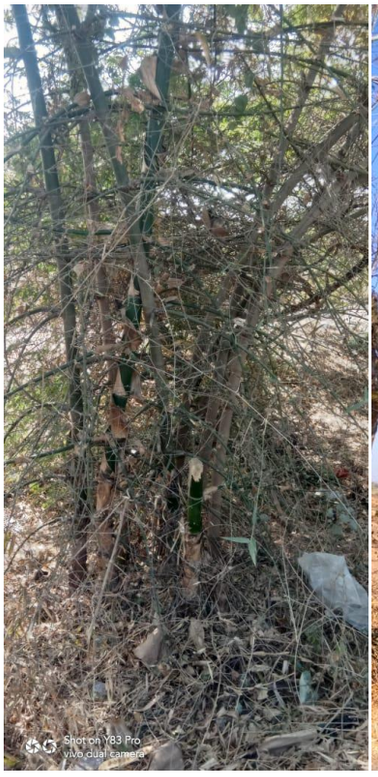
### Bamboo Resources in Gir Sasan study area

[28] https://wdcpmksy.dolr.gov.in/reports; https://wdcpmksy.dolr.gov.in/blsrptdist?id=24




Shot on Y83 Pro
vivo dual camera


Shot on Y83 Pro
vivo dual camera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vivo dual camera