

*Impact Assessment Report*  
on  
**Tree plantations and Mission Sarovar**  
*Developed by Dholakia Foundation and HK Exports*



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*Impact Assessment Report on*  
**Tree Platation and Mission Sarovar**  
*developed by the Dholkia Foundation and HK Exports in different parts of Gujarat*

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## 1. INTRODUCTION

Desertification is 'land degradation in arid, semiarid and dry sub-humid areas resulting from various factors, including climatic variations and human activities'. The UNCCD had identified desertification as one of the most challenging environmental concerns of present and future. Recent study by SAC, (2021) highlighted that 97.85 million ha area of the country is undergoing land degradation during the period 2018-19, in which 83.69 million ha area falls under drylands of the country. The most significant process of desertification/ land degradation in the country is Water Erosion (11.01%), followed by Vegetation Degradation (9.15%) and Wind Erosion (5.46%).

Gujarat is located along the western part of India, encompassing a total area of 1,96,244 km<sup>2</sup>. The statistical summary and analysis of the Land Degradation of Gujarat state revealed that 52.22% (10.24 million ha) of the total geographical area is undergoing Desertification/Land Degradation during the year 2018-19. The most significant process of desertification/ land degradation in the state is Water Erosion (19.53%) followed by Salinity (13.24%), Vegetation Degradation (11.84%) and Wind Erosion (5.99%). Further, among the states of India, salinity as a factor for desertification and land degradation is found highest (71.36%) in the Gujarat State. This could be due to natural processes or climatic factors and human induced desertification processes.

Further, climate change is affecting the rainfall patterns and increase in evaporation, which subsequently exerts enormous pressures on our ecosystems. Interestingly, trees and forests are closely linked with weather patterns and also maintain essential balance in the nature. The major challenges today is deforestation, land degradation, unsustainable farming practices, loss of biodiversity and increased risks of climate change that leads to impact on the very survival of human beings.

Therefore, it is imperative to harvesting rainwater in monsoon periods, and utilizing the same for agriculture as well planting and growing of trees offers a promising solution in the fragile, rain-fed regions of the Gujarat State. Hence, it is prerequisite to protect and enhance the trees needs to be initiated because our life depends on the availability of air, water and food. Without trees, human life would be unsustainable. Trees help us getting oxygen, healthy soil as well as wide range of products (timber,



fruit, medicine, beverages, fodder and oils) and life-supporting services (carbon sequestration, erosion control, soil fertility, shade, etc.).

Greenbelt means planting of special type of plants suitable to the particular agro-climatic zone and soil characteristics. A green belt around the periphery of boundary and along the road sides will reduce soil erosion, prevention of landslides; minimize the air and noise pollution in an area. The green plants also act as sinks for pollutants.

Greenbelt is a set of rows of trees planted in such a fashion, to create effective barrier between the plantation sites and its surroundings. The greenbelt helps to capture the fugitive emissions, attenuate the noise levels in the existing plantation area and simultaneously improving aesthetics of the surroundings. This kind of plantation/Greenbelt also helps in reducing the impact of Global Warming and Climate change by carbon sequestration.

As per the National Forest Policy (NFP, 1988), it is necessary to encourage plantation of trees alongside of roads, railway lines, rivers, streams, canals, and other unutilized lands under state/corporate, institutional or private ownership. The NFP has emphasized the green belt development in urban/industrial areas as well as in arid tracts. Such a programme will help to check erosion and desertification as well as improve the microclimate.



Further, uncertain climate force the formers to overexploit the ground water which has resulted rapid salinity ingress along the coastal belt along with inherent salinity of land in many parts of the state. During the recent decades, the rainfall pattern as well as the intensity has changed. Therefore, it is crucial to develop appropriate water harvesting structures to prevent runoff waste and wise utilisation of monsoon water. Therefore, conservation and management of watershed areas and other landscape in are pivotal to improve the natural resources and enhancing the land productivity. The process also helps in enhancing water availability for agriculture, plantations, drinking water for human and livestock and other domestic purposes. The water harvesting structures also aid in ground water recharge which will further support irrigation facilities during drier periods.

Many of the Corporate/Industry/Government or NGOs have undertaken greenbelt/ plantations in the industrial areas as compliances of MoEF&CC or other State orders. Nevertheless, there are few Corporate and Industries have carried out greenbelt development and other developmental initiatives by their own.

As part of conserving the environment, Dholakia Foundation and HK Exports has committed with a prestigious goal to conserve and improve the natural resources through a noble effort in raising over 24 lakhs tree plantations and developing 75 Sarovar (Lakes) under Mission 100 Sarovar at various parts of Gujarat and Maharashtra state from 2011 to till date. This helps in environmental development as well as enhancing livelihood and socio-economic conditions in rural and other project areas.



## 2. RATIONALE

Hari Krishna Exports and Dholakia Foundation is India's one of the important Diamond Industry, located in Gujarat State. Since the inception of Hari Krishna Exports and Dholakia Foundation, it has taken many initiatives towards social development and environment conservation in various parts of Gujarat as well as in Maharashtra states.

Dholakia Foundation and HK Exports has created 75 Sarovar in various parts of the Gujarat and Maharashtra, in which 52 Sarovar is distributed in Amreli and 10 Sarovar in Bhavnagar districts of Gujarat. A total of 24,63,923 tree plantations were carried out in 14 districts of Gujarat and two districts of Maharashtra, in which major plantations were undertaken in Bharuch and Surat districts of Gujarat (Annexure I).

In the year 2011-12, the Dholakia Foundation under took plantation at 25 locations of Southern Gujarat and Saurashtra region under the initiative "Giving back to Mother Earth" is an initiative to create greener lands in Gujarat and contribute to the restoration of the Earth's lungs and leverage overall under the Environmental, Social, Governance (**ESG**) framework for Global Corporations.

The Harikrishna Dholakia Trust (HDT), was initiated in 2002 to tackle this "salinity-led" environmental catastrophe through a series of interrelated projects. Under this primary phase of the project, "water drop conservation and management Interventions in Belts of Lathi and Babra blocks of Amreli District and Gadhada, Gariyadhar block of Bhavnagar district" has been covered under the project. The project lays focus on water conservation from rainfall which is ran away interventions and improvement of natural resources (soil and ground water) in 12 drought and salinity prone villages of two blocks of Bhavnagar and Amreli district in Gujarat state. The project aimed with water resources development has been started from February, 2013.

In order to understand the socio-economic and environmental impact of large tree plantations drive, greenbelt development and development of water bodies under Mission Sarovar, Dholakia Foundation approached to Gujarat Institute of Desert Ecology (GUIDE) for an assessment of the above mentioned activities.



GUIDE team has visited and surveyed the above mentioned project areas and assessed various activities through several parameters and indicators by using appropriate sampling methods and standard survey techniques, to assess and evaluate the impact of such activities on the environment and socio-economic of the project villages/areas.

### 3. OBJECTIVE OF THE STUDY

- To monitor and evaluate the status of plantations carried out by the Dholakia foundation and HK Exports.
- To evaluate the survival, growth and health of plantations and impact on local environment.
- To assess the impact of Mission Sarovar on agriculture, socio-economic and local environment



## 4. STUDY APPROACH AND METHODOLOGY

### 4.1. Plantation Monitoring and Assessment

A total of 2501 individual trees covering 12 sample plots under six (6) plantation locations of Surat and Bharuch districts were identified and surveyed for plantation assessment (Figure). A total of 2501 individuals of trees of various planted species were selected and sampled to assess their survival, growth and physical condition/appearance. The sampling covered all the major plantation sites, plantation type viz. farm, park, greenbelt, etc., planted species, plantation year, etc. to represent the whole plantation made by the Dholakia Foundation and HK Exports. A team of 5 researchers were involved for sampling of the plantation and its impact assessment.

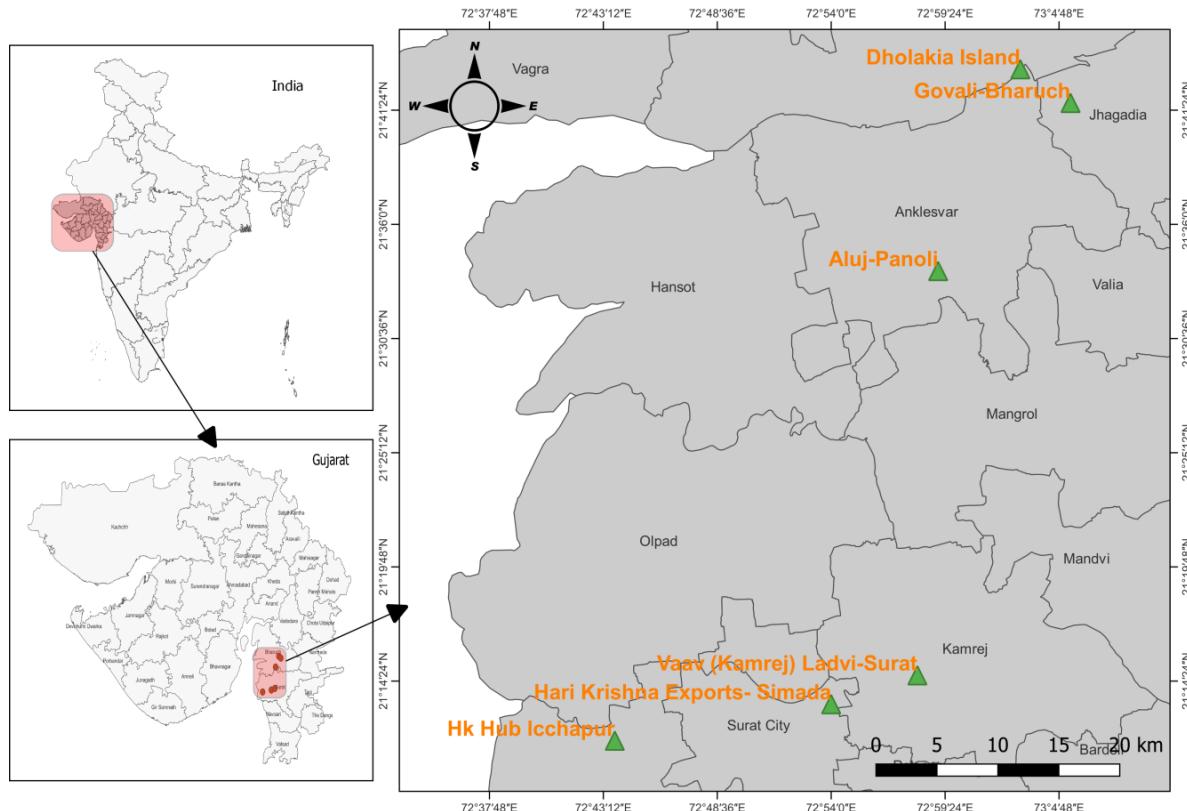


Figure 1: Sampling Location of the Plantation Survey and Monitoring for the Study

Based on the information provided by the Dholakia Foundation and standard protocol and survey techniques were used for the assessment. A total of 6 plantation plots were identified for data collection on different aspects of the plantation success and its impact on the local environment (Table 1).



As per the sampling methodology, three plantation plots each in Govali village, Dholkia Island and Aluj-Panoli village of Bharuch District, and Vav, Simada and Icchapur villages of Surat district (Figure) were surveyed.

Table 1. List of Selected Plantation Locations and Sample size for the Study

Plantation Period	Locations	Number of Trees	Sample Size
2011-21	Govali (Bharch)	6,48,745	649
2011-21	Dholkia Islands (Bharuch)	6,00,000	600
2011-21	Aluj (Bharuch)	7,52,013	752
2011-21	Simada (Surat)	3,00,000	300
2011-21	Icchapur (Surat)	1,40,104	140
2011-21	Vav (Ladvi, Surat)	11,779	12
<b>Total</b>		<b>25,00222</b>	<b>2501</b>

### Physical Verification

Each of the selected plots was systematically surveyed by the monitoring team using standard data sheet. Following parameters were documented for the plantation monitoring from the selected plots.

- Plot location and area
- Plantation model type and design
- Age of the plantation
- Number of saplings planted initially (species wise)
- Height of the saplings when planted
- Number of plants surviving at the time of monitoring
- Average height of surviving plants
- Protection system and maintenance
- Anthropogenic pressure (Grazing Pressure or illicit cutting), if any

### Data Analysis

The field data on various quantitative and qualitative parameters and indicators were used to assess the plantation success. Quantitative parameters such as Survival (%) of the plantation, Growth of plantation using indicators such as height of the tree, Girth at Breast Height (GBH) and Canopy cover, and qualitative parameters such as physical condition/appearance, watering frequency and type, management practices, etc.



## 4.2. Mission Sarovar Assessment

- Project covered 200 House Holds across 7 villages in 2 talukas
- The assessment is mainly based on primary data collection at household/farmer level, farmers' groups and Sarpanch of village panchayat institutions created in the project area.
- Following Data Collection tools have been used
  - Individual Survey at HH/farmers level- Structured Questionnaire/Schedule
  - Focus Group Discussion and Transect Walks at Village level
- Location of structures was mapped using GPS tool
- Types of Schedule/Questionnaire have been sued for primary data collection:
  - Survey at village level
  - Household- individual level survey for agriculture interventions (POP, MIS, Animal Husbandry, Horticulture)
  - Water Resource Management Group (Check dam, Salinity Control Structure/Well Recharge, Percolation T
  - Farmer Level for Water Resource Management interventions (Check dam, Well recharge, pond with Percolation Tank



## 5. OBSERVATIONS AND RESULTS

A total of six sampling locations for tree plantation at Bharuch and Surat Districts have been surveyed and assessed in the present study. Three plantation plots in each sampling location have been surveyed and collected data on the survival, growth, appearance and management measures and also photographed the plantation site.

### 5.1. Plantation Impact Assessment

#### 5.1.1. Plantation Types

The different types of plantation was categorized viz. Shelterbelt, Farm and Garden under the present study. It was found that 68% of the plantation has been recorded as farm plantation followed by 23% of plantation as garden plantation and rest of 9% plantation have been recorded as shelterbelt plantations (Figure). The Garden plantation was mainly found at Dholkia Island, Simada and Ichhapore areas. Whereas shelterbelt plantations was found at Dholkia island and pure farm plantation was observed at Govali, Aluj, Vav and Dholakia Foundation.

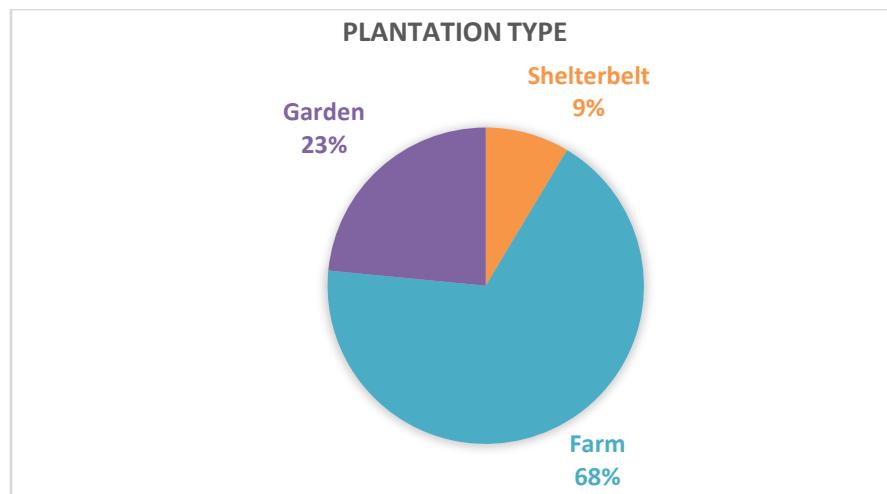


Figure 2. Showing Plantation Types in Study Area

The assessment of the plantation has been based on the survival, growth, and physical condition/general appearance and management aspects of the plantation which are described in below section:

#### 5.1.2. Survival of Plantation

The overall survival percentage of plantation was recorded 85.69% in which survival of plantation in the Surat and Bharuch districts were 80.82 and 91.13% respectively



(Table). Among the sampling locations of plantation, highest survival was recorded at Aluj-Panoli (92.56%), followed by Dholakia Island (90.67%) while lowest survival recorded from Simada (80.77%) (Table 2). Among the different species of tree planted in various locations, the highest survival recorded of *Eucalyptus globulus* (92.04%), followed by *Mangifera indica* (91.34%), *Moringa oleifera* (88.22%), while the lowest survival recorded for *Gmelina arborea* (78.86%) (Figure 3).

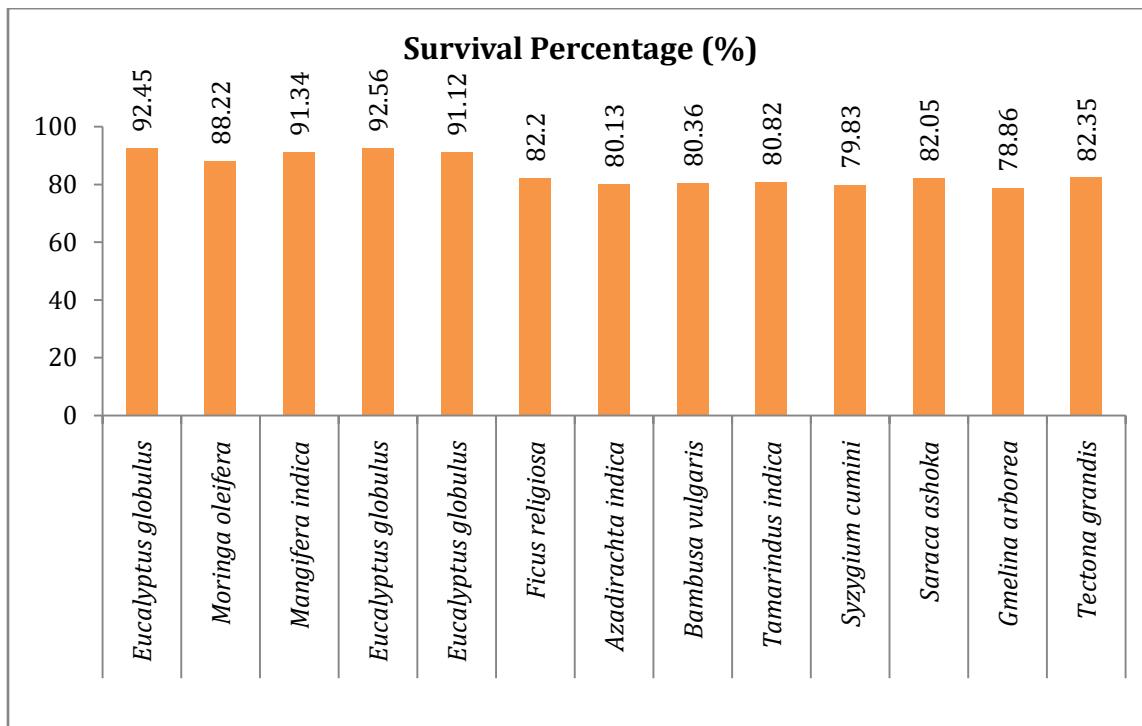


Figure 3. Survival (in percentage) of Plantation in Sample Location

Table 2: Status of Survival of Different Plant Species in Various Locations

ID	Plantation Year	Location	Plantation Type	Scientific Name	Common Name	Survival Rate		
						Initially planted	Individuals Survived	Survival (%)
5	2011-12	Dholakiya island	Shelterbelt	<i>Eucalyptus globulus</i>	Nilagiri	900	832	92.45
			Farm	<i>Moringa oleifera</i>	Saragavo	450	397	88.22
			Farm	<i>Mangifera indica</i>	Mango tree	150	137	91.34
	Aluj (panoli)	Farm	<i>Eucalyptus globulus</i>	Nilagiri	900	833	92.56	
	Govali	Farm	<i>Eucalyptus globulus</i>	Nilagiri	225	205	91.12	
	Ichhapore	Garden	<i>Ficus religiosa</i>	Pepal	7804	6415	82.2	



Plantation Year	Location	Plantation Type	Scientific Name	Common Name	Survival Rate		
					Initially planted	Individuals Survived	Survival (%)
2011-12	Simada	Garden	<i>Azadirachta indica</i>	Neem	6503	5211	80.13
			<i>Bambusa vulgaris</i>	Bamboo	4567	3670	80.36
			<i>Tamarindus indica</i>	Tamrind	464	375	80.82
			<i>Syzygium cumini</i>	Jamnun	362	289	79.83
			<i>Saraca ashoka</i>	Ashoka	234	192	82.05
			<i>Gmelina arborea</i>	Savan	123	97	78.86
			<i>Tectona grandis</i>	Saag	34	28	82.35

### 5.1.3. Growth of Plantation

#### 5.1.3.1. Girth at Breast Height (GBH) of the Plantation

The survey recorded GBH of different tree species planted in the sampling plots. As per the sampling in surveyed plots, the highest GBH has been recorded of *Azadirechta indica* (115.12 cm) at Simada, followed by *Moringa olifera* (52.78 cm) at Dholokia Island while lowest GBH recorded of *Eucalyptus globules* (20.65 cm) at Aluj (Table 3). As per the analyzed data on GBH, the growth of plantation in the sampling sites is found very good (Figure 4).

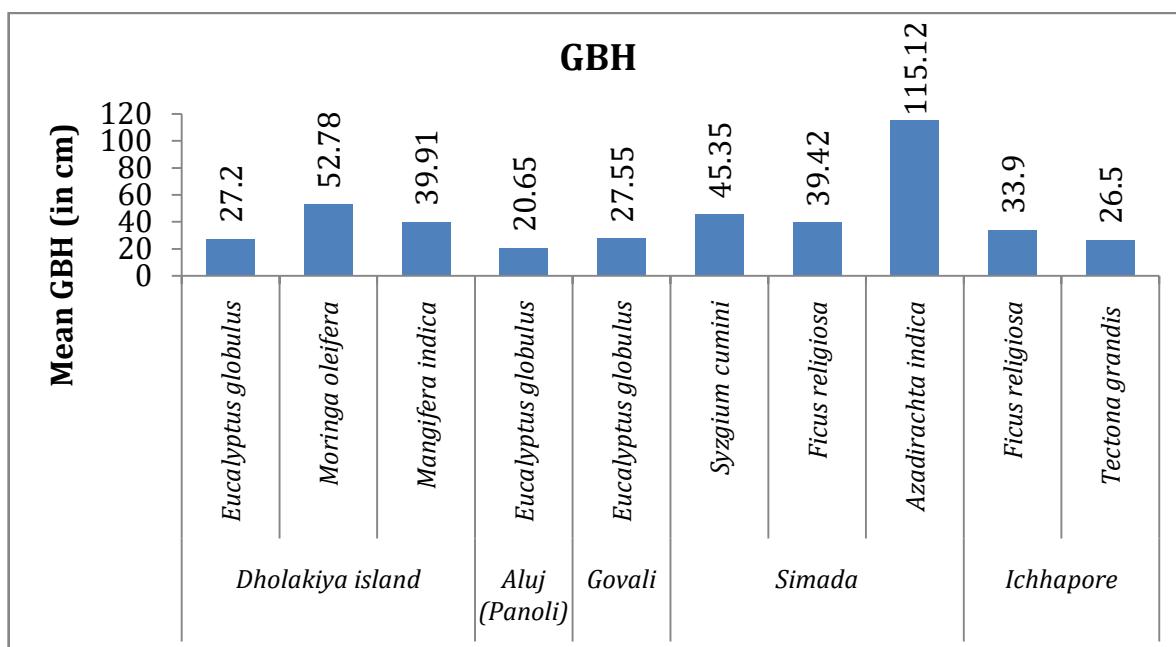


Figure 4: GBH of the recorded tree planted in various location of Gujarat

### 5.1.3.2. Tree Height of the Plantation

Among the tree species planted at various sampling site, the highest mean height of tree recorded of *Syzygium cumini* (49.5 ft.) at Simada of Surat followed by *Azadirachta indica* (47.89 ft.) at Simada, *Ficus religiosa* (47.28 ft) and lowest tree height recorded of *Tectona grandis* (10.5 ft) at Ichhapur (Figure 5).

The average height of *Eucalyptus globulus* was recorded 46.65 ft., while for the *Moringa oleifera* it was recorded 27.76 ft. and 18.19 ft. for *Mangifera indica*. The average height of *Eucalyptus globules* was recorded 39.76 ft. at Govali village of Bharuch District, whereas the average height of *Eucalyptus globules* was noted as 39.12 ft. at Aluj village of Bharuch District (Table 3).

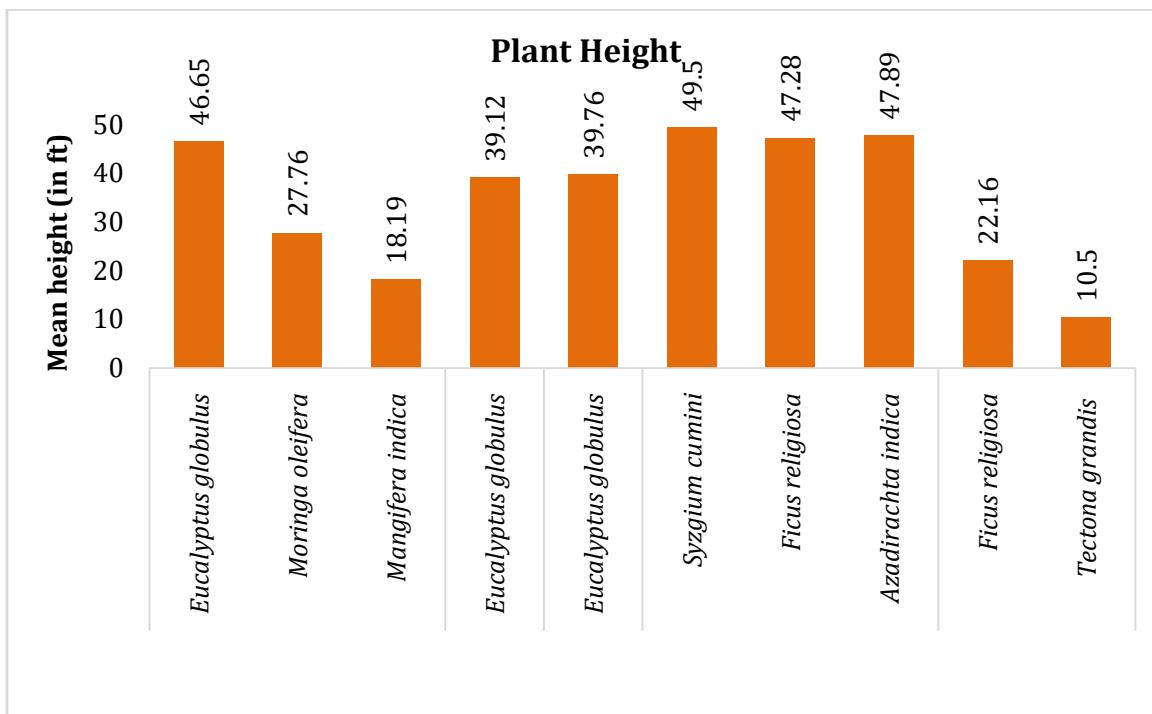


Figure 5: Height of the recorded tree planted in various location of Gujarat

### 5.1.3.3. Canopy Cover of the Plantation

Among the various tree species planted at various locations, the highest canopy cover was recorded of *Azadirachta indica* ( $864.39 \pm 209.5$  sq. ft.) at Simada Garden of Surat District, followed by *Mangifera indica* ( $738.24 \pm 33.38$  sq. ft.), *Syzygium cumini* (585.61 sq. ft.), while the lowest canopy cover was recorded of *Eucalyptus globules* ( $40.52 \pm 1.27$  sq. ft.) at Dholkia Island of Bharuch District (Figure 6 and Table 3).



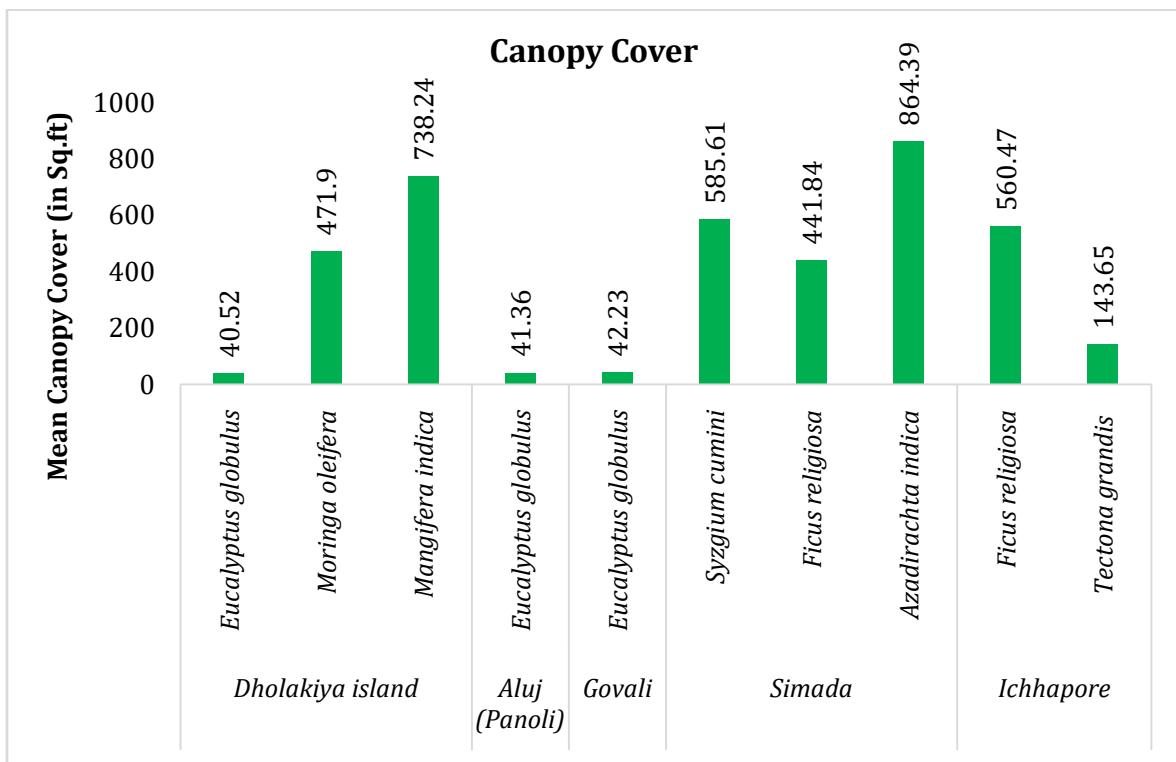


Figure 6: Canopy Cover of the Recorded Tree Plantation in Various Locations of Gujarat



Table 3. Status of the Growth of Different Species in Different Sampling Location of the Study

District	Plantation Year	Location	Plantation Type	Species	Local Name	Avg. GBH (cm)±SE	Avg. Height (ft.)±SE	Avg. canopy cover (sq.ft.)±SE
Bharuch	Dholakiya island	Shelterbelt	<i>Eucalyptus globulus</i>	Nilagiri	27.2±0.41	46.65±0.76	40.52±1.27	
			<i>Moringa oleifera</i>	Saragavo	52.78±0.67	27.76±0.37	471.90±8.47	
		Farm	<i>Mangifera indica</i>	Mango tree	39.91±0.70	18.19±0.27	738.24±33.38	
	2011-12	(Panoli)	<i>Eucalyptus globulus</i>	Nilagiri	20.65±0.27	39.12±0.45	41.36±0.75	
			<i>Eucalyptus globulus</i>	Nilagiri	27.55±0.29	39.76±0.34	42.23±0.76	
	Surat	Simada	<i>Syzygium cumini</i>	Jambu	45.35±0.60	49.5±0.63	585.61±23.82	
			<i>Ficus religiosa</i>	Pepal	39.42±2.24	47.28±1.4	441.84±10.31	
			<i>Azadirachta indica</i>	Neem	115.12±0.85	47.89±0.51	864.39±209.50	
			<i>Ficus religiosa</i>	Pepal	33.9±0.13	22.16±0.10	560.47±6.79	
	2015-16	Ichhapore	Garden	<i>Tectona grandis</i>	Saag	26.5±0.86	10.5±0.28	143.65±10.20

#### 5.1.4. Physical Condition/General Appearance

Based on the qualitative assessment of the physical condition/appearance of the plantation, it was found that 62.08% of trees were found in good condition; followed by 34.2% trees were in very good condition while 3.76% of trees were in excellent condition/appearance among the plantation made in various location of the state. Among the various sampling location of plantation, a total of 11.4% of the trees in Aluj (Panoli) were recorded in excellent condition while 83% of tree plantation at Govali was recorded in good condition (Table 4 and Figure 7).

Table 4: Physical Condition /Appearance of Plantation in Different Location

Location	Plantation Year	Sample Size	Plant Condition/Appearance (%)				
			Poor	Average	Good	Very Good	Excellent
Dholakia Island	2011-12	600	0	0	52.6	46.0	1.5
Govali	2011-12	653	0	0	83.0	15.8	1.2
Aluj (Panoli)	2011-12	350	0	0	64.3	24.3	11.4
Ichhapore	2015-16	300	0	0	66.7	28.7	4.7
Simada	2011-12	251	0	0	43.8	56.2	0.0

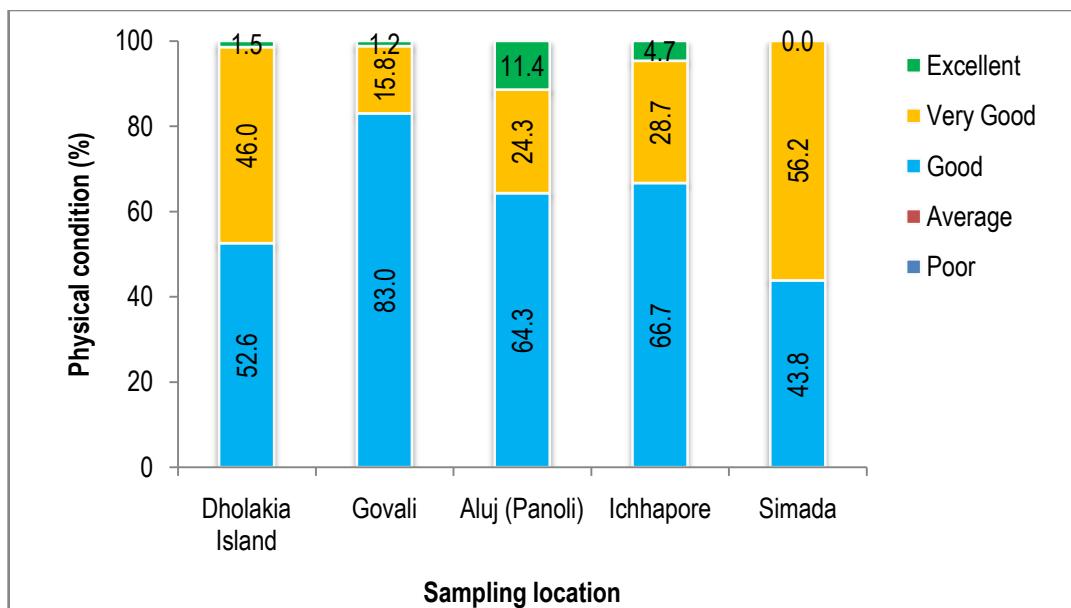


Figure 7: Physical Condition /Appearance of Plantation in Different Location

### **5.1.5. Plantation Management**

The overall management of the plantation can be rated very well. Most of the plantation locations under the study were found to be protected by fencing as well by watchmen. Irrigation system was also noticed as by channel, drip, sprinkler and manually. Good number of staff was engaged to take care of plantation at most of the locations. Use of bio-fertilizers/bio-pesticides was also observed at regular intervals. The garden development at Simada, Ichhapore and Dholkia Island was well managed with many ornamental herbaceous plants which provide aesthetic value. Regular weeding in garden (Simada, Ichhapore & Dholkia Island) was also observed.

### **5.1.6. Salient Findings on the Tree Plantation**

- The overall survival percentage is 84.26 of plantations under study which is very good.
- As per the estimate made from the present survey, a total of 9000 ha area has been brought under the plantation made by the Dholokia foundation and HK Export.
- The above estimate highlighted that approx 0.05% of the geographical area of Gujarat state has been brought under green cover by the Dholokia foundation and HK Export.
- As per the analysis, a total of 282.58 ha area of the Gujarat state have been covered under the Eucalyptus plantation.
- The plantation developed by the HK Exports has C-sequestered approximately 1,67,798 tons of CO<sub>2</sub>.
- Further, the plantation developed by the HK Exports is releasing 81,377 tons of oxygen/year.
- Plant condition/Appearance of plantations 62.08% shows good condition while 34.20% plants shows very good condition and 3.76% plants shows excellent condition. The overall condition of plantation and garden is very good.
- No major threats were noticed in the study area
- Garden development at Dholkia Island, Simada and Ichhapore well maintained & used by employees
- Good number of ornamental herbs & shrubs were also observed at Dholkia Island, Simada and Ichhapore areas.

### 5.1.7. Management Measures

- Mono culture plantation should be avoided.
- Instead of Eucalyptus species, other indigenous species should be used for plantation, since Eucalyptus need more water and also degrade soil.
- Mixed type plantation of indigenous will attract more biodiversity in the area.
- Medicinal plant garden can also be recommended.
- Botanical garden can be developed for education and research purposes.



## 5.2. Assessment of Mission Sarovar

### 5.2.1. Impact of Water Resource Management Interventions

Under WRM, activities related to check-dam, percolation tank, well recharge, salinity control structures, etc. have been taken up to augment irrigation water availability and improve quality of ground water, mainly in terms of reduced salinity levels.

In this study, a total of 11 water harvesting structures (Sarovar) and their 300 beneficiary farmers from 7 villages, namely Babra and Lathi Taluka under Amreli district were covered (Table 5). Structures like check dam, percolation tank and farm pond with percolation tanks have been studied.

Table 5: Water Harvesting Structures (Sarovar) Surveyed for the Assessment

Sr. No.	Year of Construction	Name of site	Village	Length	Breath	Depth	Area (Ha)	Capacity (in CR)
1	2017	Harikrishna Triveni Sangam	Dudhala	800	250	5	49.4	100
2	2018	Narayan Sarovar Triveni Sangam	Dudhala	623	300	6	16.1	112.1
3	2018	Harikrishna Sarovar Part-1	Shekh - Pipaliya	305	227	3	17.2	20.84
4	2018	Harikrishna Sarovar Part-3	Shekh- Pipaliya	331	570	2	21.2	37.66
5	2018	Harikrishna Sarovar- Vanadiya	Vandaliya	221	51	3	2.8	3.38
6	2019	Krishna Sarovar- Akala	Akala	728	70	5	12.6	25.53
7	2019	Krishna Sarovar- Jal Vambhide Makala	Akala	563	186	3	25.9	31.46
8	2019	Harikrishna Sarovar- Harsurpur Devadiya Sarkari Bhandaro	Devaliya	481	73	2	8.6	6.99
9	2019	Harikrishna Sarovar- Devadiya	Devaliya	506	45	3	5.4	6.86
10	2021	Ambanivadi Canal-1	Keriya	155	10	5	0.5	0.78
11	2021	Ambanivadi Canal part -2	Keriya	140	10	5	0.5	0.7

The major findings of the study are described as below:

### 5.2.2. Irrigation/Watering

Increase in surface water availability has subsequently enhanced the watering frequency for various crops. Notably, irrigation support for groundnut has been doubled. Watering frequency for the wheat crop has been dramatically increased from 6 to 10. No major changes have been observed in number of irrigation during summer, however, the area under cropping has considerably been increased (Table 6).

Table 6. Impact on Irrigation Post WRM Interventions

Crop	Season	No. of Watering Pre-Project	No. of Watering Post-Project
Groundnut	Kharif	1-2	3-4
Cotton	Kharif	4-5	5-6
Wheat	Rabi	5-6	8-10
Pearl Millet	Summer	2-3	2-3

### 5.2.3. Enhancement of Ground Water Table & Source

The surface water bodies have aided increased ground water recharge which was evident from the increased water table from 15-20 wells within 500m range and 10-20 wells within 500-1000m range of water resource structures. Few (4-5) new bore wells have also been constructed post project period in all the villages surveyed (Figure 8). On an average there has been rise in water table up to 3-3.5 metres in wells near water resource structures (Figure 8).

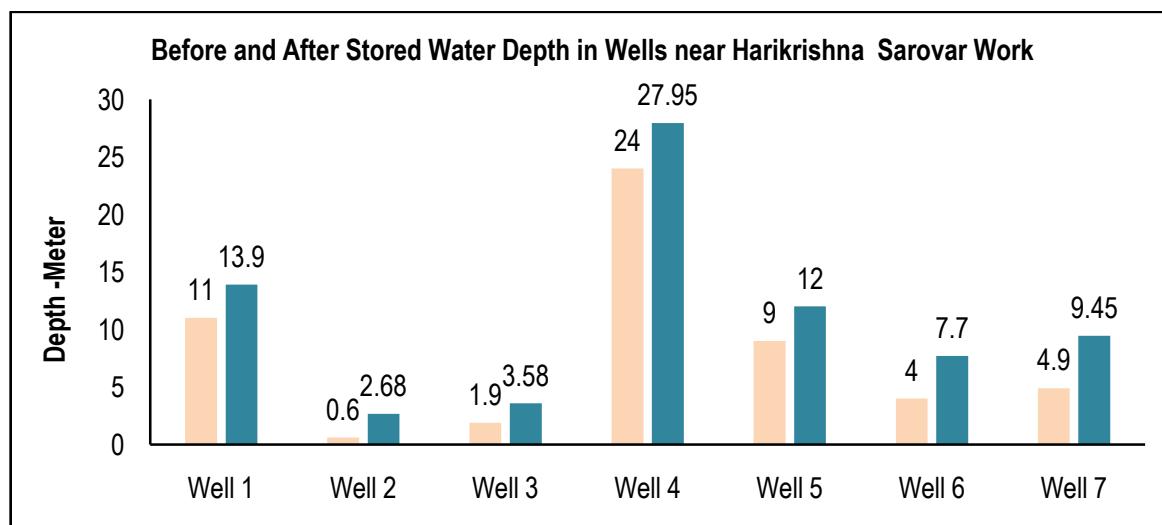


Figure 8. Change in Water Table of Wells near Kajardi Pond Water Diversion Works

#### **5.2.4. Cultivated and Irrigated Area**

Based on discussion with WRM group farmers, most of the lands (owned by WRM group farmers) were cultivated by Kharif crops. However, the water harvesting structures helped in increasing the area under irrigation which has been doubled due to the Sarovars. Irrigated land in Kharif has increased from 33% to 64% in all the surveyed villages. Rabi cultivation has increased from 30% to 71% of land surrounding the water structures. Similarly, there has been increase in cultivated land from 20% to 50% during the summer season.

#### **5.2.5. Cultivation Pattern**

Based on interaction with WRM group, it was evident that there is an increase in cultivation of wheat crop during winter due to increased water availability. Farmers have switched from Pearl millet and other crops to wheat cultivation during winter period. Groundnut an important cash crop and it dominated pre and post project interventions. Few farmers have also stated that they are cultivating Pearl millet and Til in summer due to increased water availability.

#### **5.2.6. Crop Productivity**

Along with increased irrigation facilities, farmers have also adopted changes in package of practices. This has resulted in enhanced productivity of various crops from 7 to 24% (Table 7).

Table 7. Impact on crop productivity post WRM interventions

Crop	Season	Productivity(Kg/Acre)		Increase in Productivity
		Pre-Project	Post Project	
Groundnut	Kharif	850	1050	24%
Cotton	Kharif	1000	1100	10%
Wheat	Rabi	1350	1450	7%
Pearl Millet	Summer	1500	1750	16%
Based on individual farmer survey				



### 5.2.7. Landholding

Out of the total farmers surveyed, 32% are marginal, 33% are small, 25% are semi-medium, 9.5% are medium and 0.5% is large farmers.

### 5.2.8. Cultivation Pattern

All farmers are able to take up cultivation in Kharif. While all medium and large farmers are able to take up cultivation in Rabi, 95-98% of marginal, small and semi-medium are also able to take up Rabi cultivation. All large farmers are able to take up summer cultivation. Summer cultivation is low amongst marginal farmers (Table 8).

About 97% of total land is cultivated under Kharif, 83% in Rabi and 27% in Summer. Though large numbers of farmers take up cultivation in summer, cultivated land is low due to lack of irrigation water. No major change in pattern of cultivation in Rabi and summer seen compared to baseline (Table 9).

Table 8. Seasonal Cultivation (%) and % of Farmers

% Farmers Cultivating Season Wise					
	Marginal	Small	Semi-Medium	Medium	Large
Kharif	100	100	100	100	100
Rabi	95	98	95	100	100
Summer	49	75	84	73	100

Table 9. Percentage of Cultivated Land

HH level land Cultivation Area (% cultivated area )						
	Cultivated area (%) of total landholding					
	Marginal	Small	Semi-medium	Medium	Large	Total
Kharif	100	97	98	92	100	97
Rabi	87	89	83	75	86	83
Summer	34	32	28	19	15	27

Based on HH level sample survey

### 5.2.9. Irrigation Pattern

- All farmers cultivated crops in Kharif are able to provide critical irrigation.
- About 96% farmers are able to irrigate land in Rabi. Major irrigation source is open wells. Only 2 farmers of total surveyed also using bore wells.
- About 81.5% farmers cultivate Rabi in 100% of the land.
- Irrigation water availability becomes very low in summers. Hence only 28% farmers who have irrigation water availability cultivate crops in their agriculture lands.
- Other sources of irrigation in few villages are check dam cum pond and stream.

### 5.2.10. Impact on Income

There is corresponding increase in income to formers due to increase in productivity from all the crops (Table 10). Thus the socio-economics of the farmers has increased.

Table 10. Change in crop productivity and income after the project implementation

Crop	Average Productivity (Kg/ Acre)		Average Input Cost (Rs/ Acre)		Average Sale Price (Rs/Kg)		Average Net Income (Rs/Acre)		Rise in Net Income
	Before	After	Before*	After**	Before	After	Before	After	Rs/ Acre
Groundnut	850	1050	22318	44653	40	47.5	11682	16222	4540
Cotton	1000	1100	25603	39750	40	50	14397	15250	853
Wheat	1350	1450	12418	13688	12.5	15.5	4457	8787	4330
Pearl Millet	1500	1750	15000	19625	12.5	15	5583	10385	4802

\*Based on baseline study  
 \*\*based on group discussion with farmers across talukas  
 Other data has been based on individual farmers' level survey.

Table 11. Impact on Increase in Income due to Increased Cultivated Area (WRM groups) Due to WRM Interventions

Season	Main Crop	Increase In Cultivated Area (in Acre)	Net Income /Acre (Rs.)	Increase in Total Income (Rs. In Lakhs)
Rabi	Wheat	1826	15250	278.50
Summer	Pearl Millet	2450	10385	254.43
			<b>Total</b>	<b>532.93</b>



## 5.2.11. Major Findings

### 5.2.11.1. Water Resource

Under WRM, activities related to check-dam, percolation tank, farm ponds etc have been taken up in the project to augment irrigation water availability and improve quality of water, mainly in terms of reduced salinity levels

- **Number of Watering:** With increase in water availability, number of watering has increased for various crops. Support irrigation for cotton and groundnut has been doubled. Number of watering in Wheat crop has increased from 6 to 10. No major change has been seen in number of watering in summer, but area under cultivation has increased.
- **Ground Water Table:** With increased ground water recharge due to these structures, on an average there has been increase in water table of about 6-8.5 metres in wells located near water resource structures. Major observation comes out that bore well which has no water previously and dried has been started working with increase in water table up to 30 to 35.5 meters.
- **Ground Water Quality:** In villages like Vandvijada, Akalashekhpur Pipaliya there has been 30-40% reduction in TDS from 1100-1800 ppm to 900-1300 ppm during winters due to water retaining structures. There has been drastic fall in TDS in wells in Dudhala and Devaliya village from 3500 ppm to 2200-2500 ppm.

*(Kanubhai is a beneficiary of Dudhala village pond, he said in Gujarati language "Pahelakuvaane bore napanithi cha nhoti banati atyare hve amare khetre cha banavva mate pani nathi lavvu padtu")*

- **Cultivated and Irrigated Land:** Based on discussion with farmers, most of the farm areas owned by farmers were cultivated in Kharif. However, support irrigation facilities have doubled the area under cropping. Irrigated area in Kharif has increased from 33% to 64% in total in all the surveyed villages. Rabi cultivation has risen from 30% to 71% of total land area. Similarly, there has been increase in cultivated land from 20% to 50% in summer also.
- **Cultivation Pattern:** Based on interaction with community of farmer group, it was evident that there is rise in farmers cultivating wheat crop during winter due to



increased water availability. Farmers have switched from Pearl millet (Bajri) and other crops to wheat cultivation in winter. Groundnut had been found as the major crop in Kharif before and after intervention. Few farmers have also started cultivating Pearl Millet and Sesame (Til) in summer due to increased water availability.

- **Crop Productivity:** Along with increased irrigation, farmers have also adopted changes in package of practices. This has resulted in enhanced productivity of various crops from 7-24%, which subsequently increased the socio-economic conditions of the farmers.

#### 5.2.11.2. Agricultural Practices – Improvement in Package of Practices for Major Crops

- **Cultivation Pattern:** Cotton and Groundnut is the major Kharif crop across all the villages. About 80% of land in all villages falls under cotton crop cultivation; while about 20 % area under groundnut which is second main crop and fodder crops in all surveyed villages. The major change in cropping pattern in Kharif has been increased groundnut cultivation against cotton in both blocks. There is increase in Wheat cultivation among water resource structure beneficiaries. Wheat is the major Rabi crop in all surveyed villages; while fodder and Pearl Millet are major summer crops in all 3 talukas. No major change in pattern of cultivation in Rabi and summer season was observed.
- **Crop Productivity:** Compared to the baseline data, there has been significant increase of 50% in groundnut and cotton crop. Similarly there has been more than 50% rise in Kharif Pearl Millet productivity. But there is marginal rise in the productivity, 15% rise in productivity of cotton. Wheat which has been a major Rabi crop have shown 15-20% rise in productivity, Pearl millet which been major Rabi crop in study area has shown 26% higher productivity. Productivity of summer Pearl Millet across all talukas showed increase in productivity ranging from 22-54%
- **Animal Husbandry:** Before implementation of water structures, there is lack of fodder availability; therefore, the community migrate from one place to another place with animal for survival and grazing grounds. Nowadays migration has reduced due to water available for fodder production. About the health of animals, the community has Linkages for vaccination; de-worming, animal camps, awareness on



cattle health, etc. were taken up in the project. All cattle owners undertake de-worming of cattle against only 5% cattle owners during baseline. About, 96% cattle owners undertake de-worming up to 2-3 times a year while others do it 5-6 times a year. All cattle owners were provided vaccination to cattle 1-2 times in a year against only 40% cattle owners during pre-project scenario. All these have definitely led to decrease in incidence of diseases. Moreover there is average rise in milk yield of 1-1.5 litres/day in cow and 1-3 litres/day in buffaloes. There is rise in milk fat in these cattle from 0.5-25%.

**5.2.12. Fishing:** The community living in the project villages are not engaged in fishing activity due to cultural prohibition.



## Annexure I

### Details of Plantations carried out by the Dholkia Foundation in Gujarat

Sr. No.	Locations	Number of Trees	Year
1	Ahmedabad	22575	2011-2021
2	Amreli	22,578	2011-2021
3	Anand	22,580	2011-2021
4	Banaskantha	22,582	2011-2021
5	Bharuch	22,581	2011-2021
6	Bhavnagar	22,586	2011-2021
7	Jamnagar	22,579	2011-2021
8	Junagadh	22,579	2011-2021
9	Kheda	22,583	2011-2021
10	Mahesana	22,583	2011-2021
11	Navsari	22,580	2011-2021
12	Patan	22,581	2011-2021
13	Rajkot	22,579	2011-2021
14	Saputara	22,578	2011-2021
15	Surat	22,583	2011-2021
16	Surendranagar	22,581	2011-2021
17	Vadodara	22581	2011-2021
18	Aluj-Panoli	7,52013	2011-2021
19	Govali-Bharuch	6,48,745	2011-2021
20	Panch Ganga Tirth	1,93,055	2011-2021
21	HK Hub Icchapur	1,40104	2011-2021
22	Dahanu	1003	2011-2021
23	Dahanu & Lonavala	8007	2011-2021
24	Vaav (Kamrej) Ladví- Surat	11,779	2011-2021
25	Harsurpur-Devaliya	18019	2011-2021
26	Dudhala	3302	2011-2021
	Total		



## Annexure II

### Sampling location, sample size and methodology adopted for impact assessment of Mission Sarovar

Variable	Total	Sample	Sampling Method	Remarks
Taluka	4	4	Cover two Talukas	Talukas with large scale and multiple interventions in both phases prioritized Representational sample across geographical zones
Villages	6	9	18% random stratified considering Village size	Covering four broad themes of water Resource Management, Agriculture, animal husbandry
Households	-	200 HH in Individual survey	Individual HH survey for socio economic impact through Random stratified sampling of 5.5% of total HHs, 5-10% HH sample size distributed across villages	Representational sample across all villages covering all socio economic strata. Focus on change in household income
Farmer groups & WRM group	-	9 groups	Group discussion of 2% farmer groups on process, impact, capacity building and sustainability	Prioritised to cover all major types of interventions
Panchayat institutions & Villages Level Survey	-	7 institutions	focus on capacity building, institutional strength and sustainability	Prioritised to cover different types of institutions such as post management group Focus on the sustainability of the institutions, programme and withdrawal status