

Table S1. Summary of spectral, index-based, and topographic predictor variables used for Random Forest classification

Category	Predictor Variable	Description / Formula	Data Source	Spatial Resolution	Purpose in Classification
Spectral Bands	Blue (B2)	Visible blue reflectance	Landsat 7/8/9 Surface Reflectance	30 m	Base spectral input for vegetation, water, and urban discrimination
	Green (B3)	Visible green reflectance	Landsat 7/8/9	30 m	Used in MNDWI and vegetation indices
	Red (B4)	Visible red reflectance	Landsat 7/8/9	30 m	Used in NDVI, SAVI, EVI, and MSAVI
	NIR (B5)	Near-infrared reflectance	Landsat 7/8/9	30 m	Sensitive to vegetation density
	SWIR1 (B6)	Short-wave infrared 1 reflectance	Landsat 7/8/9	30 m	Distinguishes built-up and bare surfaces
	SWIR2 (B7)	Short-wave infrared 2 reflectance	Landsat 7/8/9	30 m	Used in NDBAL, moisture detection
Vegetation Indices	NDVI	$(\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red})$	Derived	30 m	Vegetation greenness and density
	SAVI	$(\text{NIR} - \text{Red}) / (\text{NIR} + \text{Red} + L) \times (1 + L)$; $L = 0.5$	Derived	30 m	Minimises soil background effect
	EVI	$2.5 \times (\text{NIR} - \text{Red}) / (\text{NIR} + 6 \times \text{Red} - 7.5 \times \text{Blue} + 1)$	Derived	30 m	Enhances sensitivity in high-biomass areas
	MSAVI	$(2 \times \text{NIR} + 1 - \sqrt{((2 \times \text{NIR} + 1)^2 - 8 \times (\text{NIR} - \text{Red})))}) / 2$	Derived	30 m	Reduces soil influence in sparse vegetation
	NDVI-GLCM (Texture)	NDVI contrast using 3×3 GLCM kernel	Derived	30 m	Captures canopy texture and spatial heterogeneity

Category	Predictor Variable	Description / Formula	Data Source	Spatial Resolution	Purpose in Classification
Built-up Indices	NDBI	$(\text{SWIR1} - \text{NIR}) / (\text{SWIR1} + \text{NIR})$	Derived	30 m	Detects built-up and impervious surfaces
	UI (Urban Index)	$\text{NDBI} - \text{NDVI}$	Derived	30 m	Enhances separation of urban vs vegetated pixels
Bare Land Index	NDBAL	$(\text{SWIR2} - \text{SWIR1}) / (\text{SWIR2} + \text{SWIR1})$	Derived	30 m	Differentiates bare soil from vegetation
Water Index	MNDWI	$(\text{Green} - \text{SWIR1}) / (\text{Green} + \text{SWIR1})$	Derived	30 m	Identifies open water features
Topographic Predictors	Elevation	Elevation above mean sea level	SRTM DEM (30 m)	30 m	Controls vegetation and settlement distribution
	Slope	Derived from SRTM DEM	SRTM DEM	30 m	Differentiates steep vs. flat terrain
	Aspect	Derived from SRTM DEM	SRTM DEM	30 m	Influences vegetation and soil moisture