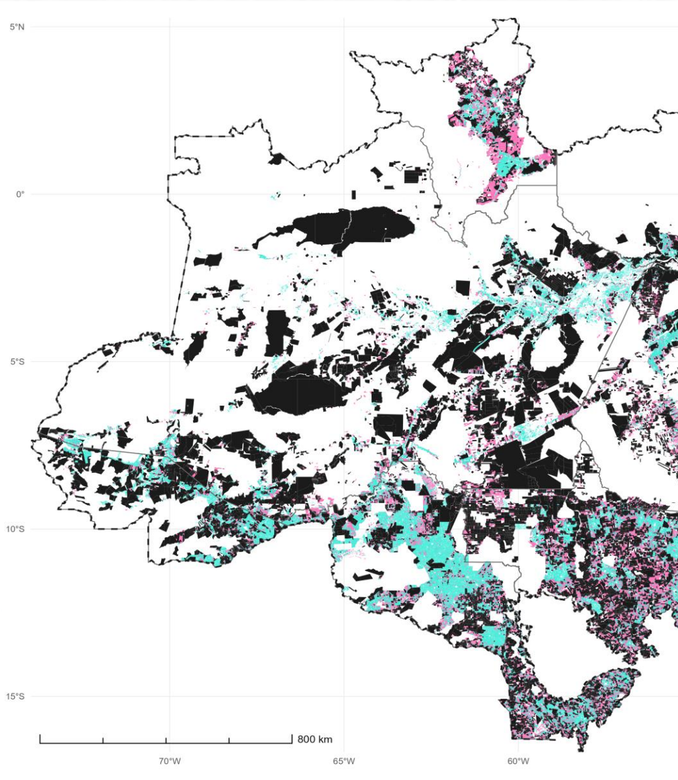
FGV | CENTRO DE ESTUDOS DO AGRONEGÓCIO

Integrated Assessment of Deforestation

Monitoring Databases in the Amazon



Guilherme Bastos

Coordinator, FGV Agro

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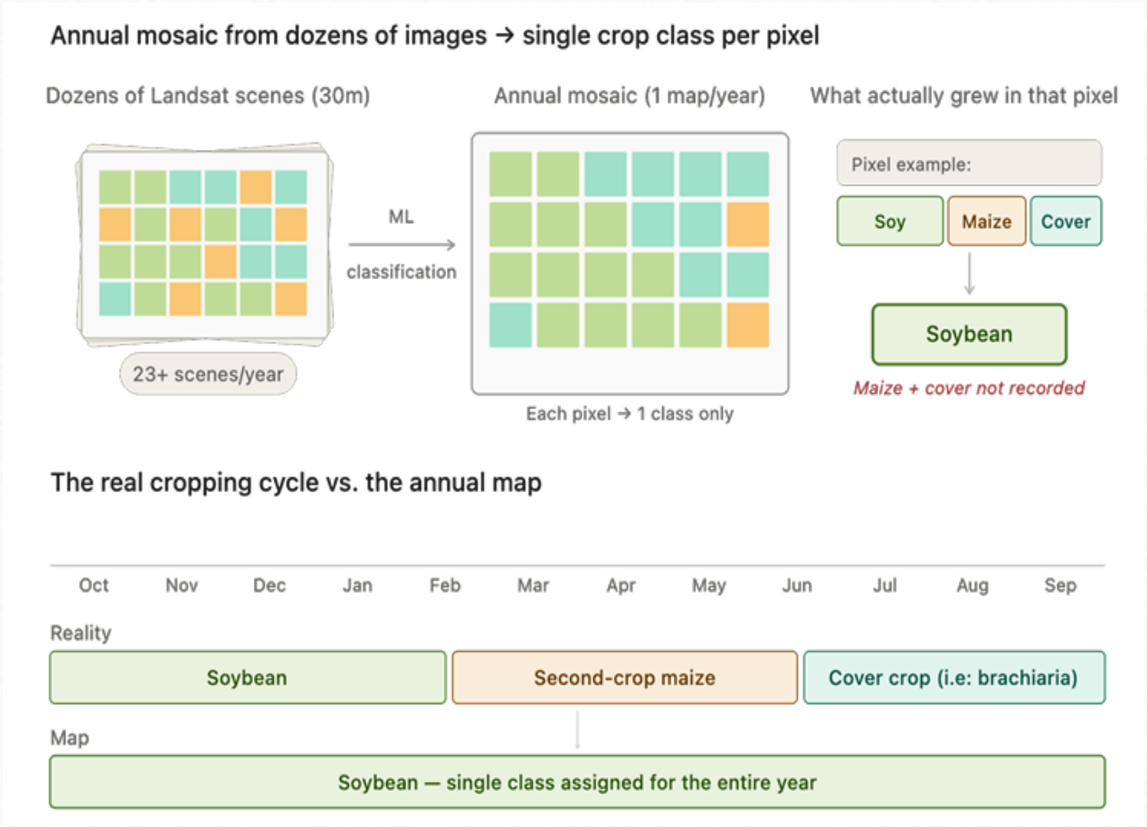
Interpretation of Land-Use Change

Multi-crop complexity missed — Brazilian agriculture often involves 2–3 cropping cycles per year (e.g., soybean → maize → cover crop), a complexity not reflected in annual classification

Occurrence vs. sequence — Crop classification records which crop occurred, not the full rotation. Soybean may be assigned as the primary class even when maize and cover crops follow in the same area

Annual snapshot limitation — Some uses 30m imagery and machine learning to generate annual land-use maps, capturing only a single classification per pixel per year

Result — Crop-system intensity and land-use efficiency are systematically under-represented when a single annual class is the sole input for territorial analysis



Three Datasets Most Commonly Cited — Three Distinct Purposes

Each dataset was designed for a specific use. Misapplication is the primary source of analytical error.

PRODES (INPE)

Designed for:

Cumulative deforestation monitoring in primary forest

✓ Appropriate uses

- Track where & when clearcut occurred
- Official national GHG accounting

✗ Common misapplications

- Current land-cover status
- Whether an area is still deforested today

⚠ Once detected, always flagged — even after full forest regeneration.

MapBiomas

Designed for:

Annual land-use & land-cover classification

✓ Appropriate uses

- Broad vegetation mapping (primary vs. secondary)
- Territorial overview by biome

✗ Common misapplications

- Sequential cropping systems (soy→maize→cover)
- Fixed policy baseline (collections revised retroactively)

⚠ Annual mosaic assigns 1 class per pixel — second crops & cover crops not recorded.

CAR (Cadastro Ambiental Rural)

Designed for:

Forest Code environmental compliance registry

✓ Appropriate uses

- Environmental compliance (APPs, Legal Reserves)
- Forest Code monitoring

✗ Common misapplications

- Land tenure or property boundaries
- Linking deforestation to specific farms or owners

⚠ Self-declared, limited field verification. Not a land-tenure database.

Source: FGV Agro — Key Methodological Sensitivities: Land Analysis (2025)

Two Critical Misreadings with Direct Policy Consequences

MISREADING 1 — PRODES as current land cover

PRODES records the deforestation event — not what happened to the land afterwards.

PRODES record:

"Deforested" — permanently flagged across all four time periods

- A historical PRODES detection does not mean the area is currently deforested.
- Areas may have regenerated, recovered secondary forest, or changed land use entirely.
- Linking current agricultural production to old PRODES flags without checking current land cover can produce inaccurate attribution.

MISREADING 2 — CAR as verified land tenure

CAR is a self-declared environmental registry — not a land-tenure system.

What CAR is	How studies misuse it
✓ Environmental registry (Forest Code)	✗ Proxy for property boundaries
✓ Self-declared by landholders	✗ Proxy for land ownership
✓ Environmental compliance purpose	✗ Link deforestation to specific farms
✓ Limited formal verification	✗ Fixed baseline for supply-chain audits

⚠ Brazil has certified systems for land tenure: SIGEF and SNCI (INCRA) provide georeferenced, legally certified property boundaries — these should be the reference for tenure analyses.

- Using self-declared CAR polygons as verified property boundaries introduces distortions in any deforestation-to-farm attribution analysis.
- Causal attribution between specific export markets and deforestation events is inherently methodologically complex.

Source: FGV Agro — Key Methodological Sensitivities: Land Analysis (2025)

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MapBiomas: Valuable — But Not a Fixed Baseline for Policy

Two structural characteristics require attention before using MapBiomas in policy or supply-chain assessments:

1 Annual mosaic → one crop class per pixel

Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug Sep

Reality

Soybean | **2nd-crop maize** | **Cover crop**

Map shows

Soybean — single class assigned for the entire year

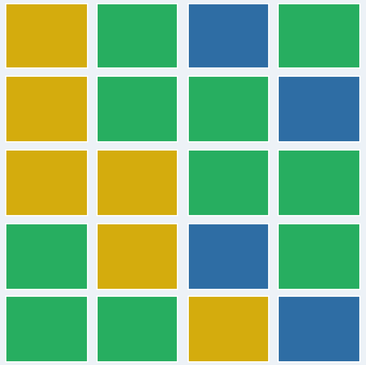
Result: second-crop maize and cover crops are not recorded. A pixel classified as soybean may have been under crop rotation for most of the agricultural year.

⚠ Crop-system intensity and land-use efficiency are systematically under-represented when a single annual class is used as the sole input to territorial or supply-chain analyses.

2 Collections are revised retroactively

Classification models improve each year — past maps change between releases:

Collection 7 (2022)
Map for year 2015



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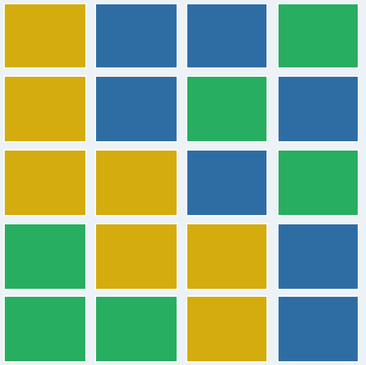
Collection 8 (2023)
Same map for year 2015



8 of 20 pixels reclassified (40%) — same location, same year, different model.

⚠ Using MapBiomas as a fixed policy baseline is inherently unstable. Territorial analyses based on one collection may be contradicted by the next release. Versioning and locking procedures are needed for any policy application.

Source: FGV Agro — Key Methodological Sensitivities: Land Analysis (2025)

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What Should Be Used — An Integrated Territorial Reading

Each analytical question requires a specific dataset — no single source is sufficient.

Policy / Analytical Question	Primary Dataset	Correct Application & Caveats
Was there deforestation?	✓ **PRODES (INPE)**	Historical clearcut record — not current land cover
What is the current land cover?	✓ **MapBiomas + LAPIG**	Combine with pasture quality data; lock collection version
Who owns the land?	✓ **SIGEF / SNCI (INCRA)**	Certified georeferenced property boundaries
Forest Code compliance?	✓ **CAR***	Useful for legal reserve / APP compliance only — not tenure
How much was produced?	✓ **CONAB / IBGE**	Cross-check MapBiomas area figures with production volumes
Logistics flow & trade routes?	✓ **Logistics & warehouse data**	Avoid misattribution of volumes to wrong origin regions
Is deforestation linked to this production?	✓ **Multi-source overlay**	Requires: PRODES event + MapBiomas current use + SIGEF tenure + CONAB/IBGE production

** CAR is self-declared and lacks full formal verification in many regions — interpret accordingly.*

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Challenges & Future Directions

Current Challenges

- Cloud coverage limitations
- Small-scale deforestation detection
- Degradation vs. deforestation distinction
- Non-forest vegetation monitoring gaps
- TerraClass: biannual only; needs improvement
- Increase frequency in monitoring to capture tropical agriculture land cover dynamics within a cycle

Emerging Solutions

→ SAR/Radar for cloud-free monitoring

→ AI/ML for automated detection

→ Higher resolution satellites

→ Expansion to non-forest areas

→ Integrated alert platforms

→ Enhanced data interoperability

Sources: INPE roadmap; Remote sensing research; Global Forest Watch

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Key Takeaways for Evidence-Based Policy

These are not critiques of the datasets — they are reminders to use each tool within its designed scope.

01

PRODES records events, not current state

A historical deforestation flag does not mean the land is still deforested. Effective attribution requires cross-referencing with current land-cover data.

02

CAR is not land tenure

For any analysis linking deforestation to farms or export flows, certified tenure systems (SIGEF / SNCI) must be the primary reference.

03

MapBiomas needs versioning & complementary data

Multi-crop systems are structurally under-represented. Retroactive revisions mean it cannot serve as a fixed policy baseline without explicit version locking.

04

Causal attribution requires multi-source integration

No single spatial dataset establishes causality between agricultural production and deforestation. Robust analysis needs PRODES + MapBiomas + SIGEF + CONAB/IBGE working together.

Strengthening Monitoring Through Cooperation

Key Recommendations for EU–Brazil Collaboration:

1. Share technological advances in SAR and AI-based detection;
2. Harmonize methodologies for cross-regional comparisons;
3. Support capacity building for emerging monitoring systems;
4. Develop integrated platforms for real-time data sharing;
5. Foster joint research on deforestation drivers and effectiveness.

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Guilherme Bastos
guilherme.bastos@fgv.br
FGV Agro – Center for Agribusiness Studies

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