



Canopy Density

User Handbook

Live-NDVI & uploaded-GeoTIFF forest canopy classification, KML boundary clipping, and FSI-aligned density reporting — a complete guide to using and interpreting the tool.

Application	ROOTPIXIN — Canopy Density
Developed by	Dr. Panda
Imagery source	Sentinel-2 L2A (Copernicus Data Space) · user-supplied GeoTIFF
Document type	User handbook & limitations reference
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1 Before You Start

A browser-based tool for classifying forest canopy density from NDVI — fetched live from Sentinel-2 or supplied as your own GeoTIFF — clipped to a KML boundary, with FSI-style density classes, area reporting, and print-ready map exports.

Access

The tool sits behind a sign-in screen. An administrator creates each User ID and password (via **Manage users**), optionally with an expiry date. Contact your administrator for credentials.



What you need per job

Boundary	A KML file containing one or more <code><Polygon></code> boundaries in WGS84 lat/lon. Points and lines are not supported.
Imagery	Nothing else if using Live Sentinel-2 — or your own NDVI GeoTIFF if using Upload GeoTIFF .

2 Quick Start

Three steps take you from a blank map to a classified canopy-density report.

1 NDVI source

Leave on **Live Sentinel-2** (default), or switch to **Upload GeoTIFF**.

2 Boundary

Upload your **KML** boundary — it's drawn on the map and the "Fetch live Sentinel-2 NDVI" button appears.

3 Classify

Click **Fetch live Sentinel-2 NDVI** (or it runs automatically after upload) to get the classified map and class-wise area table.



Insert screenshot — sidebar Steps 1–3 with green checkmarks after a successful run



Insert a 30–60 second screen recording of this exact flow — the fastest way to onboard a new user

3 Step 1 — NDVI Source

Live Sentinel-2 (default, recommended for most users)

NDVI is computed on the server from the Copernicus Sentinel-2 archive, cropped to your boundary's bounding box, at 10 m/pixel. Cloud, cloud-shadow, cirrus, and snow pixels are masked out automatically using the Sentinel-2 Scene Classification layer.

Specific acquisition date	Pick an exact date to match a field visit. The server widens its search window automatically (its own window, then ± 180 days, then ± 365 days) until a usable scene is found.
Search window	How far back from today to search for the least-cloudy scene, if no specific date is set.
Max cloud cover	Scenes above this percentage are excluded from the search.

Upload GeoTIFF

Use this if live fetching fails for your area, or you already have your own NDVI raster (Landsat, PlanetScope, drone imagery, etc.). The file is read entirely in your browser — nothing is uploaded anywhere.

Encoding	When to use it
Float NDVI (-1 to 1)	Standard NDVI output
Byte (0–255 scaled)	Common compressed export format
Integer $\times 10000$	Common in some GIS software exports

SUPPORTED FILES

Strip-based (not tiled), single-band, uncompressed / LZW / PackBits / Deflate-compressed GeoTIFFs, in a geographic CRS (lat/lon). See Section 9 for what is not supported.



Insert screenshot — Step 1 panel in both source modes

4 Step 2 — Boundary & Clipping

Choose KML boundary	Uploads and draws your polygon(s) in red on the map.
Clip to boundary	<i>(default)</i> Only pixels inside your polygon are classified and counted.
Full raster	The entire fetched/uploaded image is classified; a KML is optional and, if present, is drawn only as an outline.

Re-uploading a new KML at any time re-clips against the currently loaded NDVI — no need to refetch imagery.



Insert screenshot — boundary drawn on the map with the clip toggle

5 Step 3 — Density Classes

Choose **3, 4, or 5** classes. Defaults follow an FSI-style convention (open / moderately dense / very dense). For each class you can edit the **color**, **label**, and the **NDVI break** separating it from the class above. Click **Reprocess with these settings** to re-run classification with new thresholds — no need to re-upload anything.



Insert screenshot — the 5-class editor with custom breaks and colors

6 Classifying NDVI to Match FSI Canopy-Density Classes

The Forest Survey of India (FSI) defines canopy density classes by **percent canopy cover**, not by NDVI:

FSI class	Canopy cover
 Very Dense Forest (VDF)	> 70%
 Moderately Dense Forest (MDF)	40% – 70%
 Open Forest (OF)	10% – 40%
 Scrub	0% – <10%
 Non-Forest	0%

READ THIS BEFORE TRUSTING ANY NDVI THRESHOLD

There is no single NDVI value that always equals a fixed canopy-cover percentage. The NDVI–canopy relationship shifts with species, canopy structure, season/phenology, soil background, sun angle, and sensor. Published studies that calibrate NDVI thresholds against ground/FSI-style density classes report overall accuracies typically in the **76–97% range after local calibration** — not a universal 99%. FSI's own maps are produced by trained visual/stereo interpretation of high-resolution imagery, not a single NDVI cutoff, so some divergence should be expected, especially near class boundaries.

With that caveat, here is a **literature-informed starting set of 5-class NDVI breaks** that tracks the FSI classes reasonably well for cloud-free, peak-greenness (post-monsoon, roughly October–December) Sentinel-2 imagery over typical dry-to-moist deciduous and subtropical Indian forest:

Class	NDVI range	Approx. FSI equivalent
 Non-Forest	$\text{NDVI} \leq 0.10$	0% canopy
 Scrub	$0.10 < \text{NDVI} \leq 0.25$	0–<10% canopy
 Open Forest	$0.25 < \text{NDVI} \leq 0.45$	10–40% canopy
 Moderately Dense Forest	$0.45 < \text{NDVI} \leq 0.65$	40–70% canopy
 Very Dense Forest	$\text{NDVI} > 0.65$	> 70% canopy

To enter these in the tool: Step 3 → select **5** classes → set breaks to `0.10, 0.25, 0.45, 0.65` → rename the labels to Non-Forest / Scrub / Open Forest / Moderately Dense Forest / Very Dense Forest → click **Reprocess**.

Calibrating further for your area

1. Pull NDVI values (cursor HUD, or the exported CSV) at points whose FSI density class or field-measured canopy cover you already know.
2. Plot NDVI against known canopy cover for those points.
3. Adjust the four break values above to the crossover points you actually observe, then re-classify.
4. Re-calibrate seasonally if comparing imagery across very different months — NDVI drops in dry-deciduous canopies during leaf-off periods even with no real density change.

7 Reading the Results

Map	Classified raster drawn over your chosen basemap (Satellite / Topographic / OSM), boundary outlined in red.
Cursor HUD	Live lat/lon and NDVI value under your pointer, with a swatch showing its class.
Area table	Pixel count, hectares, km ² , and % of total area per class, plus a total row.
Map export (PNG/PDF)	A print-style layout with title, source/date caption, lat/lon graticule, scale bar, north arrow, and legend. Toggle Basemap in export on/off first.
Area report (CSV)	The area table, plus the raster's overall NDVI min/max.



Insert screenshot — exported PDF/PNG map layout



Insert screenshot — results table with the download buttons

8 Admin — Managing Users

Administrators see a **Manage users** button after login, opening a panel to:

- Add a new User ID and password, with an optional expiry date (picked from the built-in calendar).
- Edit, search/filter, and sort existing users.
- Remove a user (except the one currently signed in).

An expired account is shown in red and is blocked from signing in — enforced server-side, not just in the browser.



Insert screenshot — the user management panel

9 Limitations

Data & accuracy

- NDVI-based density classes approximate FSI's visually-interpreted canopy density maps — they are not a replacement for them (see the callout in Section 6). Treat outputs as a rapid screening/monitoring layer unless calibrated and validated against ground/FSI reference data for your area.
- NDVI does not correct for topography, shadow, or understory/soil background beyond basic cloud/shadow masking — density can be under- or over-estimated on steep slopes or in sparse-canopy areas with a bright or dark soil background.
- Live optical imagery is unavailable during persistent cloud cover; the automatic wider-window search can still fail to find a usable scene.

Coverage & size

- A single live fetch is capped at roughly **25 km × 25 km** (2,500 × 2,500 pixels at the fixed 10 m/pixel resolution the Copernicus Process API allows synchronously). Larger boundaries must be split into tiles and processed separately.
- Uploaded GeoTIFFs are down-sampled for display/classification once the classified window exceeds roughly 2600×2600 px, as a memory safeguard — areas and percentages remain correct, but the render is coarser for very large rasters.

File format

- Uploaded NDVI GeoTIFFs must be **strip-based** (not tiled) and in a **geographic CRS** (lat/lon, e.g. EPSG:4326).
- Only single-band NDVI is supported (not multi-band raw imagery).
- KML must contain `<Polygon>` geometry — points, lines, or geometry collections without a Polygon are rejected.

Platform & security

- Very large exports (PDF/PNG at high scale) depend on your device's available memory.
- The account system is intentionally lightweight — passwords are stored and displayed in plain text to admins for lookup. Suitable for keeping casual/unauthorized visitors out of a self-hosted tool, not for protecting sensitive data. Always serve the page over HTTPS.

About the screenshots in this handbook

The screenshot and video placeholders throughout this document are intentionally left for your team to fill in from your own running instance — capturing a live, authenticated app with its real data and branding isn't something that can be produced outside of it. A short screen recording of the Section 2 quick-start flow, plus the handful of static screenshots marked above, will complete this handbook.

10 Troubleshooting

Symptom	Likely cause / fix
"No usable Sentinel-2 scene found..."	Widen days back / raise max cloud % , or try a different date.
"This boundary is too large to fetch..."	Split the KML into smaller tiles (see Section 9, Coverage & size).
"This GeoTIFF is tile-based..."	Re-export with <code>gdal_translate -co TILED=NO</code> .
"No georeferencing found..."	File is missing GeoTIFF geotags; re-export with proper tags.
"This raster looks like it is in a projected CRS..."	Reproject with <code>gdalwarp -t_srs EPSG:4326</code> .
KML "No <Polygon> boundary found"	Your KML only has points/lines; redraw as a closed polygon.
Exported map missing basemap tiles	Some tile providers block cross-origin canvas export; set Basemap in export to Off and retry.

