



Per-plot record

Dated Plot Evidence

for plantations under **EUDR**

A per-plot record of what the open satellite archive shows before the 31 December 2020 cutoff, with five control campaigns published as they came out.



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Introduction



This paper describes the per-plot evidence record that Axine Laboratories issues for plantation and smallholder plots under the EU Deforestation Regulation. It is a dated, sourced statement of what the open satellite archive shows for one boundary before 31 December 2020, and it comes with the control campaigns we ran against it, published with their failures.

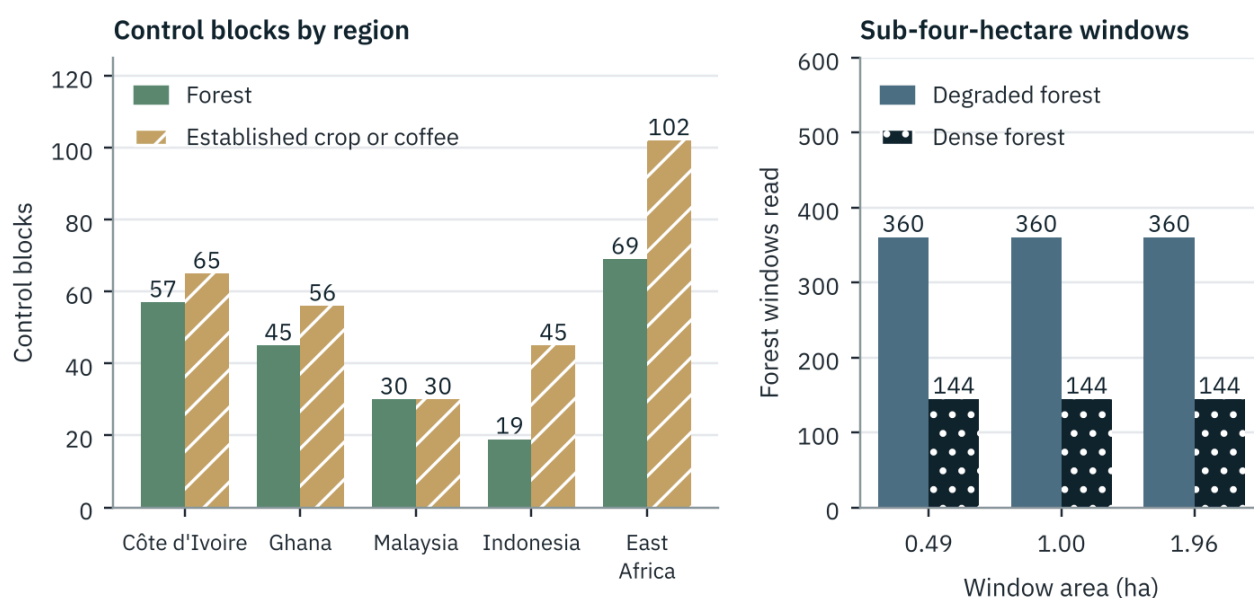


Figure 1. Left: control blocks by region, forest and established crop or coffee (Côte d'Ivoire 57 and 65, Ghana 45 and 56, Malaysia 30 and 30, Indonesia 19 and 45, East Africa 69 and 102). Right: sub-four-hectare windows carved from the Côte d'Ivoire forest control parents, 360 degraded forest and 144 dense forest at each of 0.49, 1.00 and 1.96 hectares.

Motivation: the flag and the finding

Regulation (EU) 2023/1115 requires that cocoa, coffee, rubber, oil palm, wood and the other regulated commodities placed on the Union market come from land that was not deforested after 31 December 2020¹. The Regulation applies to large and medium operators from 30 December 2026 and to micro and small operators from 30 June 2027². The Commission's simplification review estimates about 275,000 unique importing operators under the revised scope, down from 352,000³.

The forests in question are large and still shrinking. The FAO's 2025 assessment puts forest at 4.14 billion hectares and reports deforestation of 10.9 million hectares per year over 2015 to 2025, down from 17.6 million in 1990 to 2000⁴. Global Forest Watch recorded 4.3 million hectares of tropical primary forest loss in 2025, 36 percent below the 6.7 million hectares of 2024, and still 46 percent

above the level of a decade earlier⁵. For 2017, Trase data analysed by the Stockholm Environment Institute attribute 16 percent of the tropical deforestation embedded in international trade to the European Union, 203,000 hectares⁶.

An operator or trader with a register of hundreds or thousands of plots can only cover it from the open satellite record, and that record is mostly read today as a single flag: does the plot sit on ground that a public map calls forest. The Regulation asks a different question. A plot can sit on mapped forest and be an established plantation, because a mature tree crop and a cleared natural forest can show the same fall in canopy cover, and a map of forest cover in one year cannot tell them apart. The Regulation excludes agricultural plantations from its definition of forest in Article 2(6), so the file an operator keeps has to carry that distinction.

- + **A flag is a reason to look.** The Commission's own guidance says its forest-cover map carries no legal value, and FAQ guidance says that sitting on mapped forest does not by itself place a commodity outside the Regulation⁷.
- + **A finding needs a reason.** We state which scene was read, on which date, by which instrument, and why the record reached a finding or withheld one.
- + **Registers are made of small plots.** Farms under 2 hectares account for 91 percent of rubber, 81 percent of palm oil, 60 percent of cocoa and 53 percent of coffee production in forested areas, according to a 2026 preprint that has not yet been peer reviewed⁸.

Why a Map Flag Falls Short



The gap between a flag and a finding is where a due-diligence file is won or lost. Three things widen it: the way the Regulation defines forest, what inspectors ask to see, and how public maps behave at the size of a real plot.

What the Regulation defines

Article 2(3) defines deforestation as the conversion of forest to agricultural use. Article 2(6) excludes agricultural plantations from forest. Read together, land that was already a managed agricultural stand before 31 December 2020 (Article 2(21)) is not deforested by anything that happens to its canopy afterward, harvest and replanting included. Regulation (EU) 2025/2650 changed timing and scope provisions in 2025¹, and the Commission reported on its simplification review in May 2026³. We read neither as touching Articles 2(3) to 2(13), the cutoff date or the status of the Commission's reference maps, and nothing in this paper depends on a provision either one changed.

Under the amended text, downstream operators and traders do not submit a due diligence statement of their own. They keep supplier information and statement reference numbers for five years, and they verify that due diligence was done where a concrete indication of non-compliance appears⁹¹⁰. The first operator to place goods on the market carries the full duty, so the record is written for the party that files, and for whoever audits that filing.

What an inspector asks

The Dutch competent authority's dry-run audits show how far files fall short. In the Netherlands Food and Consumer Product Safety Authority's latest round, as reported by Satelligence on 28 September 2026, only two of ten companies passed the full audit¹¹. The inspector's question, in that note's words, is "what is the evidence behind your claim", and "having the information is not the same as carrying out due diligence". The note says documents "should support a rationale", and it lists conflicting sources as a risk in themselves.

A record that lists what was read, from which scene, on which date, and why a finding was or was not reached answers that question directly. A map lookup answers a different one.



Stepped terraced fields seen from above, with curving terrace edges and a patch of scrub at upper left.

What public maps do at plot scale

An assessment of 21 global forest, tree-cover and land-use maps against the Regulation's forest definition found that only two of them met every requirement, the JRC Global Forest Cover map version 2 and the PALSAR-2 forest/non-forest map version 2.0.0. All 21 are unable to separate forest from other tree-based systems¹². Ground data from coffee-growing regions of Ethiopia and Tanzania show high rates of misclassification across five global land-cover datasets, worst for shade-grown and agroforestry cultivation¹³.

The Commission's own map reports its limits. For version 2 of JRC Global Forest Cover 2020 the authors give 91.5 percent overall accuracy and an 18 percent commission error for the forest class. At a 90 percent probability threshold, 31 percent of mapped rubber area, 7 percent of oil palm and 6 percent of cocoa overlap mapped forest¹⁴. Version 3, released on 28 November 2025, reports 92.8 percent overall accuracy and a 13.1 percent commission error¹⁵. Version 4 has no published accuracy assessment as of this writing; its technical report is expected by December 2026¹⁵. The Commission also released a Global Forest Type 2020 product, version 1, on 15 January 2026, which separates primary, naturally regenerating and planted forest¹⁵.

The record described below treats these maps as one input among several, and our own control results in the sections that follow show why. Across five regions, no forest control block reached a positive finding, and the open record separated most established crop and coffee blocks from forest. It did not do so everywhere, and the places where it did not are part of what we publish.

Open Data Sources



Every reading in a record comes from an openly licensed source that is named on the record itself.

Seven groups of public data feed the record. The table gives the role of each. No commercial or proprietary imagery source is read into a plot's record. Where the open record cannot settle a plot, the next step we offer is a reading of a dated sub-metre scene from a licensed archive. We report that reading separately from the free-imagery record and never blend the two.

Source	Role in the record	Provider and licence
Sentinel-2	Optical imagery at native 10 m, the primary canopy instrument	Copernicus, European Union and ESA
Sentinel-1	C-band radar, read where cloud cover limits the optical record	Copernicus, European Union and ESA
ALOS PALSAR annual mosaics	L-band radar, read for canopy volume	JAXA, via Digital Earth Africa and the Microsoft Planetary Computer ¹⁶
Copernicus DEM GLO-30	30 m global elevation, read for terrain	European Union
ETH Global Canopy Height 2020	10 m canopy-top height trained on spaceborne lidar, read for the cutoff year	Lang et al. 2023, CC BY 4.0 ¹⁷
JRC Global Forest Cover 2020 and Global Forest Type 2020	An independent check beside the record's own instruments; currently version 4 and version 1	European Commission Joint Research Centre, CC BY 4.0
National and regional land-cover maps	The local reference against which a control campaign is scored, such as the BNETD-CIGN 2020 map of Côte d'Ivoire	Published by the national agency, CC BY 4.0 in the Ivorian case ¹⁸

The control campaigns are scored against these published maps. A count in this paper is therefore a count against a reference map, a point we return to in the section on limits.

Anatomy of a Record



A plot boundary, whether an estate polygon or a smallholder plot of a fraction of a hectare, is read once against the full pre-cutoff archive from 2016 to 2020 and produces one record.

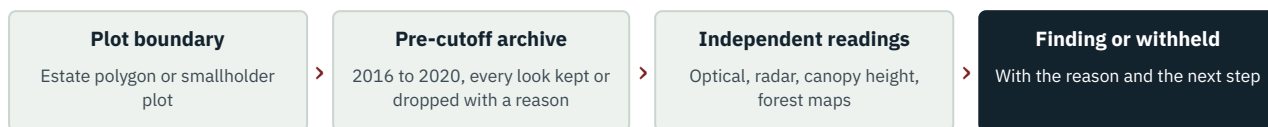


Figure 2. From a plot boundary to a finding or a withheld result.

Finding, or withheld with the reason and the next step

One true-colour look per season

20162017201820192020

Instrument readings

Canopy fraction
Canopy volume
Canopy structure
Canopy height
The Commission's 2020 forest maps

Season by season

Season	Clear looks kept	Canopy fall observed
2016		
2017		
2018		
2019		
2020		

Every look the archive held, read or dropped, with the reason

Sources behind every reading

Article 9 mapping

Figure 3. Layout of one plot's evidence record: header block with the finding or the withheld reason, one true-colour tile per year from 2016 to 2020, five instrument rows, the season table, and the looks-held, sources and Article 9 blocks. The tiles and table are empty: the figure shows the layout and contains no data.

Each record holds the following parts.

- + **Finding or withheld result.** The record states that the open archive supports an established stand before the cutoff, or it withholds that finding and gives the reason and the next step.
- + **One true-colour look per season.** A reader sees the ground, not only a number.
- + **A season-by-season table.** For each season it gives how many clear looks the archive held and whether a canopy fall was observed.

- + **Every look the archive held.** Each is marked read or dropped, with the reason for any dropped look. A look is never silently removed from the count.
- + **Sources behind every reading.** Anyone can reproduce a figure in the record from the public archive.
- + **An Article 9 mapping.** Each section of the record points to the paragraph of Article 9 it speaks to.

When a record is issued and when it is withheld

The record is issued only when independent readings of the plot agree. It is withheld whenever they do not. A forest-like reading on any one instrument withholds the finding, and no single instrument can create a finding on its own. Withholding is a designed outcome of the method. The record never states a compliance outcome: it states what the archive shows and what it does not, and the determination under Article 10 stays with the operator who files it.

Archive coverage for the next step

Before the licensed sub-metre step is offered, we check that the archive can support it. Across the 91 forest control blocks measured in the Côte d'Ivoire and Ghana cocoa belt, 70 (77 percent) hold at least one qualifying scene dated before the cutoff.

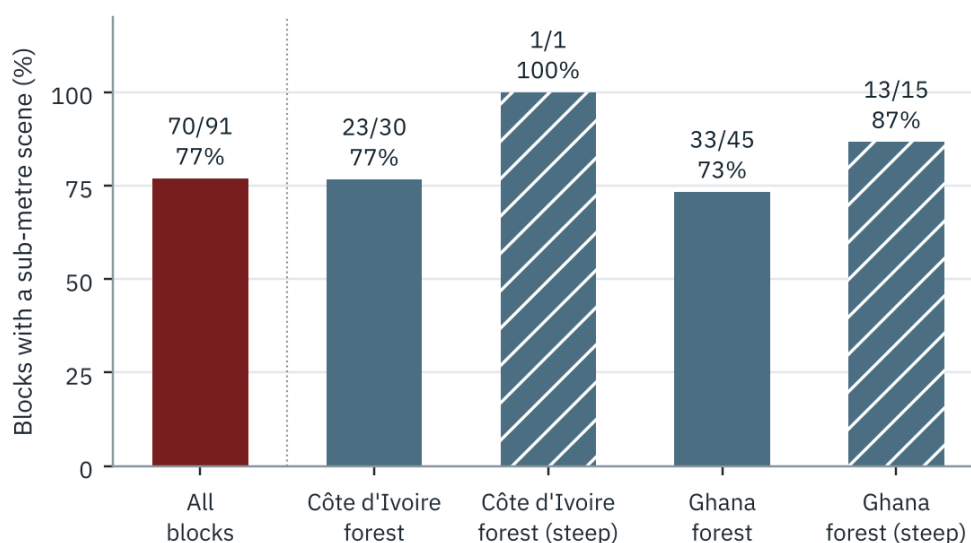


Figure 4. Share of forest control blocks with at least one sub-metre optical scene dated 1 January 2016 to 31 December 2020, whole-scene cloud at most 20 percent and resolution at most 0.6 m: all blocks 70 of 91 (77 percent), Côte d'Ivoire forest 23 of 30, Côte d'Ivoire steep forest 1 of 1, Ghana forest 33 of 45, Ghana steep forest 13 of 15.

Pre-registered Control Campaigns



Five control campaigns, run against mapped boundaries of known cover, measure how often the record reaches each outcome. The campaigns were pre-registered and the controls are not operators' plots.

Every count in the table is printed with its denominator, exactly as the campaign measured it. As of this writing the campaigns hold 518 control blocks across forest and established crop or coffee classes.

Region	Forest controls, finding issued	Established crop or coffee, finding issued
Côte d'Ivoire	0 of 57	51 of 65
Ghana	0 of 45	oil palm 12 of 16; cocoa 2 of 40
Malaysia	0 of 30	oil palm 22 of 30
Indonesia	0 of 19	oil palm 34 of 45
East Africa	0 of 69	Kenyan coffee estates 6 of 6; Ugandan coffee 19 of 21; one Tanzanian coffee estate, 61 of 75 blocks

518

control blocks in five regions

0 of 220

forest controls that reached a positive finding

2 of 40

Ghana cocoa farms that reached a finding

No forest control block, in any of the five regions, has reached a positive finding. The established-crop and coffee counts vary with the region and with whether the crop is grown in the open or under shade. The Ghana cocoa figure and the shade-coffee pattern behind it are a limit of the method and not a result in its favour, so we treat them under limits.

A second check on the Commission's forest maps

We also checked the Commission's own forest maps across the controls stored at the time. Where either of the Commission's 2020 forest maps reads at least half of a boundary as forest, the record withholds a finding whatever its own instruments show. Measured over 811 stored control blocks across these regions, the rule costs nothing on the established-crop side: every crop block that previously reached a finding still does. It newly withholds the small number of boundaries that the Commission's own maps call forest, including every forest control in East Africa read to date.

The Four-Hectare Floor

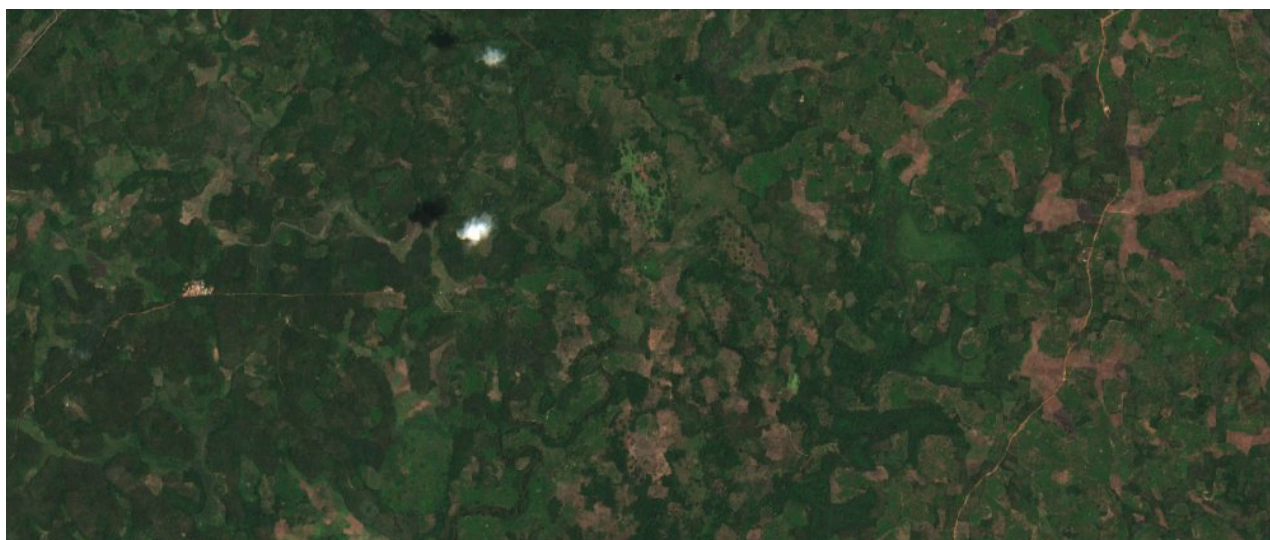


Below about four hectares we read the open archive as supporting evidence and issue no finding from it alone. The public forest-cover map shows the same size effect.

Below about four hectares, the open archive is read as supporting evidence only, and no positive finding is issued from it alone. The reason is sampling. A scene needs a usable share of a boundary free of cloud to count toward a season's record, and a day that leaves a large block comfortably past that bar can leave a small plot with no usable look for that date. Most smallholder plots farm commodities under this Regulation at or under four hectares, so every record states the floor and a reader does not find it on their own register.

The Commission's forest-cover map shows the same size effect independently. We carved the 57 Côte d'Ivoire forest control parents into windows of 0.49, 1.0 and 1.96 hectares and read each against JRC Global Forest Cover 2020 version 4. The map calls a majority of the window forest far less often than it does at the scale of the original block: 13 to 14 percent of degraded-forest windows at these sizes, against 38 percent at the parent block's scale of tens of hectares. Dense forest holds up only a little better, at 50 to 61 percent, and does not clear the majority line with margin. The size effect belongs to the public map at smallholder scale and to no instrument in the per-plot record. It argues against leaning on that map alone at the size of most operators' registers.

The floor applies to every region and every crop. A register with most of its plots under four hectares should expect most of its records to carry supporting evidence and not a finding, and each record says so on its face.



Sentinel-2 true colour of Grand-Béréby, Côte d'Ivoire, 12 March 2026.

Forest-Cover Map Versions 3 and 4



JRC Global Forest Cover 2020 has been revised twice during this programme, and the controls let us see what the latest revision changed.

Version 3 (28 November 2025) reported 92.8 percent global accuracy and a 13.1 percent forest-class commission error. Version 4 has no published accuracy assessment as of this writing. Reading the same 122 Côte d'Ivoire control boundaries fresh under both versions is the only direct way to see what moved.

Nothing moved on the established-crop side: none of 65 crop boundaries reads majority forest under either version. On the forest side, version 4 reads less of the mapped forest as forest than version 3 did. Degraded forest fell from 24 of 45 boundaries (53 percent) to 17 of 45 (38 percent), and dense forest from 8 of 12 (67 percent) to 6 of 12 (50 percent). The newer map calls real forest forest less often in exactly the class that the Commission's accuracy reporting already names as its weakest, tree crops grown under taller canopy that can be confused with degraded forest. For a record that reads the Commission's map as one of several independent checks, version 4 is a weaker second opinion than version 3 was.

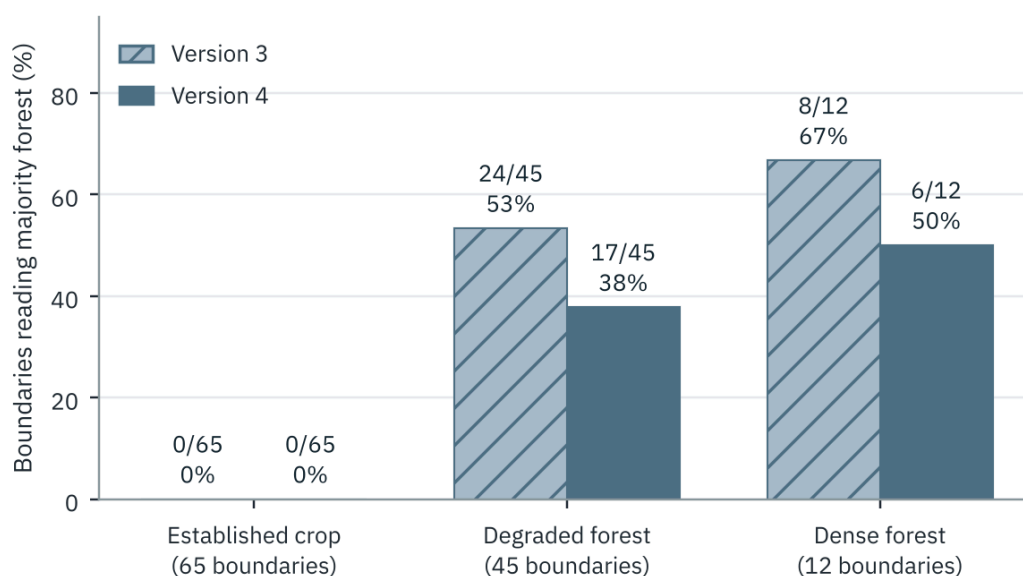


Figure 5. Share of boundaries reading majority forest under JRC Global Forest Cover 2020 version 3 (read 13 September 2026) and version 4 (read 5 October 2026), same 122 Côte d'Ivoire boundaries: established crop 0 of 65 under both, degraded forest 24 of 45 (53 percent) then 17 of 45 (38 percent), dense forest 8 of 12 (67 percent) then 6 of 12 (50 percent).

Limits



Shaded tree crops

Where a crop is grown under closed shade, canopy instruments read the shade canopy much as they read closed forest, and the record withholds a finding and does not guess. In Ghana, 2 of 40 surveyed cocoa farms reached a finding from the open record. The median farm in that survey is about 0.24 hectares, well under the size floor, and most of the sampled ground is grown under shade.

We also ran a dedicated test of whether any combination of free optical, radar, canopy-height and forest-change instruments could separate shaded cocoa from surveyed degraded forest in Ghana's cocoa belt. It was pre-registered before any candidate was scored. It found no such combination. Across 258 candidate combinations over 807 surveyed forest units and 1,514 surveyed shaded-cocoa plots in two zones, the best worst-zone finding rate for shaded cocoa was 2.2 percent, against a pre-registered target of 40 percent. The same instruments separate the two classes well in bulk. The failure sits in roughly 2 to 5 percent of surveyed forest that reads, on every instrument tried, as cocoa-like as the most cocoa-like cocoa.

A blind photo-interpretation audit of the most cocoa-like forest points tested whether this tail came from a labelling problem in the survey. It did not clear the reference map of that possibility, because the labeller could not reliably separate the two surveyed classes either. Shaded tree crops therefore remain a case for archive review, and the open record is not expected to close them.

Regional scope

A finding is issued only in regions where a control campaign has measured the method's margins: Côte d'Ivoire, Ghana, Indonesia, Malaysia, and East Africa for coffee. Outside those regions the record is issued as a reading, with sources and seasons stated, and carries no finding.

East Africa shows why this is a regional question. Degraded montane forest under naturally regenerating cover read, on the record's own canopy instruments, the same as a managed stand, and the Commission's forest-type and forest-cover maps were the check that caught it. A region enters the finding list only after an independent check of that kind has been run against mapped cover there. That is why coffee in Kenya, Uganda and one Tanzanian estate carries a finding and other East African land covers do not yet.

How the Record Is Used



The record is one input that an operator or trader reads beside the land title, the purchase record and any field evidence they hold.

Each record is a dated, sourced statement of what the open satellite archive shows for that boundary before 31 December 2020: the seasons the archive covers, the looks it held and dropped, the readings from each independent instrument, and a finding or a withheld result with its reason. Every figure on it names the public scene or product it came from, so a reader or an auditor can reproduce it.

It states no compliance outcome and names no crop species, and the operator who files decides what it means for a given supply chain.

No accuracy rate is quoted

Every count in this paper is a count of control blocks against a published reference map. None is a measured error rate against ground truth that is independent of any map, and we do not convert any of them into a percentage described as accuracy, precision or recall.

Outcome on a record	What it states	Next step
Finding	The open archive supports an established stand before the cutoff, and independent readings agree	The operator files the record beside the title and purchase record
Supporting evidence	A plot under about four hectares; the open archive is read but no finding is issued from it alone	Field evidence, or archive review
Withheld	A forest-like reading on at least one instrument, or either Commission forest map reading at least half the boundary as forest	The reason is stated on the record; archive review
Reading only	A region where no control campaign has measured the margins	Sources and seasons are stated; no finding

Where a plot needs more than the open record can give, the next step is a dated sub-metre scene from a licensed archive, checked for coverage first and reported separately from the free-imagery record.

About Axine Laboratories

Axine Laboratories builds satellite spectral analytics for forestry, agriculture, water monitoring, energy and mining. The company is registered in the United States and run by a technical team of geologists and engineers.

Our approach rests on three commitments. Detection is physics-based and reproducible, derived from measured spectra and published formulations. Every published figure is backed by a pre-registered test against an independent reference, with the validation regime stated alongside it, and a result that fails its gate is published as failed. A plot or field the method cannot assess is reported as not evaluated, because a silent clear is the most expensive output a record can give.

Every record ships with the scenes, dates and parameters behind it, so a client can check any figure against the public archive it came from.

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A DATED EVIDENCE RECORD FOR EVERY PLOT