

Fig. 3.4.13: Cropping Pattern along with Pipeline Route from Viramgam to Salaya Terminals

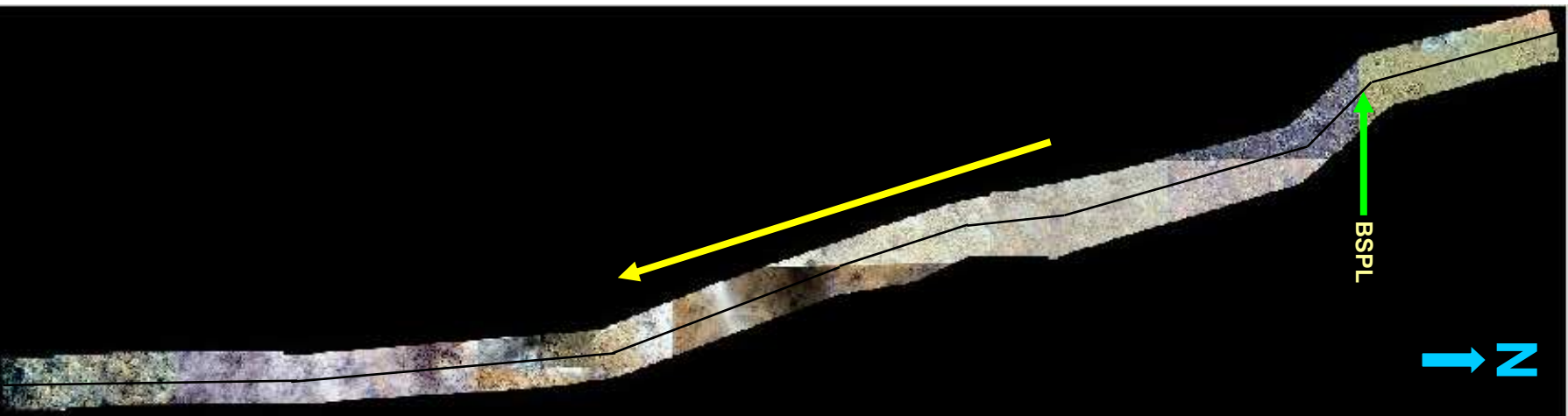


Fig. 3.4.14: Quick Bird Image of the proposed Pipeline Corridor from Barmer – Salaya
(Study corridor of 2.5 Km on either side of pipeline from Barmer to Sanchor)

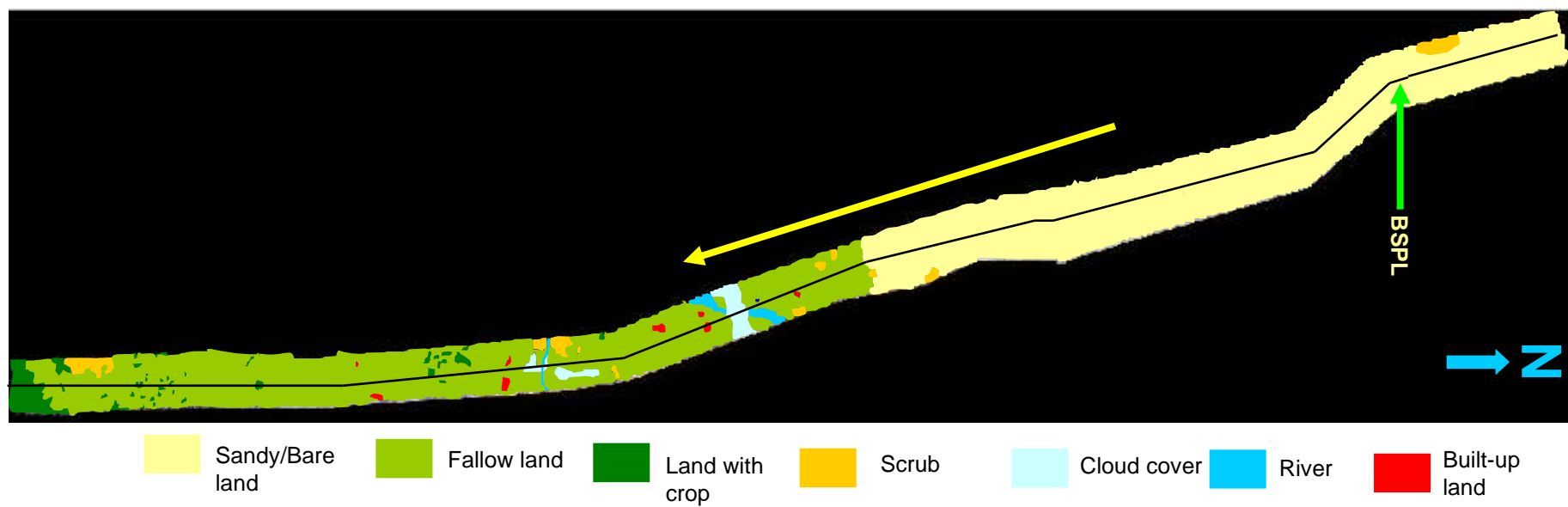
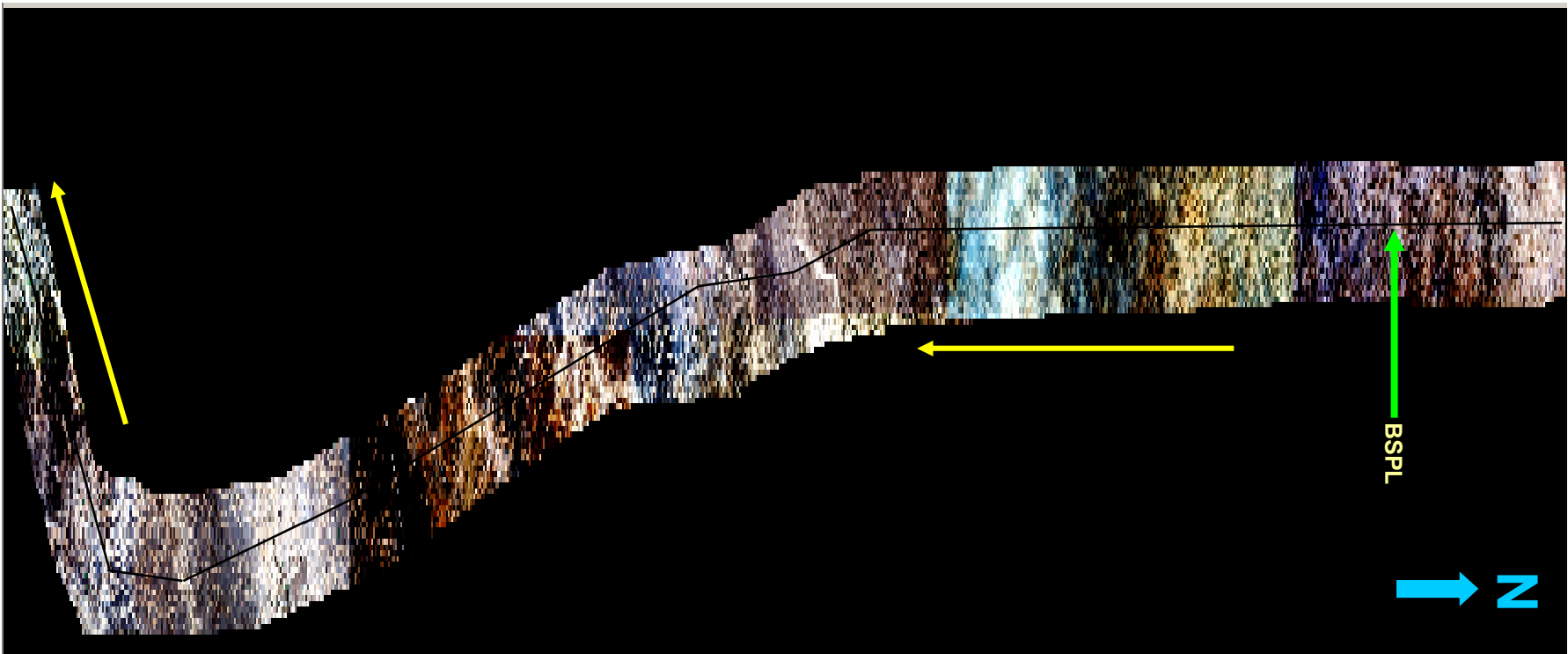


Fig. 3.4.15: Landuse/Land cover details of the proposed pipeline corridor from Barmer – Salaya
(Study corridor of 2.5 Km on either side of pipeline from Barmer to Sanchor)



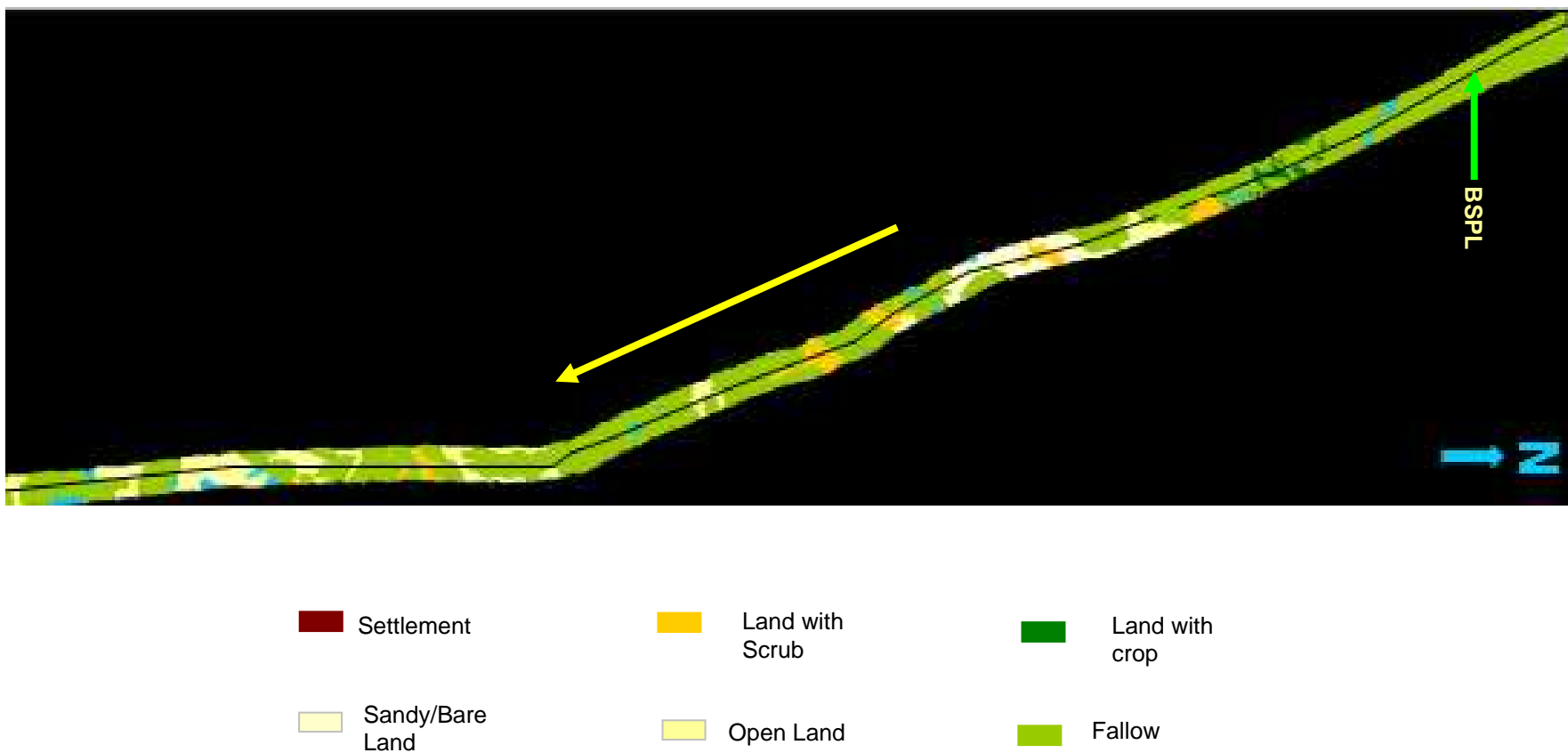
**Fig. 3.4.16: QuickBird Image of the Proposed Pipeline Corridor from Barmer-Salaya
(Study Corridor of 2.5 km on either side of Pipeline from Sanchore to Viramgam)**



**Fig. 3.4.17: Landuse/Land cover details of the Proposed Pipeline Corridor from Barmer – Salaya
(Study Corridor of 2.5 Km on Either Side of Pipeline from Sanchor to Viramgam)**



Fig. 3.4.18: Quick Bird Image of the Proposed Pipeline Corridor from Barmer – Salaya
(Study corridor of 2.5 Km on either side of pipeline from Viramgam to Salaya)



**Fig. 3.4.19: Landuse / Landcover details of the Proposed Pipeline Corridor from Barmer – Salaya
(Study Corridor of 2.5 Km on either side of Pipeline from Viramgam to Salaya)**

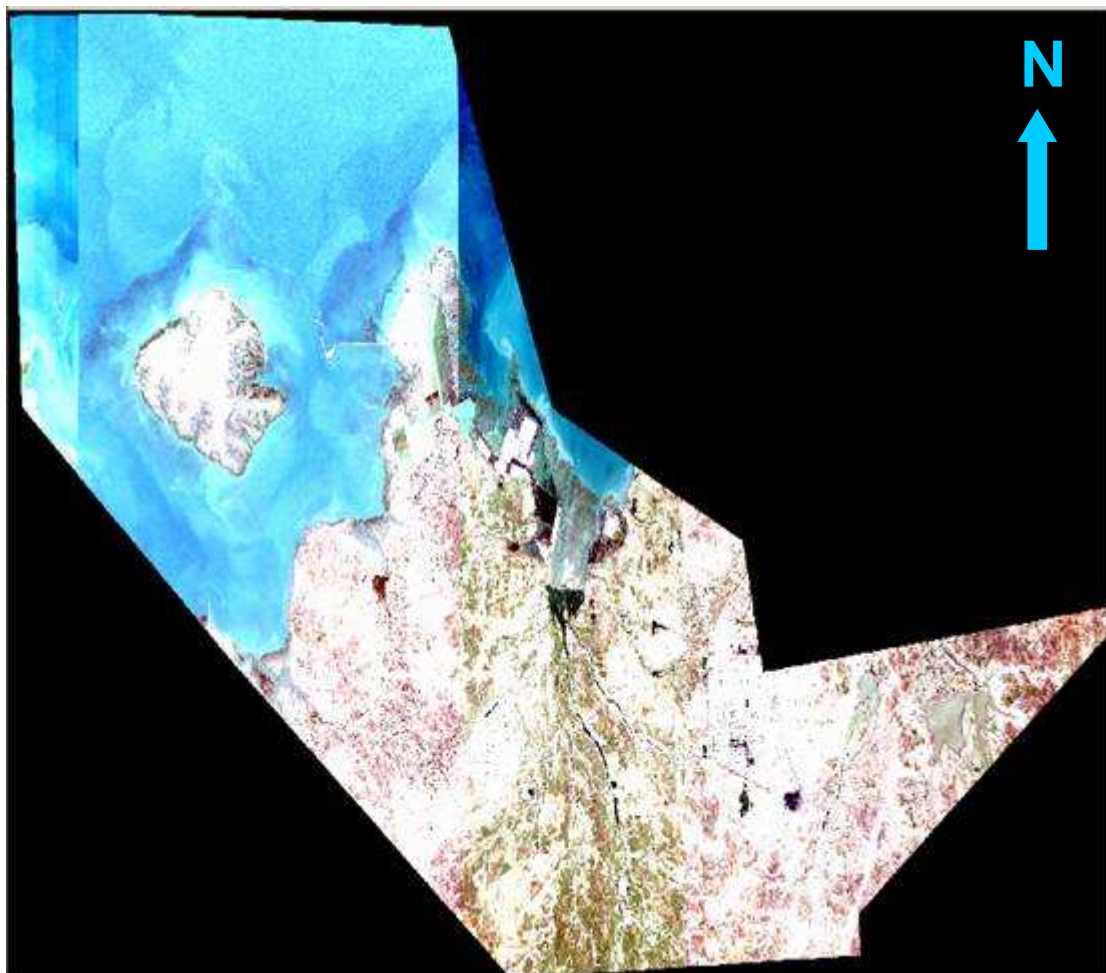


Fig. 3.4.20: Quick Bird Image of the Proposed Pipeline Corridor from Barmer – Salaya (Study Corridor of 2.5 Km on either side of Pipeline from Salaya to Sea)

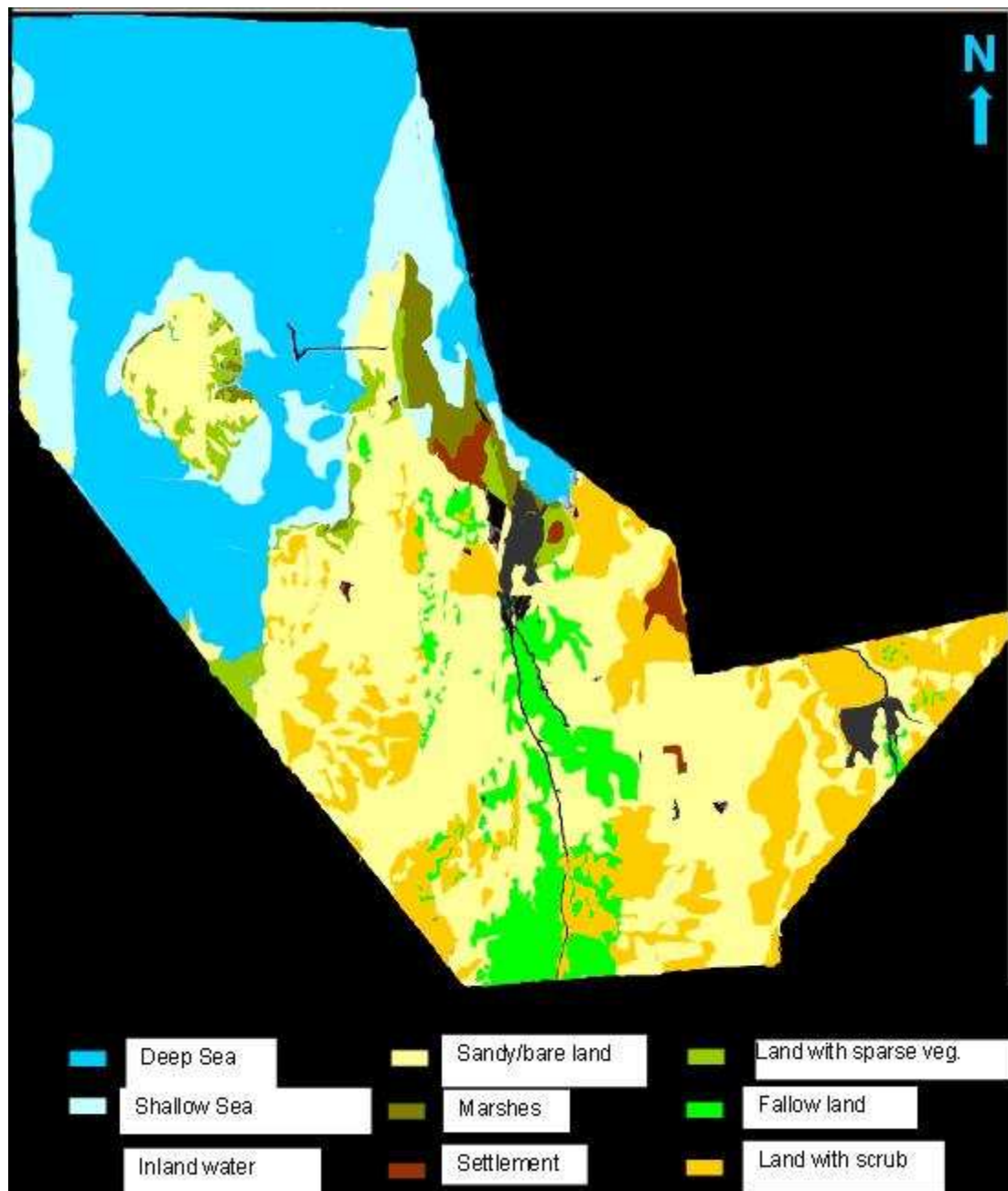


Fig. 3.4.21: Landuse/Landcover details of the Proposed Pipeline Corridor from Barmer – Salaya
(Study Corridor of 2.5 Km on either Side of Pipeline from Salaya to Sea)

Table 3.4.1
Sampling Locations of Soil in Rajasthan Region

Sr. No.	Sampling Location
Rajasthan Region	
Barmer District	
1	Fakiron ki Dhani
2	Bandra
3	Nagana
4	Jogasariya
5	Gurha Malani
Jhalor District	
6	Karola
7	Badsam
8	Kamalpura
9	Jhakal
10	Sanchole
Gujarat Region	
Banaskhanta, Patan & Ahmedabad	
11	Deodar
12	Thara
13	Viramgam terminal site
14	Nilki
15	Vani
16	Sakoli
17	Kajipur
Surendranagar, Rajkot	
18	Sami
19	Raysangpar
20	Bharad
21	Gediya
22	Lalpar
23	Paddhari
Jamnagar	
24	Padana
25	Mota Lakhiya
26	Jhankar
27	Jogwad
28	Khatia Beraja
29	Mithoi
30	Navaniya

Table 3.4.2
Soil Quality in the Rajasthan Region (Summer Season)

Sr. No.	Parameters	Barmer District	
		Minimum	Maximum
Textural Class: Particle Size Distribution			
1	Fine Sand (%)	82.2	84.2
2	Coarse Sand (%)	2.4	3.8
3	Silt (%)	11.2	11.4
4	Clay (%)	2.2	2.6
5	Textural Class	Fine Sand	Fine, sandy, loamy
Physical Properties			
6	Bulk Density (mg/m³)	1.38	1.42
7	Porosity (%)	11.6	22.8
8	Water Holding Capacity (%)	9.2	12.2
Chemical Characteristics			
9	pH	8.32	9.35
10	EC (dS/m)	0.09	1.01
11	Ca ⁺⁺ (meq/l)	1.34	2.82
12	Mg ⁺⁺ (meq/l)	1.22	1.34
13	Na ⁺ (meq/l)	1.02	1.22
14	K ⁺ (meq/l)	0.62	0.82
Heavy Metals			
15	Cadmium (mg/kg)	ND	0.6
16	Chromium (mg/kg)	12.6	22.3
17	Copper (mg/kg)	3.1	8.3
18	Nickel (mg/kg)	12.3	18.6
19	Lead (mg/kg)	ND	ND
20	Manganese (mg/kg)	14.9	37.2
21	Zinc (mg/kg)	148	262
22	Iron (mg/kg)	2998	3322
Cation Exchange Capacity [cmol (P ⁺)kg ⁻¹]			
23	Cation Exchange Capacity as Ca ²⁺	1.4	1.8
24	Cation Exchange Capacity as Mg ²⁺	0.62	0.70
25	Cation Exchange Capacity as Na ⁺	0.24	0.58
26	Cation Exchange Capacity as K ⁺	0.34	0.42
27	Cation Exchange Capacity (CEC)	3.2	3.8
28	Exchangeable Sodium Na (%)	7.4	16.1
Relationship of CEC with Absorptivity			
29	Range in cmol (P ⁺) kg ⁻¹	<10	10
30	Absorptivity	Low, Limited	Moderate
Relationship of CEC with Productivity			
31	Range in cmol (P ⁺) kg ⁻¹	<10	<20
32	Productivity	Very low	low
Fertility Status			
33	Organic Carbon (%)	0.02	0.04
34	Available Nitrogen as N (kg/ha)	50.2	58.4
35	Available Phosphorus P ₂ O ₅ (kg/ha)	6.8	9.8
36	Availabe Potassium K ₂ O (kg/ha)	23.5	30.6
Microbiological Characteristics			
37	TVC	15 x 10 ⁶	23 x 10 ⁶
38	Fungi	3 x 10 ⁴	4 x 10 ⁴
39	Actinomycetes	ND	2 x 10 ⁴
40	Rhizobium	ND	2 x 10 ⁴
41	Axotobacter	ND	ND

Table 3.4.3
Soil Quality in the Rajasthan Region (Summer Season)

Sr. No.	Parameters	Jhalor District	
		Minimum	Maximum
Textural Class: Particle Size Distribution			
1	Fine Sand (%)	81.6	82.6
2	Coarse Sand (%)	3.8	4.2
3	Silt (%)	10.4	11.2
4	Clay (%)	2.2	2.6
5	Textural Class	Loamy	Loamy
Physical Properties			
6	Bulk Density (mg/m³)	1.4	4.4
7	Porosity (%)	22.2	22.8
8	Water Holding Capacity (%)	10.8	12.4
Chemical Characteristics			
9	pH	8.24	8.88
10	EC (dS/m)	0.70	0.78
11	Ca ⁺⁺ (meq/l)	3.00	3.22
12	Mg ⁺⁺ (meq/l)	1.2	1.5
13	Na ⁺ (meq/l)	0.86	0.92
14	K ⁺ (meq/l)	0.60	0.68
Heavy Metals			
15	Cadmium (mg/kg)	ND	0.2
16	Chromium (mg/kg)	22.3	23.0
17	Copper (mg/kg)	9.0	9.4
18	Nickel (mg/kg)	20.0	22.2
19	Lead (mg/kg)	ND	ND
20	Manganese (mg/kg)	14	16
21	Zinc (mg/kg)	232	240
22	Iron (mg/kg)	3302	3388
Cation Exchange Capacity [cmol (P ⁺)kg ⁻¹]			
23	Cation Exchange Capacity as Ca ²⁺	1.4	1.8
24	Cation Exchange Capacity as Mg ²⁺	0.62	0.82
25	Cation Exchange Capacity as Na ⁺	0.24	0.58
26	Cation Exchange Capacity as K ⁺	0.34	0.42
27	Cation Exchange Capacity (CEC)	3.2	3.8
28	Exchangeable Sodium Na (%)	8.4	16.1
Relationship of CEC with Absorptivity			
29	Range in cmol (P ⁺) kg ⁻¹	<10	<20
30	Absorptivity	Low	Moderate
Relationship of CEC with Productivity			
31	Range in cmol (P ⁺) kg ⁻¹	<10	20
32	Productivity	Very low	low
Fertility Status			
33	Organic Carbon (%)	0.02	0.04
34	Available Nitrogen as N (kg/ha)	50.2	58.4
35	Available Phosphorus P ₂ O ₅ (kg/ha)	6.8	9.8
36	Avalable Potassium K ₂ O (kg/ha)	23.5	30.6
Microbiological Characteristics			
37	TVC	15 x 10 ⁶	23 x 10 ⁶
38	Fungi	3 x 10 ⁴	4 x 10 ⁴
39	Actinomycetes	ND	2 x 10 ⁴
40	Rhizobium	ND	2 x 10 ⁴
41	Axotobacter	ND	ND

Table 3.4.4
Soil Quality in the Gujarat Region (Summer Season)

Sr. No.	Parameters	Banaskhanta, Patan, Ahmedabad Dist.	
		Minimum	Maximum
Textural Class: Particle Size Distribution			
1	Fine Sand (%)	14.2	68.8
2	Coarse Sand (%)	2.2	18.8
3	Silt (%)	10.2	29.8
4	Clay (%)	2.2	53.8
5	Textural Class	Clay	Loamy
Physical Properties			
6	Bulk Density (mg/m³)	1.16	1.4
7	Porosity (%)	22.8	49.6
8	Water Holding Capacity (%)	11.8	56.8
Chemical Characteristics			
9	pH	6.99	8.42
10	EC (dS/m)	0.34	1.88
11	Ca ⁺⁺ (meq/l)	1.66	4.88
12	Mg ⁺⁺ (meq/l)	0.14	1.8
13	Na ⁺ (meq/l)	0.27	1.27
14	K ⁺ (meq/l)	0.36	1.08
Heavy Metals			
15	Cadmium (mg/kg)	ND	0.5
16	Chromium (mg/kg)	19.0	48.8
17	Copper (mg/kg)	4.6	25.7
18	Nickel (mg/kg)	19.0	57.0
19	Lead (mg/kg)	ND	14.0
20	Manganese (mg/kg)	ND	32.8
21	Zinc (mg/kg)	251	377
22	Iron (mg/kg)	3178	3690
Cation Exchange Capacity [cmol (P ⁺)kg ⁻¹]			
23	Cation Exchange Capacity as Ca ²⁺	1.6	28.8
24	Cation Exchange Capacity as Mg ²⁺	0.88	16.6
25	Cation Exchange Capacity as Na ⁺	0.28	4.8
26	Cation Exchange Capacity as K ⁺	0.64	1.8
27	Cation Exchange Capacity (CEC)	3.6	53.2
28	Exchangeable Sodium Na (%)	3.0	9.0
Relationship of CEC with Absorptivity			
29	Range in cmol (P ⁺) kg ⁻¹	<20	30
30	Absorptivity	Moderate	High
Relationship of CEC with Productivity			
29	Range in cmol (P ⁺) kg ⁻¹	20	>50
30	Productivity	Low	High
Fertility Status			
33	Organic Carbon (%)	0.02	0.26
34	Available Nitrogen as N (kg/ha)	51.6	262.6
35	Available Phosphorus P ₂ O ₅ (kg/ha)	9.8	22.6
36	Available Potassium K ₂ O (kg/ha)	32.0	272.2
Microbiological Characteristics			
37	TVC	26 x 10 ⁶	67 x 10 ⁶
38	Fungi	2 x 10 ⁴	9 x 10 ⁴
39	Actinomycetes	2 x 10 ⁴	3 x 10 ⁴
40	Rhizobium	2 x 10 ⁴	6 x 10 ⁴
41	Axotobacter	1 x 10 ⁴	3 x 10 ⁴

Table 3.4.5
Soil Quality in the Gujarat Region (Summer Season)

Sr. No.	Parameters	Surendranagar, Rajkot District	
		Minimum	Maximum
Textural Class: Particle Size Distribution			
1	Fine Sand (%)	18.6	66.8
2	Coarse Sand (%)	2.4	8.8
3	Silt (%)	7.9	29.8
4	Clay (%)	1.5	52.2
5	Textural Class	Clay	Fine, Loamy
Physical Properties			
6	Bulk Density (mg/m³)	1.14	1.38
7	Porosity (%)	18.8	50.2
8	Water Holding Capacity (%)	8.8	58.8
Chemical Characteristics			
9	pH	7.74	8.31
10	EC (dS/m)	0.56	2.0
11	Ca ⁺⁺ (meq/l)	1.2	3.26
12	Mg ⁺⁺ (meq/l)	0.08	0.9
13	Na ⁺ (meq/l)	0.70	1.30
14	K ⁺ (meq/l)	0.48	0.80
Heavy Metals			
15	Cadmium (mg/kg)	ND	1.2
16	Chromium (mg/kg)	1.1	34.1
17	Copper (mg/kg)	1.14	88.9
18	Nickel (mg/kg)	22.0	79.0
19	Lead (mg/kg)	ND	2.1
20	Manganese (mg/kg)	ND	57.7
21	Zinc (mg/kg)	41	897
22	Iron (mg/kg)	2802	4206
Cation Exchange Capacity [cmol (P ⁺)kg ⁻¹]			
23	Cation Exchange Capacity as Ca ²⁺	1.2	30.6
24	Cation Exchange Capacity as Mg ²⁺	0.68	14.6
25	Cation Exchange Capacity as Na ⁺	0.12	3.8
26	Cation Exchange Capacity as K ⁺	0.32	1.8
27	Cation Exchange Capacity (CEC)	2.6	55.8
28	Exchangeable Sodium Na (%)	4.6	7.4
Relationship of CEC with Absorptivity			
29	Range in cmol (P ⁺) kg ⁻¹	>20	>30
30	Absorptivity	High	Very High
Relationship of CEC with Productivity			
29	Range in cmol (P ⁺) kg ⁻¹	20	50
30	Productivity	Low	Moderate
Fertility Status			
33	Organic Carbon (%)	0.02	0.48
34	Available Nitrogen as N (kg/ha)	68.2	288.2
35	Available Phosphorus P ₂ O ₅ (kg/ha)	6.8	24.2
36	Avalable Potassium K ₂ O (kg/ha)	28.8	312.2
Microbiological Characteristics			
37	TVC	17 x 10 ⁶	38 x 10 ⁶
38	Fungi	3 x 10 ⁴	4 x 10 ⁴
39	Actinomycetes	ND	3 x 10 ⁴
40	Rhizobium	ND	4 x 10 ⁴
41	Axotobacter	ND	2 x 10 ⁴

Table 3.4.6
Soil Quality in the Gujarat Region (Summer Season)

Sr. No.	Parameters	Jamnagar District	
		Minimum	Maximum
Textural Class: Particle Size Distribution			
1	Fine Sand (%)	13	33
2	Coarse Sand (%)	10	12
3	Silt (%)	15	39
4	Clay (%)	11	48
5	Textural Class	Clay, Sandy	Sandy, Loamy
Physical Properties			
6	Bulk Density (mg/m³)	1.12	1.68
7	Porosity (%)	31	66
8	Water Holding Capacity (%)	22	68
Chemical Characteristics			
9	pH	7.23	8.3
10	EC (dS/m)	0.55	217
11	Ca ⁺⁺ (meq/l)	0.18	5.1
12	Mg ⁺⁺ (meq/l)	0.11	2.3
13	Na ⁺ (meq/l)	0.10	0.93
14	K ⁺ (meq/l)	0.03	0.40
Heavy Metals			
15	Cadmium (mg/kg)	ND	13.3
16	Chromium (mg/kg)	4.7	168.7
17	Copper (mg/kg)	27.3	106.0
18	Nickel (mg/kg)	32.8	116.0
19	Lead (mg/kg)	ND	5.7
20	Manganese (mg/kg)	ND	ND
21	Zinc (mg/kg)	41.5	87.1
22	Iron (mg/kg)	9280	53742
Cation Exchange Capacity [cmol (P ⁺)kg ⁻¹]			
23	Cation Exchange Capacity as Ca ²⁺	12.6	26.6
24	Cation Exchange Capacity as Mg ²⁺	5.6	14.8
25	Cation Exchange Capacity as Na ⁺	0.95	1.8
26	Cation Exchange Capacity as K ⁺	0.1	1.7
27	Cation Exchange Capacity (CEC)	20.0	50.2
28	Exchangeable Sodium Na (%)	2.1	7.35
Relationship of CEC with Absorptivity			
29	Range in cmol (P ⁺) kg ⁻¹	<20	>30
30	Absorptivity	Moderate	Very High
Relationship of CEC with Productivity			
29	Range in cmol (P ⁺) kg ⁻¹	>20	>50
30	Productivity	Moderate	High
Fertility Status			
33	Organic Carbon (%)	0.24	0.81
34	Available Nitrogen as N (kg/ha)	132.2	278.0
35	Available Phosphorus P ₂ O ₅ (kg/ha)	11.6	18.6
36	Avalable Potassium K ₂ O (kg/ha)	107.0	148.8
Microbiological Characteristics			
37	TVC	15 x 10 ⁶	44 x 10 ⁶
38	Fungi	3 x 10 ⁴	12 x 10 ⁴
39	Actinomycetes	5 x 10 ⁴	21 x 10 ⁴
40	Rhizobium	4 x 10 ⁴	24 x 10 ⁴
41	Axotobacter	2 x 10 ⁴	7 x 10 ⁴

Table 3.4.7
District Wise Terrain and Land use along the Pipeline Route

Section	Terrain	Land use
Barmer		
From Take off point at Mangala Crude Oil Terminal near Barmer 0/00 Km to SH-28 (Nawanagar – Gurha Malani) 81/83 Km (Length 81.83 Km)	<ul style="list-style-type: none"> ♦ Undulating and falling terrain interspersed with sand dunes of varying heights. ♦ Surface soil is Sand with Gypsum deposit at shallow depth at the initial stretch. 	<ul style="list-style-type: none"> ♦ Barren land interspersed with dry cultivation fields. Cultivation includes Bajra / Jowar. ♦ Communication network is fair.
Jalaore		
From SH-28 (Nawanagar – Gurha Malani) 81/83 Km to Rajasthan Gujarat Border 152/68 Km (Length 70.85 Km)	<ul style="list-style-type: none"> ♦ Gently undulating and falling terrain with sand dunes of relatively lower heights. ♦ Surface Soil is mostly sand. 	<ul style="list-style-type: none"> ♦ Barren land interspersed with dry cultivation fields. Cultivation includes Bajra / Jowar. ♦ Communication network is fair.
Banaskhantha, Patan, Ahmedabad		
From Rajasthan Gujarat Border 152/68 Km to NH-14 (Radhanpur – Deesa) at 228/09 Km (Length 75.41 Km)	<ul style="list-style-type: none"> ♦ Gently falling ground ♦ Surface soil are mostly silty, sandy, loamy, hilly 	<ul style="list-style-type: none"> ♦ Barren land interspersed with dry cultivation fields. Cultivation includes bajra, jowar, wheat, pulses, sugarcane, groundnut, potato ♦ Communication network is fair
From NH-14 (Radhanpur – Deesa) at 228/09 Km to SH-221 (Sankeshwar – Bechraji) at 279/63 (Length 51.54 Km)	<ul style="list-style-type: none"> ♦ Gently falling ground ♦ Surface soil is sandy, saline, loamy 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly cotton, wheat, arhar, moong, pulses, jowar, bajra ♦ Communication network is good
From SH-221 (Sankeshwar – Bechraji) at 279/63 to Viramgam Crude Oil Terminal 328/00 Km (Length 48.37 Km)	<ul style="list-style-type: none"> ♦ Gently falling ground ♦ Surface Soil is silty clay. 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly paddy, wheat, cotton, mango, sugarcane, groundnut, pulses, Bajra ♦ Communication network is good

Section	Terrain	Land use
Surendranagar, Rajkot		
From Take off point at Proposed Viramgam Terminal 328/00 Km to SH-20 (Dhrangadhra – Surendranagar) 386/21 Km (Length 58.21 Km)	<ul style="list-style-type: none"> ♦ Gently rising terrain with cotton and Groundnut fields ♦ Surface soil are hilly, black, barren area 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly cotton, wheat, groundnut, gram, jowar, bazra ♦ Communication network is good.
From SH-20 (Dhrangadhra – Surendranagar) 386/21 Km to SH 119 (Dhrangadhra - Than) 424/46 Km (Length 38.25 Km)	<ul style="list-style-type: none"> ♦ Gently rising terrain followed by rocky outcrops and Stony waste area near 95/00 Km. ♦ Soil is silty, red and yellow, medium, mountain soil interspersed with clayey sand and with rocky outcrops near 95/00 Km 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly Cotton, Jowar, Bajra fields. ♦ Communication network is good.
From SH-119 (Dhrangadhra - Chotila) 424/46 Km to Western Railway 463/68 Km (Length 39.22 Km)	<ul style="list-style-type: none"> ♦ Gently rising ground with rocky outcrops and stony waste from 96/50 Km to 114/00 Km ♦ Soil is silty clay interspersed with clayey sand and stony wastes 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly Cotton, Jowar, Bajra fields. ♦ Communication network is good.
Jamnagar		
From Western Railway 463/68 Km to Und River 519/89 Km (Length 56.21 Km)	<ul style="list-style-type: none"> ♦ Gently Falling ground with broken grounds along banks of river ♦ Surface soil is medium black cotton soil, saline soil interspersed with clayey sand 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly cotton, jowar, bajra and groundnut ♦ Communication network is good
From Und River 518/89 Km to Salaya Terminal 589/00 Km (Length 69.11 Km)	<ul style="list-style-type: none"> ♦ Fairly level ground with cotton and Groundnut fields. ♦ Surface soil is Black Cotton Soil interspersed with clayey sand. ♦ Surface soil is Black Cotton Soil interspersed with clayey sand. 	<ul style="list-style-type: none"> ♦ Cultivated land includes mainly Cotton, Jowar, Bajra and groundnut ♦ Communication network is good ♦ Communication network is good.

Table 3.4.8
Cropping in Rajasthan and Gujarat

Sr. No.	Location	Length (km)
Mangala to Viramgam Sections		
1.	Bajara	131.20
2.	Jowar	98.40
3.	Castor	65.60
4.	Barren land	32.80
Viramgam – Salaya Section		
5.	Bajara	156.60
6.	Jowar	52.20
7.	Cotton	13.05
8.	Groundnut	13.05
9.	Barren land	26.10

Table 3.4.9

Section I: Classification of Landuse – Landcover: Barmer to Sanchores

Sr. No.	Class	Area %
1	Built –up land	3
2	Sand	30
3	Cloud cover	8
4	Land with crop	10
5	Fallow	40
7	Land with scrub	7
8	River	2

Table 3.4.10

Section II: Classification of Landuse – Landcover: Sanchores to Viramgam

Sr. No.	Class	Area %
1	Fallow land	76.8
2	Land with crop	1.2
3	Barren	7.2
4	Open land	5.7
5	Land with scrub	6.3
6	Water bodies	2.8

Table 3.4.11**Section III: Classification of Landuse – Landcover: Viramgam to Salaya**

Sr. No.	Class	Area %
1	Built –up land	2.7
2	Sand	3.2
3	Open land	2.7
4	Land with crop	0.3
5	Fallow	86
6	Land with scarce vegetation	2.3
7	Land with scrub	2.0

Table 3.4.12**Section IV: Classification of Landuse – Landcover: Salaya to Costal area of Sea**

Sr. No.	Class	Area %
1	Sand	27.4
2	Sea	28.7
3	Land with scrub	15.2
4	Fallow	12.5
5	Inland water	5.7
6	Land with sparse vegetation	4.0
7	Marsh	4.2
8	Settlement	1.3

3.5 Biological Environment

Study of biological environment is one of the most important components for Environmental Impact Assessment. In view of the need for conservation of environmental quality and biodiversity, ecological systems show complex inter-relationships between biotic and abiotic components including dependence, competition and mutualism. Biotic components comprises of both plant and animal communities which interact not only within and between themselves but also with the abiotic components viz. Physical and chemical components of the environment.

Generally, biological communities are good indicators of climatic and edaphic factors. Studies on biological aspects of ecosystems are important in Environmental Impact Assessment for safety of natural flora and fauna. Information on the impact of environmental stress on the community structure serves as an inexpensive and efficient early warning system to check the damage to a particular ecosystem. The biological environment includes mainly terrestrial ecosystem and aquatic ecosystem.

Biological communities are dependent on environmental conditions and resources of its location. They show various responses and sensitivities to anthropogenic influents. In this regard the baseline condition of the area needs to be studied.

3.5.1 Study Area (Along Pipeline Route)

The proposed pipeline will be passing through two states i.e. Rajasthan and Gujarat State. The study was under taken into consideration within 1 km distance along the proposed pipeline route. Most of the vegetation is aggregated on agricultural boundaries, road side plantation and social forest area. The study area along the proposed pipeline route mainly comprises of terrestrial ecosystem (agricultural land, wasteland and barren land) and aquatic ecosystem (Rivers, Lakes, Canals, etc.). Vegetation along the pipeline route comprises of mainly dry deciduous thorny and scrubby type. Some protected forest (mainly afforestation along the national and state highways in Gujarat) come under proposed pipeline route. The list of sampling location for biological environment is given in **Table 3.5.1** and Pipeline route map is presented in **Fig. 3.5.1**.

3.5.2 Climatic Conditions

The region under study is characterized by low and uneven distribution of rainfall causing high soil water stress throughout the year. High potential evaporation and strong wind also add adversity to the area. The summer is the most dominant season characterized by high temperature spreading over March to mid of July, coupled with high wind velocity and drifting sands. Three seasons that can be distinguished in this region are long dry season from March to mid of July; a short monsoon season from mid July to September receiving most of the rainfall and a winter season from November to February. The long dry season is generally pronounced and predictable, while the short rainy seasons are unreliable both in time and amount of rainfall.

3.5.3 Temperature

The most characteristic feature of the climate is the wide variation in the temperature. The maximum temperature rises to 48°C in summer and drops down to 2°C in winter.

3.5.4 Survey Methodology

The study area is dominated by the vegetation of dry deciduous scrub of small tree, shrub and very few large trees along with agricultural fields. Therefore the observation of vegetation was made by visiting different sampling stations and accordingly among available plants, the dominant plants species were recorded.

Actual counts of birds were made following the standard survey technique. Observations were made during a walk through in the chosen transect for sighting birds and animals. The number of animals and birds observed in one-kilometer stretch of the site were directly counted and listing was made. The kilometer of the car / jeep was used to measure the stretch of the study transect. Birds were noted, counted and identified with the help of binocular and standard field identification guides. Other animals were directly counted from amongst the vegetation, bushes and the roadside fields.

Information was collected on the live stock, fisheries and indigenous fauna of the locality from the State / Central Government Departments. This information has been incorporated in the report wherever essential.

3.5.5 Vegetation Diversity along the Pipeline Route

Plant diversity along the Mangala to Salaya pipeline shows three different types of vegetation are:

- ◆ Desert vegetation in Barmer and Jalore District of Rajasthan
- ◆ Scrub land in Banaskantha, Patan, Ahmedabad, Surendranagar, Rajkot, Jamnagar district of Gujarat
- ◆ Coastal vegetation found near the Salaya, Jamnagar district of Gujarat

According to Champion and Seth, the vegetation in the study area can be classified as Tropical Thorn type, Tropical Dry Deciduous type and Littorial and Swamp Type. That can be further classified as Riverian forests, Plain forests and Mangrove forests. The most dominant trees in this region are *Acacia sp.*, *Mangifera indica*, *Ficus religiosa*, *Butea monosperma*, *Terminalia bellerica*, *Terminalia tomentosa* are found in co-association and phytosociological order with *Syzygium cumini*, *Azadiracta indica*, *Bauhinia racemosa*, *Emblica officinalis*, which are sparse in distribution.

The subdominant species recorded are *Prosopis sp.*, *Capparis sp.*, *Euphorbia sp.*, and *Opuntia sp.* *Ficus bengalensis* is observed near villages and by the roadside. Other rare species in this area recorded are *Casuarina*, *Parkinsonia* and *Cocos nucifera*. Among the shrubs *Euphorbia sp.* and *Opuntia sp.* are abundant followed by *Cassia sp.*, *Zizyphus sp.*, and *Phoenix sp.*, are dominantly observed along with *Cassia siamea* and *Delonix regia* at some places in villages and on private land. Many tree species are found to be planted in the greenbelt of small and large industries in the area consisting of *Cassia siamea*, *Delonix regia*, *Bauhinia*, *Acacia auriculoformis*, *Eucalyptus*, *Mangifera indica* etc.

Study area shows presence of medicinal plants. 51 plant species of 25 trees, 10 herbs and 16 shrubs are of medicinal value. However, the scattered distribution and low density of these plants does not allow their commercial use.

3.5.5.1 Rajasthan Region

The survey was carried out around the 10 Km radius of the Mangala terminal and along the proposed pipeline route from Barmer and Jalore district of Rajasthan State. The study area falls under Thar Desert which supports Desert vegetation.

A major portion of the area is occupied either by dry open grassland or by grassland interspersed with trees and thorny bushes (Gupta, 1975). Most of the grasslands are *Dichanthium* – *Lasiurus* – *Cenchrus* type (Dabadghao and

Shankarnarayan, 1973) and the vegetation consists drought resistant stunted, thorny or prickly shrubs and perennial herbs (Bhandari, 1990). Vegetations of Thar are divided into following habitats (Shetty, 1994).

Sand Dunes and Interdunal Plains

Nearly 58% of the Thar is covered with sand dunes and interdunal plains. Many shifting dunes are bare but stabilized dunes are generally covered with *Capparis deciduas* (Ker), *Calotropis procera* (Aak), *Calligonum polygonoides* (Phog), *Acacia Senegal* (Kumat), *Prosopis cineraria* (Khejri), *Aerva javanica*, *Aristida funiculata*, *Aristida adsensionis*, *Dactyloctenium aegyptium*, *D. indicum* and other psammophytic species. At the base of the dunes and interdunal plains, which retain comparatively more moisture, the vegetation may consist of trees and shrubs such as *Acacia senegal*, *A. jacquemontii*, *P. cineraria*, *Tecomella undulata*, *Salvadora persica* and *Zizyphus nummularia*. *Citrus colosynthesis* and *C. lanatus* are the creepers. A view of Sand dunes and interdunal plains in Barmer is presented in **Fig. 3.5.2**. A list of plants species of Rajasthan is given in **Table 3.5.2**.

Sandy Plains

Besides some of the trees and shrubs mentioned above sandy plains may also have herbs and shrubs such as *Arnebia*, *Crotalaria burhia*, *Farseti hamiltonii*, *Helipterium*, *Indigofera cordifolia*, *Leptadenia pyrotechnica* and *Tephrosia purpurea*.

Gravelly Pediments

Beside, the sandy plains and sand dunes, the most common feature of the Thar is gravelly pediments and low hills seen around Barmer. The dominant tree is *P. cineraria* and *Salvadora persica*. Dominant shrub species are of *Maytenus emarginata* (Hingot), *Calotropis procera*, *Euphorbia*, *Capparis decidua* and *Zizyphus nummularia*. Common grass is *Aristida funiculata*.

Hilly and Rocky Outcrops

This feature exists in some parts of Barmer. However, it spreads about 13,200 km² areas in western Rajasthan, mainly near Barmer, Kailana- Jodhpur-Mador and Jalor. The characteristic plants of these rocky outcrops are thor (*Euphorbia caducifolia*), kumatha (*Acacia senegal*), dhok (*Anogeissus pendula*), ker (*Capparis decidua*), gugal (*Commiphora wightii*), kankera (*Maytenus emarginata*) and dholken (*Grewia tenax*). There are a large number of shrubs, annual herbs and climbers recorded in the region.

Saline Flats and Depressions

There are many saline depressions in the Thar with their characteristic halophytic vegetation consisting of *Salsola baryosma*, *Chenopodium*, *Haloxylon salinicornicum* and *Sueda fruticosa*. The major grasses and sedges are *Eleusine compressa*, *Eragrostis ciliaris*, *Dactyloctenium aegyptium*, *Cyperus rotundus* and *C. arenarius*. The most famous saline depressions are in Pachpadra Lake. The other depression is at Kawas and has tree species *Tamarix auriculata*, *Fagonia cretica*, *P. juliflora* etc.

River Beds

Luni and its tributaries flow only during the monsoon for three to four months, although pools remain for a much longer period. It enters into Pachpadra tehsil and after passing through Sinadhari and Guda-Malani region of Barmer it enters into Sanchor tehsil of Jalore division. At Gadav in Barmer, this river receives water from Sukari flowing through the Bagoda and Sanchor tehsil of Jalor district. Most of the riverbed is covered with *P. juliflora* as the dominant species. *Tamarix ericoides* is also common in some of the places. The grasses are generally represented by *Desmostachya bipinnata* in association with *P. juliflora*, *Dactyloctenium aegyptium*, and *Eragrostis ciliaris*. The main sedge is *Cyperus rotundus*.

Seasonal Wetlands

Interestingly there are many tanks and ponds in the villages in the Thar Desert for storing and collecting rainwater. These wet lands receive water during rainy season and become dry in Decemeber. These smaller wetlands and village ponds have *Potentilla supine*, *Pullicaria crispa*, *Cyperus rotundus*, *Fimbristylis dichotoma* and *Scirpus roylei* species along the edge and *Ceratophyllum*, *Hydrilla verticillata*, *Ipomea aquatica*, *Nymphoea* and *Vallisneria spiralis* in the water.

3.5.5.2 Gujarat Region

Land Areas (Banaskantha, Patan, Ahmedabad, Surendranagar, Rajkot)

The floristic study reveals species composition, which represents poor gene pool uniformly spread in restricted vegetation patches around human settlements. Collection of dead and dried branches for fuel, hard wood and local trees for construction purpose, grazing practice on vegetated land is also common. The nature of vegetation cover in this region is mixed, tropical dry, uneven-aged-deciduous vegetation with marked dominance of *Acacia* sp., *Dalbergia latifolia*, *Bauhinia purpurea*, *Ficus racemosa*, *Mangifera indica*, *Butea monosperma*, *Sapindus*

emarginatus, and *Gmelia arborea*. Most of the vegetation aggregates on agricultural bunds, near roadsides, on degraded village lands, canal sides and wastelands.

The vertical structure of the vegetation shows three distinguished storey i.e. Top, Middle and Ground. *Azadirachta indica*, *Dalbergia latifolia*, *Bauhinia purpurea*, *Ficus racemosa*, *Mangifera indica*, *Butea monosperma* etc. comprises top storey of the forest. *Adhatoda vasica*, *Bougainvillia tochtglory*, *Cassia fistula*, *Calotropis gigantean*, *Dalbergia sissoo*, *Lantana camara*, *Euphorbia nebulia*, *Opuntia elator*, *Prosopis juliflora*, *Zizyphus rugosa* etc. forms middle storey of region. Ground vegetation cover is of *Ageratum conizoides*, *Argemone mexicana*, *Aloe vera*, *Dipcadi montanum*, *Erantemum roseum*, *Leucas aspera*, *Phyllanthus niruri*, *Solanum xanthocarpum*, *Tinospora cardifolia* etc. List of Plant species present in Gujarat is given in **Table 3.5.3**.

Coastal Areas (Jamnagar)

The composition of vegetation in some coastal region like Salaya, Sikka, etc. is littorial and swamp, uneven-aged, mixed, moist deciduous natural forests. Vegetation is extremely irregular and varying considerably in condition, composition, and density. Generally trees observed here have low stunted branches, diffuse crown. Dependency of villagers on natural vegetation in this region is more for timber and firewood. Most of the vegetation aggregates near villages mainly composed of *Albizzia chinensis*, *Bauhinia racemosa*, *Ficus recimosa*, *Syzygium cumini*, *Terminalia tomentosa* etc.

The phyto-ecological structure of vegetation shows three different strata i.e. Top, Middle and Ground. Top storey covered by, *Albizzia chinensis*, *Bauhinia racemosa*, *Bombax malabaricum*, *Butea monosperma*, *Ficus recemosa*, *Syzygium cumini*, *Sapindus emarginatus*, *Terminalia tomentosa* etc. Middle storey in this region comprises *Adhatoda vasica*, *Capparis spinosa*, *Euphorbia nebulia*, *Crotolaria retusa*, *Embllica officinalis*, *Lantana camara* etc. The dominant herbs in ground vegetation are *Aegeratum conyzoides*, *Argemone mexicana*, *Celosia argentea*, *Aloe vera*, *Indigofera tinctoria*, *Tridax procumbens* etc.

Near the coastal area i.e. near jetty sides, saltpan, mangrove species are found. Mainly six species of mangrove are commonly found in this area are *Avicenia marina*, *A alba*, *A. officinalis*, *Ceriops species*, *Rhizophora mucronata* and *Aegiceros corniculata*. The density and vegetation changes with change in locations. A view of mangrove vegetation near Vadinar village area is shown in **Fig. 3.5.3**. The area near

coastal villages has poor vegetation as compared to other places. Trees species like *Cocos nucifera*, *Phoenix robusta*, *Ficus sp*, *Bahunia racemosa*, *Cassia fistula*, *Acacia catechu* and *Azadiracta indica* along with *Prosopis juliflora* are observed in some places. The vegetation is degraded due to the human and live stock interference in this region. Herbs are abundant only during monsoon. The area is dominated with tree members as compared to shrubs and herbs. The vegetation in this region has been exploited in the past therefore the present condition is degraded. *Mangifera indica* and *Azadiracta indica* are the dominant tree species.

Productivity of the agricultural crops in this region is very low because of poor soil quality, infrequent and inadequate rainfall, water scarcity, low consumption of fertilizer, shifting cultivation, lack of improved agricultural technology and improper communication.

3.5.6 Medicinal Plants in along the Pipeline Route

Ayurveda says “There is no plant on the Earth, which does not possess medicinal property”. This means that each and every plant is equally important for its biological activities, ecology and environment. Therefore, the conservation of medicinal plants means every species of plant in its actual habitat should be protected and preserved. Because of continuous exploitation of medicinal plants from their natural habitats, it is required to regenerate and conserve them elsewhere having similar habitat or environment. Due to over exploitation of natural resources many plant species have become extinct from the wild area.

The study area along the Mangala to Salaya Pipeline shows sparse occurrence of medicinal plants. A total of 51 plant species comprising 25 trees, 16 shrubs and 10 herbs are of medicinal value. The List of Medicinal Plants is presented in **Table 3.5.4**.

Ground flora in the study area is moderately covered by herbaceous vegetation, which has a very few Ayurvedic medicinal plants and edible tubers. Edible tubers are cultivated forms for staple food. In addition, the area abounds in production of a few kinds of fruits, flowers, seeds, leaves, etc.

The common herbal medicinal flora of the study area consists of *Datura metal*, *Calotropis procera*, *Sida cordifolia*, *Lawsonia inermis*, *Aegle marmelos*, *Azadirachta indica*, *Mangifera indica*, *Terminalia arjuna*, *Terminalia chebula*, *Terminalia bellerica*, *Tamarindus indica* etc.

3.5.7 Social Forestry

To reduce biotic pressure on existing forest, to provide fuel wood, fodder, fruits etc to the local people. To check soil erosion and also to maintain ecological balance of the area, Social Forestry Division of State Forest Department carried out plantation along the roadsides, highways, village land and revenue land.

The species planted are primarily native in nature except one exotic species (*Eucalyptus hybrid*). These are *Azadirachta indica*, *Salvadora oeloides* (**Fig. 3.5.4**), *Tamarindus indica*, etc. This is done to discourage monoculture plantation as well as to maintain soil moisture, groundwater level and also biodiversity of the area. The list of plant species used in social forestry is listed in **Table 3.5.5**.

3.5.8 Reserved Forests, National Parks and Sanctuaries

The pipeline route avoids passage through any national parks or sanctuaries or any of the other notified biosphere reserves. The pipeline passes through no reserved forest areas along the route. However some of protected forest (Like roadside Plantation) comes under pipeline route.

3.5.9 Environmental Sensitive Areas

Wild Ass Wildlife Sanctuary

Wild Ass Wildlife Sanctuary also known as the India Wild Ass Sanctuary is located in the Little Rann of Kachchh (LRK) about 15 Km north of pipeline route. The sanctuary is spread over 4953 Km² area and is the largest wildlife sanctuary in India. Also an area of 5 Km all around the sanctuary has been earmarked as non-mining area.

This unique terrain, a saline desert (Salt marsh) is home to nearly 4000 Indian Wild Ass, Nilgai, Chinkara, Wild Boar, Blackbuck, Hare, Wolf, Jackal, Fox, Desert fox, Desert cat, Hyena, Crested porcupine. Spiny tailed Lizards which are abundant.

Rann being a wet-land during monsoon is rich in avi-fauna. Water fowls like Flamingoes, Pelicans, Herons, storks, Egrates, Terns, Wader and Ducks come in millions of number to feed on rich marine fauna during the monsoon.

Nal Sarovar Bird Sanctuary

The Nalsarovar bird sanctuary is spread over in Ahmedabad and Surendranagar districts and about 40 kms away from the proposed pipeline route.

Primarily comprising of a huge lake and ambient marshes is situated about 30 km southwest of the pipeline route. The lake measures 123 km² and is mainly inhabited by migratory birds in winter and spring season and is the largest wetland bird sanctuary in Gujarat and one of the largest in India.

Rampura Vidi Wildlife Sanctuary

Rampura Vidi Wildlife Sanctuary is spread over an area of 15.01 Km² in village Vidi Bhojpara in Wankaner taluka of Rajkot district. The whole sanctuary is in the form of grassland and is mainly inhabited by Great Indian Bustard and some migratory birds in winter and spring season. Rampura Vidi Wildlife Sanctuary is situated approx. 5 Km away from the proposed pipeline route.

Marine National Park

Marine National Park (MNP) area, which is spread around an area of 162.89 km² found in the Gulf of Kutch provides very good grounds for roosting and the mangroves vegetation provides nesting ground to the avifauna. The coastal wetlands in Jamnagar with broad intertidal mudflats, mangroves, coral reefs, salt pans, sand and rock beaches offer a great diversity of habitats for birds to utilize for roosting, nesting and breeding. The area is very rich in the diversity and sheer number of both migratory and residence birds. A number of migratory birds pass through the Gulf of Kachchh and non-breeding adults of many species spend the summer in this region. Marine National Park is situated approximately 15 Km from the coast of Jamnagar and approximately 30 Km from the Salaya Terminal.

Pipeline route map showing Environmental Sensitive areas is presented in **Fig. 3.5.1**.

3.5.10 Threatened Plant Species

National threatened species are those found only in small numbers or those very near to extinction in the country. India has a list of threatened species at the All India level, published by the Botanical Survey of India entitled 'Red Data Book'. Three Plant species these are *Barleria prionitis*, *Cenchrus prieurii*, *Tecomella undulata*, are observed to be threatened in the study area.

3.5.11 Agriculture

Rajasthan Region

Agriculture is the main source of livelihood other than the livestock rearing. Rainwater is the main source for irrigation and drinking water in the region, tubewells

also supplement as a source of water for irrigation purposes, sprinkler systems are utilized for irrigating crops through tubewells.

During the monsoon people prefer to grow pearl millet, commonly called as Bajra (*Pennisetum typhoides*). The other main crops are mungbean (*Vigna radiata*), moth (*Vigna aconitifolia*), til (*Sesamum indicum*) and the cash crop gaur (*Cyamopsis tetragonoloba*). In most of the region, a single crop is harvested, i.e the rainfed. Both irrigated and rain fed crops are taken by the farmer in some tehsils of the region like Guda Malani tehsil in Barmer and Bhinmal, Bagoda and Sanchor tehsil of Jalore district.

Under irrigated conditions wheat (*Triticum aestivum*), bajra (*Penisetum glaucum*), zeera (*Cuminum cymium*), Isabgol (*Plantago ovata*) are the common crops sown. Irrigation from Narmada project includes 73000 hectares in the arid areas of Barmer and Jalore districts in Rajasthan.

Gujarat Region

The staple food of the people in this region is rice and wheat. The common *Kharif* crops of this region are groundnut, sesaun, cotton, castor, bajra etc. whereas wheat, gram, cumain, ajwan (semi-rabi) are the *Rabi* crops. Productivity of the agriculture crops in this region is medium to low because of low per hectare consumption of fertilizer, illiteracy and also due to the weather condition. List of Agricultural crops grown in Rajasthan and Gujarat is given in **Table 3.5.6**.

3.5.12 Assessment of Wildlife and Avifauna

Since animals are capable of movement from one place to another, this makes their study entirely different. Therefore, specific methods were adopted for counting these animals in the field. The on-site information collected during survey was further enriched by the information collected from different secondary sources.

3.5.12.1 Faunal Diversity

a) Wild Animals

The diversity in fauna basically depends upon density and diversity of flora. The richer the diversity among the flora better will be the diversity in fauna. The study area has sparse, dry and thorny vegetation. Present conditions of the area do not support higher mammals. There are animals like Hare, Mouse, Wild boar, Chinkara (**Fig. 3.5.5**), Blackbuck, Porcupine (**Fig. 3.5.6**), Fox, Wildcat, Nilgai, Wild Ass (**Fig. 3.5.7**) and Squirrels. The faunal elements commonly reported in the study area are presented in **Table 3.5.7** and **Table 3.5.8**.

b) Domestic Animals

The animals in study area mostly consist of domestic species such as camels, cow, buffaloes, sheep, goats, donkeys, horses, dogs and pigs. Animal census data revealed that among domestic animals cattle constituted the most abundant species, followed by buffaloes, goats, sheep and other animals.

c) Reptiles

About twenty-five species of snakes have been recorded so far from different regions of Rajasthan and Gujarat. Family Typhlopidae includes Brahminy, blind snake (*Ramphotyphlops bramina*) (**Fig. 3.5.8**) and beaked Blind Snake (*Typhlina acutus*). Family Leptotyphlopidae includes beaked Thread Snake (*Leptotyphlops macrorhynchus*). Family Boidae includes Indian Sand Boa (*Eryx johni johni*) and Russell's Sand Boa (*Eryx conicus*). Family Colubridae includes Dhaman (*Ptyas mucosus*), Trinket Snake (*Elaphe Helena*), Glossy-bellied racer (*Argyrogena ventromaculatus*), Royal Snake (*Sphalerosophis atriceps*), Diadem Snake or Rajatbansi (*Sphalerosophis diadema diadema*), Red Spotted Diadem Snake (*Sphalerosophis arenarius*), Wolf Snake (*Lycodon aulicus*), Checkered Keelback (*Xenochrophis piscator*), Green Keelback (*Macropisthodon plumbicolor*), Green Whip Snake (*Ahaetulla nasutus*); Indian Cat Snake (*Boiga trigonata*) and Afro-Asian Sand Snake (*Psammophis schokari*). Family Elapidae includes Indian Krait (*Bungarus caeruleus*), Binocellate Cobra, (*Naja naja*), Oxus Cobra or Black Cobra (*Naja naja oxiana*). Family Viperidae includes Saw Scaled Viper (*Echis carinatus*), Viper (*Vipera russelli russelli*).

3.5.12.2 Avifauna

Rajasthan

Many bird species including partridges, quails, sand grouses, bayas, sparrows, munias, crows, mynas, starlings, parakeets, kites, hawks, vultures (**Fig. 3.5.9**), doves, bee-eaters, ibis, bulbuls, babblers, larks, ducks, peafowls, lapwings, pigeons, cranes etc are recorded from the Barmer and Jalore districts during the recent survey done by NEERI team. These bird species have composition of raptors, insectivorous and granivorous birds. Occurrence of bird species in low numbers is evidently due to hostile climatic factors, sparse vegetation cover, very little tree cover with small canopy and almost rare water bodies and above all no surety of regular food availability. However, in Sanchoe bird species number is better than Barmer due to suitable climate and availability of food. Some of the common birds observed during recent survey by state forest departments indicate

the presence of pea fowl or peacock (*Pao cristatus*), bhat titar (*Pterocles exuslus*), gidh (*Neophron peronoterus*), house crow (*Corvus splendense*), wood pecker (*Picoides nanus*), Baya (*Ploceus philippinus*), kabboter (*Columbia livia*), owl (*Bubo bubo*), house sparrow (*Passer domesticus*), chil (*Falco jugger*) and Baj or eagle (*Corcatus gallicus*).

Gujarat

a) **Around Land Areas near Banaskantha, Patan, Viramgam, Laktar, Wankaner, Rajkot**

The birds like peafowl, mynas, crows, sparrows, bulbuls, babblers and pigeons are observed in and around villages. In areas with agriculture fields, the grain eating herbivorous species are dominant. These species are Doves, Sparrows, Cattle egrets, Parakeets etc. Insectivorous bird species viz. Bee-eaters, Wagtails, White breasted kingfisher, Egrets, Swallows, Indian Roller, Larks, are found around water bodies and in low-lying vegetation areas.

b) **Around Coastal Areas near Salaya, Jamnagar**

Varieties of shore birds are found to nesting and roosting on the coastal area. There are about 190 species available in the Marine National Park (MNP) area, which is spread around an area of 162.89 Km² found in the Gulf of Kutch provides very good grounds for roosting and the mangroves vegetation provides nesting ground to the avifauna. Birds nesting on the island mainly feed in the surrounding reef and mudflats but sometimes they move to nearby islands or coasts during low tide. The birds nesting on the coastal sites collect food from the mudflats, reefs, tidal creeks and channels on the coast. The coastal wetlands in Jamnagar with broad intertidal mudflats, mangroves, coral reefs, salt pans, sand and rock beaches offer a great diversity of habitats for birds to utilize for roosting, nesting and breeding. The area is very rich in the diversity and sheer number of both migratory and residence birds. A number of migratory birds pass through the Gulf of Kachchh and non-breeding adults of many species spend the summer in this region. A view of birds observed in the study area is shown in **Fig. 3.5.10**.

3.5.13 Fishery

As the study area is also located nearby the coastal belt in Jamnagar district, major fishing activities takes place in sea by the villagers of Salaya, Vadinar, Sikka etc. However, some fresh water fishing activities are also done by the local people in dams situated in Lalpur taluka, but in a small scale. These dams are usually given for fresh water fishing activities on lease basis. In Lalpur taluka two

dams – Sasoi (1278 ha.) and Panna (363 ha.) area are used for fishing activities. In Jalore district in Rajasthan some fresh water fishes were cultivated for commercial use but in very few quantity which depends on availability of water in dams. Fresh water fishes are mainly comprises of Rohu, Catla and Mrigal. A list of fresh water fishes found along the Pipeline route from Mangala to Salaya is given in **Table 3.5.9**.

A list of marine fishes found in Jamnagar district and different Prawn species occurring in the Gulf of Kachchh are given in **Table 3.5.10** and **Table 3.5.11** respectively.

3.5.14 Livestock Population

A major portion of the Thar is occupied either by dry open grassland or by grassland interspersed with tree and thorny bushes (Gupta, 1975). Thus, cattle rearing or animal husbandry is one of the main occupations of the people in the region resulting in high livestock population. Animal husbandry is the one of the most important sources of livelihood in these villages. Cows, camels and buffaloes are more important for richer people while goats, sheep and donkeys are the most important animals for the poorest families. Livestock densities are higher in Jalore region as compared to Barmer region. However, the ratio of livestock to human densities in these districts indicated 2.13 in Barmer as compared to 1.25 in Jalor district. Small ruminants like goat and sheep represent about 50% of the total livestock population. Such high load of livestock results in overgrazing of the existing vegetation. The grazier is used to pollard or debranch the trees for their cattles. Most of the communities and castes in the region including 'Rabaries' (the main grazier) and other pastoral group lopp *P. cineraria* (Khejri) tree used for fodder and fuel wood. Whereas in the Bishnoi community residing areas, this tree remain unlopped.

3.5.15 Rare, Endangered and Vulnerable Faunal Species

A comprehensive central legislation namely Wild Life (Protection) act was enforced in 1972. This law provides protection to wild animals and for matters related to their ancillary or incidental death.

Among mammals, Blackbuck, Chinkara, Indian Wild Ass and Desert Fox are found to be Vulnerable, while Desert cat is found to be endangered as per as Z.S.I. Red Data Book of India. During the survey Chinkara is observed in the study area of Barmer.

In birds, two species i.e. Great Indian Bustard (*Ardeotis nigriceps*) and Whitebeaked Vulture (*Gyps bengalensis*) are found to be critically endangered, while

common peafowl (*Pavo cristatus*) is found to be vulnerable. Whitebeaked Vulture is also seen in the study area along the pipeline route near Mangala Terminal, Barmer.

In Reptiles only Python is found to be vulnerable as per as Z.S.I. Red Data Book of India. The list of Rare, Endangered and Vulnerable Animals along the Mangala to Salaya Pipeline route is given in **Table 3.5.12**.

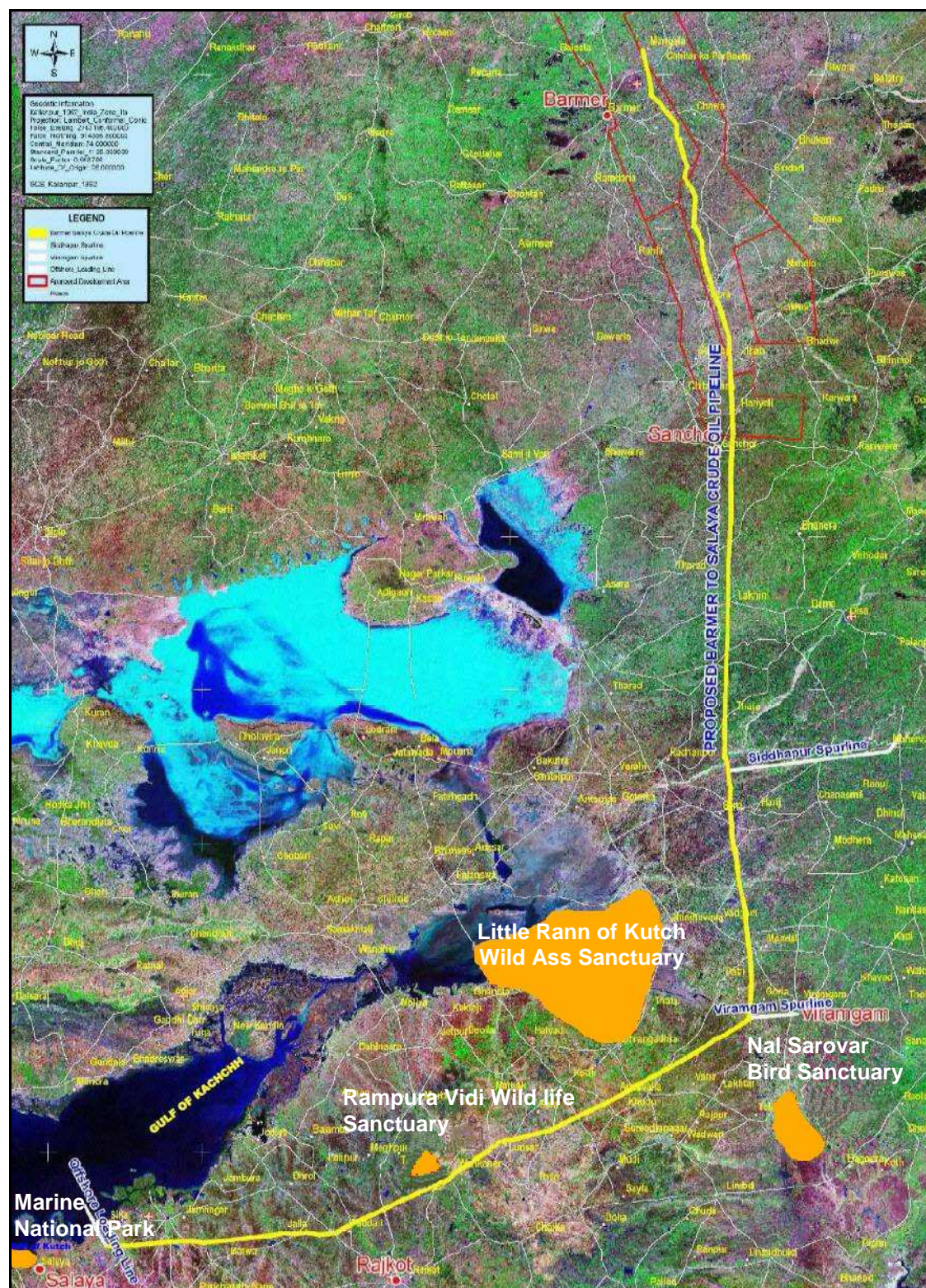


Fig. 3.5.1: Pipeline Route Map Showing Environmental Sensitive Areas



Fig. 3.5.2: A view of Desert Vegetation (Sand dunes and interdunal plains) in Barmer



Fig. 3.5.3: A View of Mangrove Vegetation near Vadinar Village



Fig. 3.5.4: Roadside Plantation of *Salvadora oeloides* at Laktar, Surendranagar



Fig. 3.5.5: Chinkara / Indian Gazelle seen near Guda Malani, Barmer



Fig. 3.5.6: Porcupine seen near Mangala Terminal, Barmer



Fig. 3.5.7: Wild Ass seen near Malban, Surendranagar



Fig. 3.5.8: Blind snake observed near Wankaner, Rajkot



Fig. 3.5.9: Vultures observed near Barmer



Fig. 3.5.10: Reef Heron observed near the Vadinar Jetty

Table 3.5.1
Sampling Locations for Biological Environment Survey in the Study Area

Sr. No.	Name of the Villages
Rajasthan	
1.	Barmer
2.	Jalore
Gujarat	
3.	Banaskantha
4.	Patan
5.	Ahmedabad
6.	Surendranagar
7.	Rajkot
8.	Jamnagar

Table 3.5.2
Common Plant Species Present in Rajasthan

Sr. No.	Local Name	Botanical Name
(A) Tree		
1.	Kumat	<i>Acacia Senegal</i>
2.	Kankara	<i>Myrtinus emerginata</i>
3.	Khejri	<i>Prosopis cineraria</i>
4.	Kikar	<i>Acacia nilotica</i>
5.	Neem	<i>Azadirachta indica</i>
6.	Hingota	<i>Balanites egyptiaca</i>
7.	Ker	<i>Capparis deciduas</i>
8.	Jal	<i>Salvadora oeloides</i>
9.	Jal (Khara)	<i>Salvadora persica</i>
10.	Rohira	<i>Tecomela undulate</i>
11.	Juliflora	<i>Prosopis juliflora</i>
(B) Shrubs		
1.	Gugal	<i>Commiphora wightii</i>
2.	Khimp	<i>Lapadenia pyrotechnica</i>
3.	Aak	<i>Calotropis procera</i>
4.	Senia	<i>Crotolaria burhia</i>
5.	Thore	<i>Euphorbia royleana</i>
6.	Ber	<i>Ziziphus mauritiana</i>
7.	Murali	<i>Lyceum barbarun</i>
8.	Iana	<i>Haloxylon salicornicum</i>
(C) Grass		
1.	Bhurat	<i>Cenchrus biflorus</i>
2.	-	<i>Cenchrus prieurii</i>
3.	Siwan	<i>Lasiurus indicus</i>
4.	Bura	<i>Cymbopogon jwarancusa</i>
5.	Lampra	<i>Aristida mutica</i>
6.	Kucha	<i>Sarccharus</i>
7.	Murat	<i>Panicum turgidum</i>
8.	Chaman	<i>Sarccharus ciliaris</i>
9.	Bui	<i>Areva pseudotomentosa</i>
10.	Phog	<i>Calhomum polygonoides</i>

Source: Desert National Park, Jaisalmer

Table 3.5.3
Common Plant Species Present in Gujarat
(Banaskhanta, Patan, Ahmedabad, Surendranagar, Rajkot and Jamnagar)

Sr. No.	Botanical Name	Local Name	Family
Trees			
1.	<i>Acacia catechu</i> *	Khair	Mimoseae
2.	<i>Acacia ferruginea</i>	Kanti	Mimoseae
3.	<i>Acacia leucophloea</i>	Hermo	Mimoseae
4.	<i>Acacia nilotica</i> *	Baval	Mimoseae
5.	<i>Acacia planifrons</i>	Chhatralo baval	Mimoseae
6.	<i>Acacia senegal</i> *	Gorad	Mimoseae
7.	<i>Aegle marmelos</i> *	Bili	Rutaceae
8.	<i>Ailanthus excelsa</i> *	Arduso	Simaroubaceae
9.	<i>Albizia lebbeck</i> *	Kalo sarsdo	Mimoseae
10.	<i>Albizia odoratissima</i>	Dholo sarsado	Mimoseae
11.	<i>Albizia odoratissima</i>	Sarasdo	Mimoseae
12.	<i>Albizia procera</i> *	Kamai	Mimoseae
13.	<i>Allangium salivifolium</i>	Ankol	Alangiaceae
14.	<i>Anogiessus latifolia</i>	Dhavado	Combretaceae
15.	<i>Annona squamosa</i> *	Anuri	Annonaceae
16.	<i>Avicennia officinalis</i> *	Cher	Avicenniaceae
17.	<i>Azadirachta indica</i> *	Limbdo	Meliaceae
18.	<i>Balanites aegyptiaca</i>	Ingoriyo	Balanitaceae
19.	<i>Bauhinia racemosa</i>	Asundro	Caesalpiniaceae
20.	<i>Bombax ceiba</i> *	Semlo	Bombacaceae
21.	<i>Borassus flabellifer</i> *	Tad	Arecaceae
22.	<i>Boswellia serrata</i>	Saledi	Burseraceae
23.	<i>Bridelia retusa</i>	Akal kanto	Euphorbiaceae
24.	<i>Butea monosperma</i> *	Khakhro	Fabaceae
25.	<i>Cassia fistula</i> *	Garmalo	Caesalpiniaceae
26.	<i>Cassia siamea</i> *	Kasid	Caesalpiniaceae
27.	<i>Casuarina equisetifolia</i> *	Saru	Casuarinaceae
28.	<i>Ceriops candolleans</i>	Kunri	Rhizophoraceae
29.	<i>Cocos nucifera</i> *	Narial	Arecaceae
30.	<i>Commiphora wightii</i>	Gugal	Burseraceae
31.	<i>Cordia dichotoma</i>	Gundi	Ephretiaceae

Sr. No.	Botanical Name	Local Name	Family
32.	<i>Cordia monoica</i>	Cut gundi	Ehretiaceae
33.	<i>Dalbergia sissoo</i> *	Sissoo	Caesalpiniaceae
34.	<i>Delonix elata</i>	Sandesaro	Caesalpiniaceae
35.	<i>Delonix regia</i> *	Gulmohar	Caesalpiniaceae
36.	<i>Diospyros melanoxylon</i> *	Timru	Ebenaceae
37.	<i>Emblica officinalis</i> *	Amla	Euphorbiaceae
38.	<i>Erythrina suberosa</i>	Jungli khakhro	Fabaceae
39.	<i>Erythrina variegata</i>	Panarv	Fabaceae
40.	<i>Eucalyptus hybrid</i> *	Nilgiri	Myrtaceae
41.	<i>Ficus benghalensis</i> *	Vadlo	Moraceae
42.	<i>Ficus racemosa</i> *	Umro	Moraceae
43.	<i>Ficus religiosa</i> *	Pipalo	Moraceae
44.	<i>Ficus tsiela</i>	Piper	Moraceae
45.	<i>Garuga pinnata</i>	Karpati	Burseraceae
46.	<i>Gmelina arborea</i>	Sevan	Verbenaceae
47.	<i>Grewia tiliaefolia</i>	Dhaman	Tiliaceae
48.	<i>Grewia tenax</i>	Gangeti	Tiliaceae
49.	<i>Holoptelea integrifolia</i>	Charal	Ulmaceae
50.	<i>Lannea coromandelica</i>	Moledi	Anacardiaceae
51.	<i>Mangifera indica</i> *	Ambo	Anacardiaceae
52.	<i>Manilkara hexandra</i>	Rayan	Sapotaceae
53.	<i>Melia azedarach</i> *	Bakan limdo	Meliaceae
54.	<i>Mellingtonia hortensis</i>	Akash nim	Bignoniaceae
55.	<i>Mimusops elengi</i> *	Bakul or borsali	Sapotaceae
56.	<i>Mitragyna parvifolia</i>	Kalam	Rubiaceae
57.	<i>Morinda tinctoria</i>	Al or rangari	Rubiaceae
58.	<i>Moringa oleifera</i>	Saragvo	Moringaceae
59.	<i>Musa sepianum</i>	Kel	Musaceae
60.	<i>Parkinsonia aculeate</i> *	Ram baval	Caesalpiniceae
61.	<i>Phoenix sylvestris</i> *	Khajuri/Khaleranuzad	Arecaceae
62.	<i>Pithecellobium dulce</i> *	Goras amli	Mimoseae
63.	<i>Polyalthia longifolia</i> *	Asopalav	Annonaceae
64.	<i>Pongamia pinnata</i> *	Karanj	Fabaceae
65.	<i>Prosopis juliflora</i> *	Gando baval	Mimoseae
66.	<i>Prosopis cineraria</i> *	Khijado	Mimoseae

Sr. No.	Botanical Name	Local Name	Family
67.	<i>Rhizophora conjugata</i> *	Karod	Rhizophoraceae
68.	<i>Salvadora oleoides</i>	Mithijar, Pilu	Salvadoraceae
69.	<i>Salvadora persica</i>	Kharijar	Salvadoraceae
70.	<i>Santalum album</i>	Sukhad	Santalaceae
71.	<i>Sapindus emarginatus</i>	Aritha	Sapindaceae
72.	<i>Schleichera oleosa</i>	Kusum ujan	Sapindaceae
73.	<i>Soymida febrifuga</i>	Ron	Meliaceae
74.	<i>Sterculia urens</i>	Kadayo	Sterculiaceae
75.	<i>Syzygium cumini</i> *	Jambudo	Myrtaceae
76.	<i>Tamarindus indica</i> *	Amlı	Caesalpiniaceae
77.	<i>Tecomella undulata</i>	Ragat Rohido	Bignoniaceae
78.	<i>Terminalia bellirica</i> *	Behdo	Combretaceae
79.	<i>Terminalia catappa</i>	Badam	Combretaceae
80.	<i>Terminalia arjuna</i> *	Arjun sadad	Combretaceae
81.	<i>Thespesia populnea</i>	Paraspipalo	Malvaceae
82.	<i>Wrightia tinctoria</i> *	Dudhlo	Apocynaceae
83.	<i>Woodfordia fruticosa</i>	Dhavadi	Myrtaceae
Shrub			
84.	<i>Abutilon indicum</i> *	Khaper	Malvaceae
85.	<i>Acacia jacquemontii</i>	Tal baval	Mimoseae
86.	<i>Adhatoda vasica</i> *	Ardushi	Acanthaceae
87.	<i>Alhagi pseudalhagi</i>	Dhomso	Fabaceae
88.	<i>Alysicarpus longifolius</i>	Ghoda samervo	Fabaceae
89.	<i>Barleria prionitis</i>	-	Acanthaceae
90.	<i>Calotropis gigantea</i> *	Ankdo moto	Asclepiadaceae
91.	<i>Capparis deciduas</i>	Kerdo	Capparidaceae
92.	<i>Capparis spinosa</i>	Karvatiral	Capparidaceae
93.	<i>Cassia auriculata</i>	Awal	Caesalpiniaceae
94.	<i>Commiphora wrightii</i>	Gugal	Burseraceae
95.	<i>Cressa cretica</i>	Lano	Convolvulaceae
96.	<i>Dichrostachys cinerea</i>	Majith	Mimoseae
97.	<i>Euphorbia neriifolia</i>	Kantalo thor	Euphorbiaceae
98.	<i>Euphorbia tirucalli</i>	Karsani thor	Euphorbiaceae
99.	<i>Euphorbia nebulia</i> *	Thor	Euphorbiaceae
100.	<i>Gardenia resinifera</i>	Dikamali	Rubiaceae

Sr. No.	Botanical Name	Local Name	Family
101.	<i>Hibiscus vitifolius</i>	Bhindi	Malvaceae
102.	<i>Lantana camara</i> *	Danidharia	Verbenaceae
103.	<i>Lawsonia inermis</i> *	Mehndi	Lecythidaceae
104.	<i>Leptadenia spartium</i>	Khip	Asclepiadaceae
105.	<i>Nerium indicum</i> *	Karen	Leguminosae
106.	<i>Ocimum americanum</i>	Jungli tulsi	Lamiaceae
107.	<i>Ocimum sanctum</i> *	Tulsi	Lamiaceae
108.	<i>Opuntia elatior</i> *	Hanthalo Thor	Cactaceae
109.	<i>Tamarix stricta</i>	Chini	Tamaricaceae
110.	<i>Thevetia peruviana</i>	Kaner	Apocynaceae
111.	<i>Triumfetta rotundifolia</i>	Zipto	Tiliaceae
112.	<i>Xanthium stromarium</i> *	Gadaria	Asteraceae
113.	<i>Xeromphis spinosa</i>	Mindhol	Rubiaceae
114.	<i>Zizyphus nummularia</i> *	Chanibor	Rhamanaceae
Herb			
115.	<i>Achyranthes aspera</i> *	Aghedo	Amaranthaceae
116.	<i>Agave americana</i> *	Ketki	Agaveceae
117.	<i>Aloe barbadensis</i> *	Kunwar	Liliaceae
118.	<i>Argemone mexicana</i> *	Darudi	Papveraceae
119.	<i>Cassia tora</i> *	Tarota	Caesalpiniaceae
120.	<i>Celosia argentea</i> *	Lamdi	Amarantaceae
121.	<i>Cleome viscosa</i>	Pili Talvani	Cleomaceae
122.	<i>Datura metel</i> *	Dhaturo	Solanaceae
123.	<i>Flacourtia occidentalis</i>	Lodri	Flacourtiaceae
124.	<i>Haloxylon recurvum</i>	Kharilani	Chenopodiaceae
125.	<i>Helicteres isora</i>	Atedi or marda sing	Sterculiaceae
126.	<i>Indigofera tinctoria</i> *	Gali	Fabaceae
127.	<i>Martynia annua</i>	Vichhhudo	Martyniaceae
128.	<i>Maytenus emarginata</i>	Vikro	Celastraceae
129.	<i>Pedaliium murex</i>	Ghokharu	Pedaliaceae
130.	<i>Premna obtusifolia</i>	Kanther	Verbenaceae
131.	<i>Pupalia lappacea</i>	Dhola zipto	Amarantaceae
132.	<i>Solanum nigrum</i> *	Piludi	Solanaceae
133.	<i>Solanum suratense</i> *	Bhoiringani	Solanaceae

Sr. No.	Botanical Name	Local Name	Family
134.	<i>Suaeda fruticosa</i>	Luno	Chenopodiaceae
135.	<i>Suaeda nudiflora</i>	Luni	Chenopodiaceae
136.	<i>Typha angustata</i>	Gabajaria	Typhaceae
137.	<i>Urgenia indica</i>	Jangli kand	Liliaceae
Bamboo and Grasses			
138.	<i>Apluda mutica</i>	Bhangr	Poaceae
139.	<i>Aristida adscensionis</i>	Lapdu	Poaceae
140.	<i>Bambusa bamboos *</i>	Katis (Vans)	Poaceae
141.	<i>Bothriochloa inschaemum</i>	Zinzavo	Poaceae
142.	<i>Bothriochloa glabra</i>	Dhrafo	Poaceae
143.	<i>Chloris dolichostachya</i>	Sikaria	Poaceae
144.	<i>Cymbopogon jwarancusa</i>	Gandharia	Poaceae
145.	<i>Cymbopogon martini *</i>	Rosha	Poaceae
146.	<i>Cynodon dactylon *</i>	Dhrub	Poaceae
147.	<i>Dendrocalamus strictus *</i>	Mavel (Vans)	Poaceae
148.	<i>Desmostachya bipinnata</i>	Darabh	Poaceae
149.	<i>Dichanthium annulatum</i>	Jhinvo	Poaceae
150.	<i>Dinebra retroflexa</i>	Khariu	Poaceae
151.	<i>Eragrostis uncioides</i>	Chaklu	Poaceae
152.	<i>Heteropogon contortus</i>	Dabh saliu	Poaceae
153.	<i>Ischaemum rugosum</i>	Dholiu	Poaceae
154.	<i>Iseilema prostratum</i>	Moshti	Poaceae
155.	<i>Oplismenus burmanii</i>	Gandhelu	Poaceae
156.	<i>Sehima sulcatum</i>	Shanar	Poaceae
157.	<i>Seteria glauca</i>	Ziptis ghas	Poaceae
158.	<i>Sorghum halepense</i>	Baru	Poaceae
159.	<i>Sporolobus coromandelianus</i>	Khario	Poaceae
160.	<i>Themeda quadrivalve</i>	Ratad	Poaceae

Sr. No.	Botanical Name	Local Name	Family
Climbers			
161.	<i>Abrus precatorius</i>	Chanothi	Fabaceae
162.	<i>Acacia pinnata</i>	Khirvel	Mimoseae
163.	<i>Asparagus racemosus</i>	Satawari	Liliaceae
164.	<i>Bougainvillea spectabilis</i> *	Boganvel	Nyctaginaceae
165.	<i>Capparis sepiaria</i>	Kanther	Capparidaceae
166.	<i>Celastrus paniculata</i>	Malkankani	Celastraceae
167.	<i>Cissus quadrangularis</i>	Hadsankal	Vitaceae
168.	<i>Cocculas villosus</i>	Vevadi	Menispermaceae
169.	<i>Combretum ovalifolium</i>	Malvel	Combretaceae
170.	<i>Convolvulus microphyllus</i>	Sankhawali	Convolvulaceae
171.	<i>Cuscuta reflexa</i> *	Amarvel	Convolvulaceae
172.	<i>Ipomoea biloba</i> *	Rawal patri	Convolvulaceae
173.	<i>Leptadenia reticulata</i>	Khirikhodi	Asclepiadaceae
174.	<i>Pueraria tuberosa</i>	Vidari	Fabaceae
175.	<i>Rivea hypocrateriformis</i>	Fagvel	Convolvulaceae
176.	<i>Tinospora cordifolia</i>	Galo	Menispermaceae

Source: State Forest Department, Jamnagar

*These species were observed during the Survey by NEERI Team

Table 3.5.4
Medicinal Plants in Gujarat and Rajasthan with their Medicinal Value

Sr. No.	Scientific Name	Common Name	Family	Medicinal Value
Trees				
1.	<i>Acacia catechu</i>	Khair	<i>Fabaceae</i>	Bark is used in Asthma and bronchites
2.	<i>Alstonia scholaris</i>	Saptaparni	<i>Apocynaceae</i>	Roots are used in biliousness
3.	<i>Atlantia racemosa</i>	Makadi	<i>Rutaceae</i>	Antispasmodic (fruit), dysentery (leaf)
4.	<i>Bombax malabaricum</i>	Kate sawar	<i>Bombacaceae</i>	Aphrodisiac (root bark), debility (gum)
5.	<i>Bridelia retusa</i>	Khaja	<i>Euphorbiaceae</i>	Astringent, debility rheum
6.	<i>Butea monosperma</i>	Palas	<i>Fabaceae</i>	Blood pressure (root bark), diarrhoea, dog bite (flower)
7.	<i>Careya arborea</i>	Kumbha	<i>Myrtaceae</i>	Cold, cough (calyx), stomach ache (bark, fruit)
8.	<i>Caryota urens</i>	Bherali mad	<i>Palmae</i>	Laxative (wood sap)
9.	<i>Cassia fistula</i>	Bahava	<i>Fabaceae</i>	Burns, eczema (leaf), purgative (root), ringworm (leaf)
10.	<i>Cordia dichotoma</i>	Bhokar	<i>Boraginaceae</i>	Astringent (bark), cough
11.	<i>Dillenia pentagyna</i>	Karmal	<i>Dilleniaceae</i>	Cold (leaf, root)
12.	<i>Emblica officinalis</i>	Awala	<i>Euphorbiaceae</i>	Wound maggots (leaf)
13.	<i>Erythrina stricta</i>	Pangara	<i>Fabaceae</i>	Snakebite (bark), vermicidal leaf
14.	<i>Ficus racemosa</i>	Umbar	<i>Urticaceae</i>	Dermatitis (bark) urinary disease (bark),
15.	<i>Garcinia indica</i>	Kokam	<i>Guttiferae</i>	Skin diseases (bark)
16.	<i>Gmelina arborea</i>	Shivan	<i>Verbenaceae</i>	Cholera (bark), rat bite, syphilis, spleen trouble
17.	<i>Macaranga peltata</i>	Chandava	<i>Euphorbiaceae</i>	Bleeding wounds

Sr. No.	Scientific Name	Common Name	Family	Medicinal Value
18.	<i>Mallotus philippinensis</i>	Shendari	<i>Euphorbiaceae</i>	Vermifuge (fruit)
19.	<i>Mangifera indica</i>	Am	<i>Anacardiaceae</i>	Dysentery (bark)
20.	<i>Memeceylon umbellatum</i>	Anjani	<i>Melastomataceae</i>	Swell (bark)
21.	<i>Pongamia pinnata</i>	Karanj	<i>Fabaceae</i>	Diarrhea (leaf), ear
22.	<i>Syzygium cumini</i>	Jambhul	<i>Myrtaceae</i>	Diabetes (seed, fruit) Fish poison (bark)
23.	<i>Terminalia bellerica</i>	Beheda	<i>Combretaceae</i>	Asthma (fruits) cholera, cough, measles
24.	<i>Terminalia chebula</i>	Hirda	<i>Combretaceae</i>	Bronchitis, constipation (fruit bark), purgative (fruit)
25.	<i>Thespesia populnea</i>	Ranbhendi	<i>Malvaceae</i>	Arthritis, eczema (leaf)
Shrubs				
26.	<i>Abutilon indicum</i>	-	<i>Malvaceae</i>	Cough (seed), demulcent (leaf), laxative
27.	<i>Adhatoda vasica</i>	AduArushalasa	<i>Acanthaceae</i>	Rheumatisium
28.	<i>Barleria prionitis</i>	Kholeta	<i>Acanthaceae</i>	Leucoderma, toothache (leaf)
29.	<i>Calotropis gigantea</i>	Rui	<i>Asclepiadaceae</i>	Diarrhea, dysentery, skin disease
30.	<i>Carrisa carandus</i>	Karwanda	<i>Apocynaceae</i>	Skin disease (root)
31.	<i>Cassia auriculata</i>	Tarwad	<i>Fabaceae</i>	Antifertility (root), labour pain
32.	<i>Euphorbia nerifolia</i>	Niwdung	<i>Euphorbiaceae</i>	Asthma, earache (leaf)
33.	<i>Gnidia glauca</i>	-	<i>Thymelaeaceae</i>	Bruises, swell (leaf)
34.	<i>Helicteres isora</i>	Murudsheng	<i>Sterculiaceae</i>	Cholera, demulcent (fruit), colic,
35.	<i>Holarrhena pubescens</i>	Kuda	<i>Apocyanaceae</i>	Amoebic dysentery (bark), antitetanic
36.	<i>Homonoia riparia</i>	Sherani	<i>Euphorbiaceae</i>	Gravel (root)
37.	<i>Indigofera cassioides</i>	Chimnati	<i>Fabaceae</i>	Piles (leaf)

Sr. No.	Scientific Name	Common Name	Family	Medicinal Value
38.	<i>Lepidagathis cuspidate</i>	Kate-adulasa	<i>Acanthaceae</i>	Measles (whole plant)
39.	<i>Murraya koenigii</i>	Kadhi-patta	<i>Rutaceae</i>	Stomach ache (bark root), tonic (leaf)
40.	<i>Vitex nigundo</i>	Nirgudi	<i>Verbenaceae</i>	Rheumatism, head ache, liver disease
41.	<i>Woodfordia fruticosa</i>	Dhayati	<i>Lythraceae</i>	Bleeding, menorrhagia, sprains (flower)
Herbs				
42.	<i>Alternanthera sessilis</i>	-	<i>Amaranthaceae</i>	Eye complaints (leaf)
43.	<i>Argemone maxicana</i>	Dhatura	<i>Papaveraceae</i>	Eczema (seed oil), jaundice (seed, root) scabies (leaf, root)
44.	<i>Asclepias curassavica</i>	Halad-kunku	<i>Asclepiadaceae</i>	Hemorrhage (leaf), piles (root)
45.	<i>Eranthemum roseum</i>	Dashmuli	<i>Acanthaceae</i>	Leucorrhoea (root)
46.	<i>Lagascea mollis</i>	-	<i>Asteraceae</i>	Ear complaints (leaf)
47.	<i>Launaea procumbens</i>	Pathari	<i>Asteraceae</i>	Piles (leaf),
48.	<i>Polygonum glabra</i>	Sheral	<i>Polygonaceae</i>	Dislocated bone
49.	<i>Sopubia delphinifolia</i>	-	<i>Scrophulariaceae</i>	Heals sores (whole plant)
50.	<i>Sphaeranthus indicus</i>	Gorakhmundi	<i>Asteraceae</i>	Digestive disorders (whole plant)
51.	<i>Tridax procumbens</i>	Ek dandi	<i>Asteraceae</i>	Bruises, cough, cuts, injuries (leaf)

Source: State Forest Department, Jamnagar, Surendranagar and State forest department, Barmer