

Supplementary Materials

Table S1. LandTrendr parameters used for temporal segmentation implementation.

Parameter	Input value
maxSegments	8
spikeThreshold	0.9
vertexCountOvershoot	3
preventOneYearRecovery	False
recoveryThreshold	1
pvalThreshold	0.1
bestModelProportion	0.75
minObservationsNeeded	6

Table S2. Predictor variables derived from each temporal segment for the Random Forest (RF) models.

Temporal segment	Predictor variable	Spectral index	Description
Focal	Start value	NBR, TCB, TCG, TCW, TCA, NDVI, EVI, NDMI	Fitted spectral index value for the first year of the segment.
	End values	NBR	Fitted spectral index value for the last year of the segment.
	Spectral magnitude	NBR, TCB, TCG, TCW, TCA, NDVI, EVI, NDMI	Difference of the fitted spectral index values between the first and last years of the segment.
	Duration	-	Years of the temporal segment.
	DNSR	NBR	Spectral magnitude divided by root mean square error of fitted and actual values.
	Change rate	NBR, TCB, TCG, TCW, TCA, NDVI, EVI, NDMI	Spectral magnitude divided by duration.
	Relative change	NBR, TCB, TCG, TCW, TCA, NDVI, EVI, NDMI	Spectral magnitude divided by start value.
Pre-/post-	Start value	NBR	Fitted spectral index value for the first year of the pre-/post- segments.
	Spectral magnitude	NBR	Fitted spectral index value for the last year of the pre-/post- segments.
	Duration	-	Years of the pre-/post- temporal segments.
	DNSR	NBR	Spectral magnitude divided by root mean square error of fitted and actual values for the pre-/post- segments.
	Change rate	NBR	Spectral magnitude divided by duration for the pre-/post- segments.

Table S3. Accuracy assessment for Land use/Land cover (LULC) change/forest disturbance classes. Producer's accuracy (PA) and User's accuracy (UA) for each class and overall accuracy (OA) are shown with the 95% confidence intervals.

Class	PA (%)	UA (%)	OA (%)
Cropland	48.9 (±7.4)	70.7 (±11.2)	45.2 (±4.1)
Barren	0.1 (±0.1)	25.9 (±13.2)	
Forest	94.6 (±3.1)	44.5 (±5.7)	
Grass/Shrub	4.5 (±2.8)	17.8 (±11.7)	
Settlement	38.9 (±19.8)	38.4 (±14.5)	
Water	61.3 (±19.4)	79.5 (±12.0)	
Others to Forest	19.0 (±10.3)	20.5 (±11.5)	
Others to Others (excluding forest)	18.5 (±9.1)	24.5 (±11.7)	
Disturbance with forest to forest	20.7 (±6.2)	48.1 (±14.3)	
Disturbance with forest to others	1.6 (±1.5)	9.0 (±11.8)	
Disturbance with others to forest	0.3 (±0.2)	50.7 (±20.1)	

Table S4. Population error matrix for LULC change/forest disturbance classes with area estimates and 95% confidence intervals (CI).

Classification	Reference											Area (ha)	(95% CI)
	Cropland	Barren	Forest	Grass/ Shrub	Settlement	Water	Others to Forest	Others to Others	Disturbance with forest to forest	Disturbance with forest to others	Disturbance with others to Forest		
Cropland	0.0976	0.0000	0.0000	0.0066	0.0071	0.0000	0.0066	0.0179	0.0000	0.0000	0.0022	2,430,326	337,209
Barren	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	23,740	20,576
Forest	0.0377	0.0000	0.2696	0.0596	0.0000	0.0022	0.0537	0.0144	0.1195	0.0086	0.0409	3,470,931	436,915
Grass/Shrub	0.0063	0.0000	0.0009	0.0041	0.0014	0.0000	0.0036	0.0035	0.0022	0.0005	0.0005	1,099,638	298,212
Settlement	0.0009	0.0013	0.0000	0.0004	0.0078	0.0004	0.0009	0.0082	0.0000	0.0004	0.0000	243,779	111,058
Water	0.0003	0.0007	0.0000	0.0000	0.0000	0.0115	0.0007	0.0003	0.0000	0.0000	0.0010	228,061	71,849
Others to Forest	0.0420	0.0000	0.0058	0.0086	0.0016	0.0000	0.0167	0.0048	0.0016	0.0000	0.0001	1,068,039	294,956
Others to Others (excluding forest)	0.0146	0.0000	0.0000	0.0095	0.0022	0.0046	0.0009	0.0112	0.0016	0.0000	0.0012	737,614	220,264
Disturbance with forest to forest	0.0000	0.0000	0.0086	0.0014	0.0000	0.0000	0.0029	0.0000	0.0327	0.0058	0.0165	1,922,442	363,577
Disturbance with forest to others	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0019	0.0001	0.0001	0.0002	0.0004	189,326	122,376
Disturbance with others to Forest	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	0.0002	767,387	245,826

Table S5. Population error matrix for LULC 1988 classification with area estimates and 95% CI.

Classification	Reference						Area (ha)	(95%CI)
	Cropland	Barren	Forest	Grass/Shrub	Settlement	Water		
Cropland	0.1641	0.0056	0.0050	0.0273	0.0088	0.0060	3,382,192	376,141
Barren	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	146,463	100,371
Forest	0.0760	0.0022	0.4702	0.1239	0.0000	0.0022	5,940,172	430,606
Grass/Shrub	0.0277	0.0000	0.0111	0.0213	0.0030	0.0009	2,201,380	396,742
Settlement	0.0086	0.0026	0.0000	0.0063	0.0082	0.0004	243,779	111,058
Water	0.0012	0.0016	0.0013	0.0018	0.0000	0.0125	267,298	88,407

Table S6. Population error matrix for LULC 2019 classification with area estimates and 95% CI.

Classification	Reference						Area (ha)	(95%CI)
	Cropland	Barren	Forest	Grass/Shrub	Settlement	Water		
Cropland	0.1053	0.0022	0.0066	0.0156	0.0208	0.0012	2,608,872	349,171
Barren	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	101,763	78,981
Forest	0.0908	0.0023	0.5278	0.1218	0.0076	0.0080	6,650,738	435,929
Grass/Shrub	0.0159	0.0000	0.0071	0.0139	0.0027	0.0000	1,847,761	372,250
Settlement	0.0018	0.0022	0.0013	0.0004	0.0205	0.0013	634,562	183,068
Water	0.0003	0.0016	0.0016	0.0000	0.0000	0.0168	337,587	107,086

Table S7. Population error matrix for disturbance detection 1988-2019 for the entire study area with area estimates and 95% CI.

Classification	Reference		Area (ha)	(95% CI)
	Disturbance	No-disturbance		
Disturbance	0.0560	0.0151	2,879,155	398,270
No-disturbance	0.1804	0.7486	9,302,128	398,270

Table S8. Accuracy assessment for LULC 2019 classification by Phan et al. (2021) in this study. PA and UA for each class and OA are shown with the 95% confidence intervals.

Class	PA (%)	UA (%)	OA (%)	Original class
Cropland	67.8 (± 7.9)	65.3 (± 8.3)	73.4 (± 3.7)	Cropland, Rice paddies
Barren	1.2 (± 1.2)	0.5 (± 0.4)		Barren land
Forest	94.0 (± 2.8)	81.7 (± 4.1)		Forest
Grass/Shrub	29.3 (± 9.7)	48.4 (± 13.7)		Grassland, Scrub land
Settlement	27.5 (± 11.4)	77.1 (± 15.3)		Residence
Water	60.6 (± 17.7)	89.9 (± 10.9)		Wetland, Open water, Aquaculture

Table S9. Area estimates for LULC 1988 and 2019 and area changes 1988–2019.

Class	1988	2019	1988–2019	
	Area (ha)	Area (ha)	Change (ha)	Change (%)
Cropland	3,382,192	2,608,872	-773,320	-22.9
Barren	146,463	101,763	-44,699	-30.5
Forest	5,940,172	6,650,738	+710,566	+12.0
Grass/Shrub	2,201,380	1,847,761	-353,618	-16.1
Settlement	243,779	634,562	+390,783	+160.3
Water	267,298	337,587	+70,289	+26.3