Criteria & Indicators for Site Selection

Case Study sites

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Select 6 case study sites for a micro-economic assessment in arid, semi-arid and dry sub-humid regions of the country, identify the data requirements and sources of information

The Drylands of India

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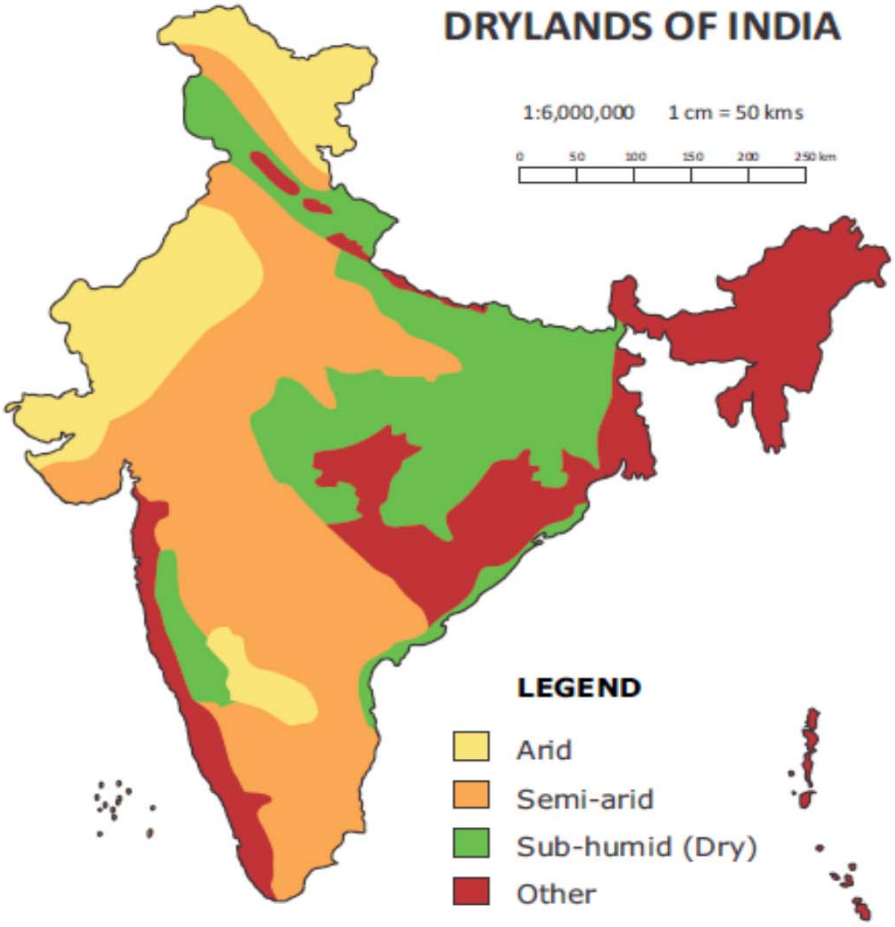
Desertification Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UNCCD)



Source: Agro-Ecological Subregions of India, NBSS&LLP (ICAR), Nagpur

Arid: 34.89mha
Semi-arid: 31.99mha
Sub-humid: 14.57 mha
Other
Area under Drylands:81.45mha

First tier of selection

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3 sites from the arid, 2 from the semi-arid and 1 site from the dry sub-humid regions of India

Second Tier of Selection

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- Selection of states that include
  - **Those most impacted by desertification**
  - **That include the major processes of land degradation (water, wind, salinity/alkalinity, vegetal)**
  - **Include anthropogenic and natural causes of desertification**
  - **Geographical representation of the country**

DLDD Status of India (SAC, 2007)

Processes of Desertification / land degradation	Area covered	
	Area (mha)	% of Total Geog. Area
Water Erosion	33.56	10.21
Vegetal Degradation	31.66	9.63
Wind/Eolian Degradation	17.56	5.34
Frost Shattering	10.21	3.10
Salinity/Alkalinity	5.26	1.60
Mass Movement	4.45	1.35
Water logging	0.98	0.30
Rocky areas/ Barren	1.65	0.50
Others (Man made, frost heaving etc.)	0.15	0.04
	105.48	32.07

NE- Highest vegetal degradation (but outside arid, semi-arid and dry sub-humid)

Gujarat: 68.43% (Salinisation & : Water erosion

Rajasthan: 67% (**Wind Erosion**)

J and K (cold): 60.7%

LD in drylands is 81.45 mha (24.78% of GA)

Land Degradation Status of India

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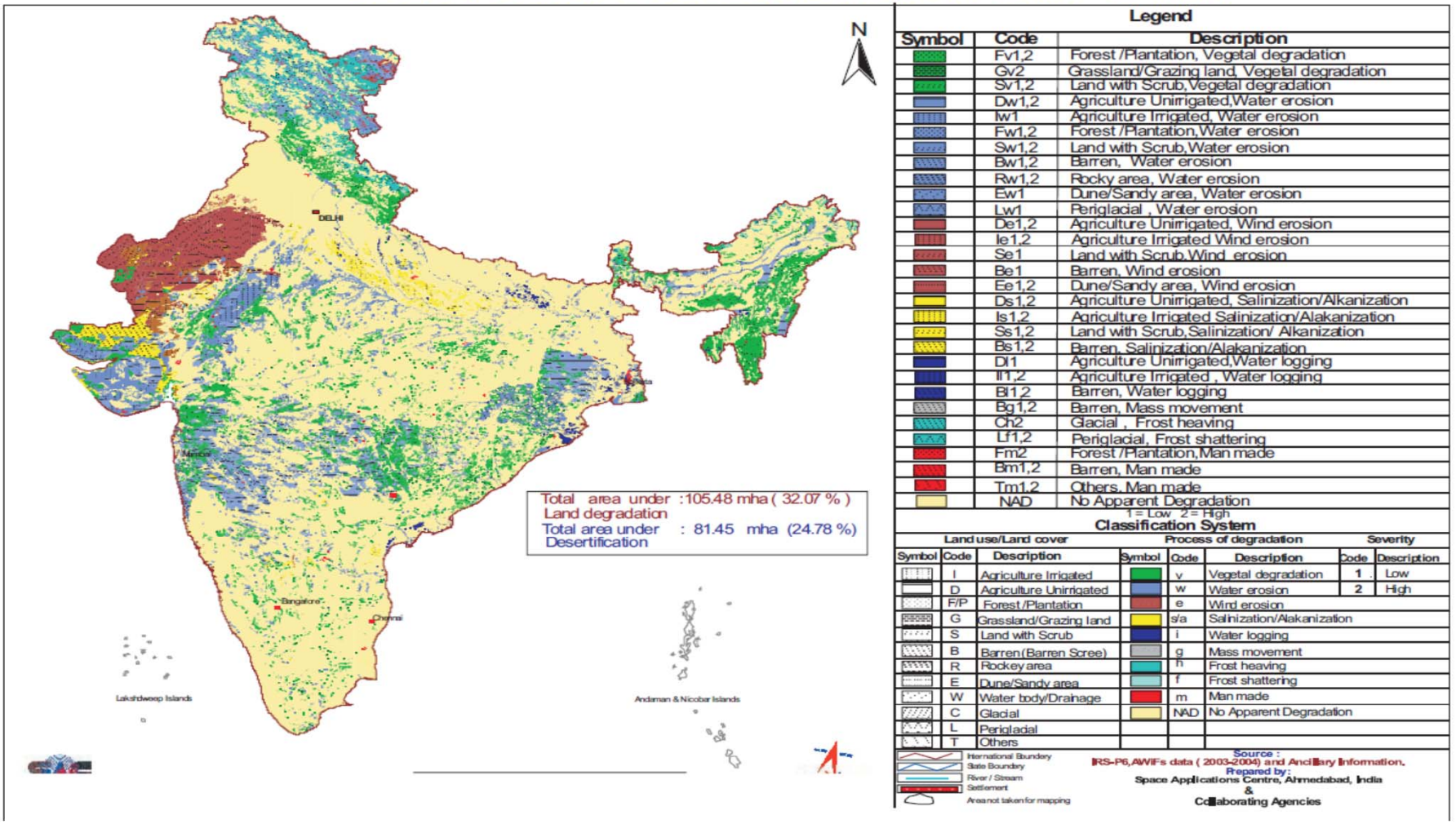
DESERTIFICATION/ LAND DEGRADATION STATUS MAP OF INDIA



Legend

Symbol	Code	Description
	Fv1,2	Forest /Plantation, Vegetal degradation
	Gv2	Grassland/Grazing land, Vegetal degradation
	Sv1,2	Land with Scrub,Vegetal degradation
	Dw1,2	Agriculture Unirrigated,Water erosion
	Iw1	Agriculture Irrigated, Water erosion
	Fw1,2	Forest /Plantation,Water erosion
	Sw1,2	Land with Scrub,Water erosion
	Bw1,2	Barren, Water erosion
	Rw1,2	Rocky area, Water erosion
	Ew1	Dune/Sandy area, Water erosion
	Lw1	Periglacial , Water erosion
	De1,2	Agriculture Unirrigated, Wind erosion
	Ie1,2	Agriculture Irrigated Wind erosion
	Se1	Land with Scrub,Wind erosion
	Be1	Barren, Wind erosion
	Ee1,2	Dune/Sandy area, Wind erosion
	Ds1,2	Agriculture Unirrigated, Salinization/Alkanization
	Is1,2	Agriculture Irrigated Salinization/Alakanization
	Ss1,2	Land with Scrub,Salinization/ Alkanization
	Bs1,2	Barren, Salinization/Alakanization
	DI1	Agriculture Unirrigated,Water logging
	II1,2	Agriculture Irrigated , Water logging
	BI1,2	Barren, Water logging
	Bg1,2	Barren, Mass movement
	Ch2	Glacial , Frost heaving
	Lf1,2	Periglacial, Frost shattering
	Fm2	Forest /Plantation,Man made
	Bm1,2	Barren, Man made
	Tm1,2	Others, Man made
	NAD	No Apparent Degradation

1 = Low 2 = High

Classification System

Land use/Land cover			Process of degradation			Severity	
Symbol	Code	Description	Symbol	Code	Description	Code	Description
	I	Agriculture Irrigated		v	Vegetal degradation	1	Low
	D	Agriculture Unirrigated		w	Water erosion	2	High
	F/P	Forest /Plantation		e	Wind erosion		
	G	Grassland/Grazing land		s/a	Salinization/Alakanization		
	S	Land with Scrub		i	Water logging		
	B	Barren(Barren Scree)		g	Mass movement		
	R	Rockey area		h	Frost heaving		
	E	Dune/Sandy area		f	Frost shattering		
	W	Water body/Drainage		m	Man made		
	C	Glacial		NAD	No Apparent Degradation		
	L	Periglacial					
	T	Others					

International Boundary
State Boundary
River / Stream
Settlement
Area not taken for mapping

Source : IRS-P6,AWIFs data (2003-2004) and Ancillary Information.
Prepared by:
Space Applications Centre, Ahmedabad, India
&
Collaborating Agencies

Some state-wise area statistics of wastelands/degraded lands (Harmonised Data)

State	Area (mha)	% of TGA	Dryland category
Rajasthan	20.46	6.23	Arid
Madhya Pradesh	14	4.26	Semi-arid & sub-humid
Uttar Pradesh	14.58	4.43	Semi-arid & sub-humid
Maharashtra	10.05	3.06	Largely sub-humid
Andhra Pradesh	9.57	2.91	Largely semi-arid
Karnataka	8.5	2.59	Largely semi-arid
Chattisgarh	4.71	1.43	Others and sub-humid
Uttarakhand	1.25	0.38	Largely sub-humid
Tamil Nadu	3.21	0.98	Semi-arid
Gujarat	3.07	0.93	Arid & semi-arid
Total	**120.72**	**36.72**	

State wise ranking based on LD criteria

Ranking based on water erosion

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State	TGA (km^2)	Degraded and wastelands classes* ('000 ha)			Area (%)
		1	2	(1+2)	
Uttar Pradesh	238,566	12,370	514	12,884	54
Madhya Pradesh	308,641	11,881	1,584	13,465	44
Karnataka	191,791	7,450	349	7,799	41
Jharkhand	79,714	2,825	356	3,181	40
Andhra Pradesh	275,045	8,050	814	8,864	32
Meghalaya	22,429	127	579	706	31
Asom	78,438	1,929	437	2,366	30
Maharashtra	307,713	8,400	422	8,822	29
Rajasthan	342,239	7,436	1,196	8,632	25
Orissa	155,707	2,176	1,152	3,328	21
Delhi	1,483	28	0	28	19
Uttarakhand	55,845	829	180	1,009	18
Chhattisgarh	134,805	2,347	75	2,422	18
Himachal Pradesh	55,673	941	43	984	18
Tamil Nadu	130,058	2,063	71	2,134	16
West Bengal	88,752	1,167	97	1,264	14
Bihar	94,163	820	229	1,049	11
Jammu and Kashmir	222,236	1,327	674	2,001	9
Tripura	10,486	26	48	74	7
Manipur	22,327	36	114	150	7
Haryana	44,212	303	0	303	7
Punjab	50,362	228	74	302	6
Gujarat	196,024	979	32	1,011	5
Arunachal Pradesh	83,743	165	215	380	5
Kerala	38,863	112	5	117	3
Nagaland	16,579	1	30	31	2
Sikkim	7,096	2	0	2	0
Goa	3,702	1	0	1	0
Mizoram	21,081	0	0	0	0
Andaman and Nicobar Islands	8,249	0	0	0	0
Others**	1,248			0	0
Total	3,287,263	74,020	9,290	83,310	

Notes: Classes*: **1** Exclusively water erosion (>10 tonnes/ha/yr); **2** Water erosion under open forest
Others**: Chandigarh, Dadar and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry
Source: NBSS&LUP

UP-highest percent of GA-54%

Ranking based on acid soils

Creating Innovative Solutions for a Sustainable Future

State	TGA (km^2)	Degraded and wastelands classes* ('000 ha)				Area (%)
		3	4	5	(3+4+5)	
Nagaland	16,579	17	45	1454	1,516	91
Manipur	22,327	115	86	1396	1,597	72
Tripura	10,486	101	83	525	709	67
Kerala	38,863	1,961	378	87	2,426	62
Mizoram	21,081	150	0	1013	1,163	55
Meghalaya	22,429	52	175	796	1,023	46
Goa	3,702	103	0	0	103	28
Asom	78,438	411	1,319	265	1,995	25
Arunachal Pradesh	83,743	300	501	968	1,769	21
Chhattisgarh	134,805	812	1,383	147	2,342	17
Jharkhand	79,714	226	394	115	735	9
Sikkim	7,096	2	43	13	58	8
Uttarakhand	55,845	13	189	198	401	7
West Bengal	88,752	240	165	13	418	5
Tamil Nadu	130,058	161	216	50	427	3
Madhya Pradesh	308,641	121	332	29	482	2
Orissa	155,707	107	51	45	203	1
Himachal Pradesh	55,673	34	41	1	76	1
Maharashtra	307,713	41	228	0	269	1
Karnataka	191,791	69	24	0	93	1
Bihar	94,163	19	22	0	41	0
Jammu and Kashmir	222,236	21	42	15	78	0
Haryana	44,212	2	0	0	2	0
Andhra Pradesh	275,045	1	0	0	1	0
Punjab	50,362	0	0	0	0	0
Andaman and Nicobar Islands	8,249	0	0	0	0	0
Delhi	1,483	0	0	0	0	0
Gujarat	196,024	0	0	0	0	0
Rajasthan	342,239	0	0	0	0	0
Uttar Pradesh	238,566	0	0	0	0	0
Others**	1,241					
Total	3,287,263	5,080	5,720	7,130	17,930	

Notes: Classes*: **3** Exclusively acid soils ($pH < 5.5$); **4** Acid soils under water erosion; **5** Acid soils under open forest
Others**: Chandigarh, Dadar and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry
Source: NBSS&LUP

Chhattisgarh: An option (17%)

Ranking based on saline soils

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State	TGA (km²)	Degraded and wastelands classes* ('000 ha)							Area (%)
		7	8	9	10	11	12	(7+8+9+ 10+11+12)	
Andaman and Nicobar Islands	8,249	71	0	0	0	0	0	71	9
Gujarat	196,024	1495	4	0	0	60	0	1,559	8
West Bengal	88,752	408	0	0	0	0	0	408	5
Rajasthan	342,239	74	8	0	110	0	0	192	1
Maharashtra	307,713	164	7	0	0	0	0	171	1
Orissa	155,707	131	0	0	0	0	6	137	1
Kerala	38,863	1	0	20	0	0	0	21	1
Haryana	44,212	44	2	0	0	0	0	46	1
Andhra Pradesh	275,045	56	4	0	0	0	17	77	0
Bihar	94,163	39	1	0	0	0	5	45	0
Uttar Pradesh	238,566	9	13	0	0	0	0	22	0
Tamil Nadu	130,058	10	1	0	0	0	2	13	0
Karnataka	191,791	2	0	0	0	0	0	1	0
Arunachal Pradesh	83,743	0	0	0	0	0	0	0	0
Asom	78,438	0	0	0	0	0	0	0	0
Chhattisgarh	134,805	0	0	0	0	0	0	0	0
Delhi	1,483	0	0	0	0	0	0	0	0
Goa	3,702	0	0	0	0	0	0	0	0
Himachal Pradesh	55,673	0	0	0	0	0	0	0	0
Jammu and Kashmir	222,236	0	0	0	0	0	0	0	0
Jharkhand	79,714	0	0	0	0	0	0	0	0
Madhya Pradesh	308,641	0	0	0	0	0	0	0	0
Manipur	22,327	0	0	0	0	0	0	0	0
Meghalaya	22,429	0	0	0	0	0	0	0	0
Mizoram	21,081	0	0	0	0	0	0	0	0
Nagaland	16,579	0	0	0	0	0	0	0	0
Punjab	50,362	0	0	0	0	0	0	0	0
Sikkim	7,096	0	0	0	0	0	0	0	0
Tripura	10,486	0	0	0	0	0	0	0	0
Uttarakhand	55,845	0	0	0	0	0	0	0	0
Others**	1,241	124	0	0	0	0	0	124	4
Total	3,287,263	2,635	48	29	120	71	42	2,887	

Notes: Classes*: **7** Exclusively saline soils; **8** Eroded saline soils; **9** Acid saline soils; **10** Saline soils under wind erosion; **11** Saline soils under open forest; **12** Waterlogged saline soils
Others**: Chandigarh, Dadar and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry
Source: NBSS&LUP

Gujarat: An option (8%)

Ranking based on sodic soils

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State	TGA (km^2)	Degraded and wastelands classes* ('000 ha)						Area (%)
		13	14	15	16	17	(13+14+ 15+16+ 17)	
Uttar Pradesh	238,566	626	692	0	2	0	1,320	6
Haryana	44,212	183	1	0	0	0	184	4
Punjab	50,362	151	1	0	0	0	152	3
Gujarat	196,024	545	0	0	0	0	545	3
Tamil Nadu	130,058	305	28	0	17	2	352	3
Maharashtra	307,713	256	164	0	0	1	421	1
Andhra Pradesh	275,045	154	39	0	0	1	194	1
Rajasthan	342,239	108	26	30	1	16	181	1
Karnataka	191,791	97	48	0	0	0	145	1
Bihar	94,163	98	8	0	0	0	106	1
Madhya Pradesh	308,641	74	49	0	1	0	124	0
Chhattisgarh	134,805	10	3	0	0	0	13	0
Andaman and Nicobar Islands	8,249	0	0	0	0	0	0	0
Arunachal Pradesh	83,743	0	0	0	0	0	0	0
Asom	78,438	0	0	0	0	0	0	0
Delhi	1,483	0	0	0	0	0	0	0
Goa	3,702	0	0	0	0	0	0	0
Himachal Pradesh	55,673	0	0	0	0	0	0	0
Jammu and Kashmir	222,236	0	0	0	0	0	0	0
Jharkhand	79,714	0	0	0	0	0	0	0
Kerala	38,863	0	0	0	0	0	0	0
Manipur	22,327	0	0	0	0	0	0	0
Meghalaya	22,429	0	0	0	0	0	0	0
Mizoram	21,081	0	0	0	0	0	0	0
Nagaland	16,579	0	0	0	0	0	0	0
Orissa	155,707	0	0	0	0	0	0	0
Sikkim	7,096	0	0	0	0	0	0	0
Tripura	10,486	0	0	0	0	0	0	0
Uttarakhand	55,845	0	0	0	0	0	0	0
West Bengal	88,752	0	0	0	0	0	0	0
Others**	1,241						0	0
Total	3,287,263	2,620	1,073	45	37	20	3,737	

Notes: Classes*: **13** Exclusively sodic soils; **14** Eroded sodic soils; **15** Sodic soils under wind erosion; **16** Sodic soils under open forest; **17** Eroded sodic soils under open forest
Others**: Chandigarh, Dadar and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry

Source: NBSS&LUP

Uttar Pradesh-6%/Tamil Nadu-3%

Sodic soils are characterized by a disproportionately high concentration of sodium (Na) in their cation exchange complex. They are usually defined as containing an exchangeable sodium percentage greater than 15%.


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Third Tier of Selection (Sub-state)

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- Within these states and for each causal process, we will select the districts with the highest levels of land degradation
- Within the identified districts, we will randomly select a small watershed
- Therefore, the scale for the 6 case studies will be small watersheds
- We will use remote sensing data to assess 1) extent and types of degradation and changes over 20 years
- 2) Quantify the economic impacts of degradation
- 3) Explore options for restoration/prevention
- Based on the nature, magnitude of the degradation and its economic impacts we will suggest technical options and costs for a restoration/preventative plan for each selected site.
- Based on the cost-benefit ratio, preventative/restorative plans will be suggested.

Thank you!