TIME2GRAZE · GLOBAL METHANE HUB

Field protocol alignment

in-situ sampling for grassland and pasture biomass productivity

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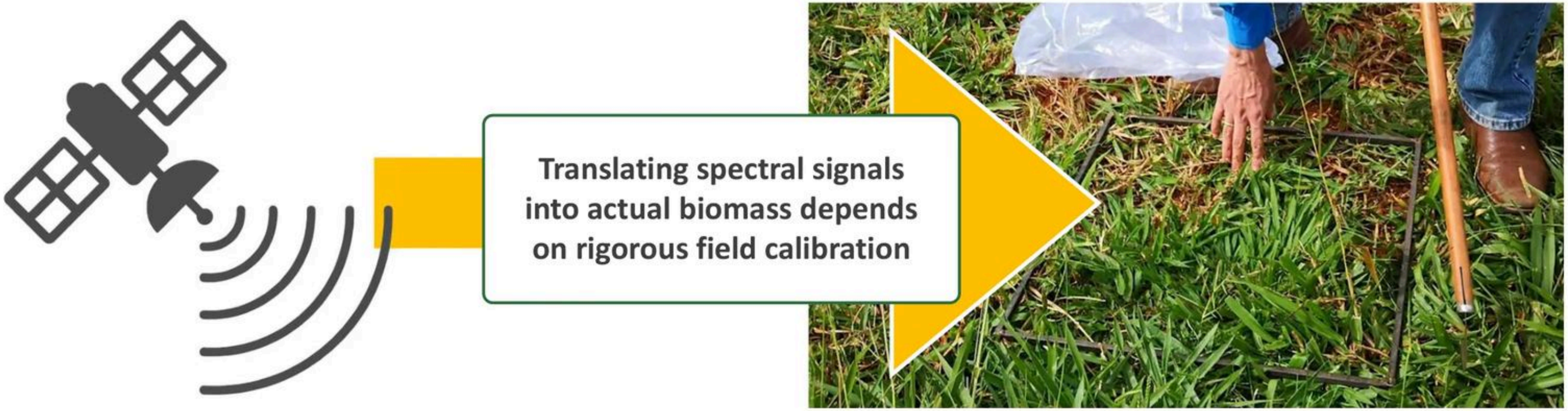
LAPIG Remote Sensing and GIS Lab · UFG Universidade Federal de Goiás · OpenGeoHUB Connect · Create · Share · Repeat · Land & Carbon Lab · Global Methane Hub · time2graze

WHY THE FIELD DATA PLAN EXISTS

Why ground data?

Satellite indices are proxies for vegetation condition, not direct measurements.



Spectral Signals

Indices correlate with biomass, but they don't measure it directly.

Physical Biomass

kg of dry matter per hectare.
On the ground reality.

Ground data provides the necessary **accuracy, specificity,** and **local context** to make global models work locally.

WHY THE FIELD DATA PLAN EXISTS

Pillars of the Field Data Mobilization Plan

Ensuring our ground-truth data is rigorous, representative, and comparable across all target countries.

Calibration & validation

Physical field data is actively recommended to calibrate and validate satellite-derived biomass models.

Statistically Collected for Representativeness

Probability-based spatial design ensures we capture the full ecological and landscape gradient.

Executed by Experts

High-fidelity data capture relies on specialized field teams navigating complex local contexts and species variations.

Standardized for Consistency

Harmonized, standardized protocols keep results comparable across countries.

FIELD DATA MOBILIZATION PLAN

Goal — a modular, statistically robust sampling strategy

To design a comprehensive Field Data Mobilization Plan built on a probability-based sampling strategy, **complemented by standardized field protocols.**

- **Multi-level** — stratified across ecological and operational gradients
- **Modular** — nested subsets for spatial and temporal fidelity
- **Scalable** — sequential GRTS supports phased implementation
- **Statistically robust** — known inclusion probabilities, quantified uncertainty

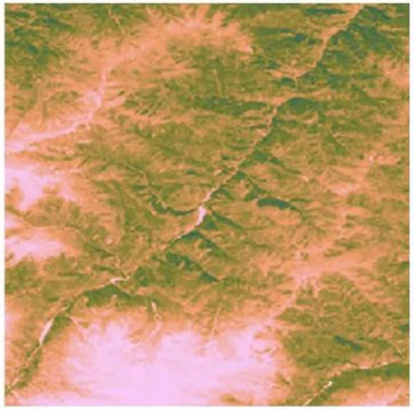
FIELD DATA MOBILIZATION PLAN

Data and resources — harmonized geospatial layers

We are leveraging the following geospatial datasets:

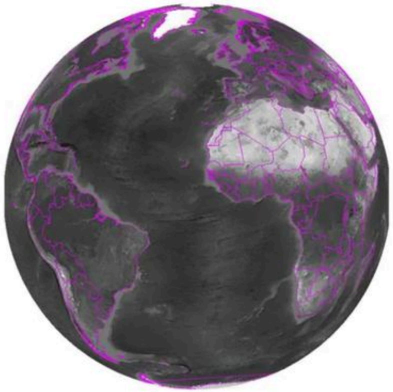
GPW Grassland Extent & Type

Defines the target population
(Parente et al., 2024)

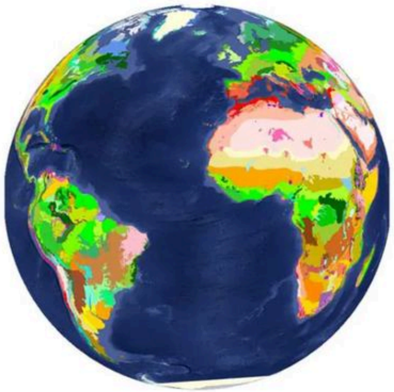


GPW Aboveground Dry Biomass
(derived from uGPP)

Productivity stratum from calibrated GPP
(Isik et al., 2025)



Natural Earth Political Boundaries

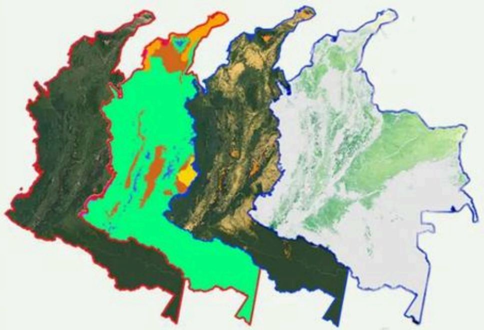


WWF Terrestrial Ecoregions

Biogeographical context
(Olson et al., 2001)

FIELD DATA MOBILIZATION PLAN

Sampling strategy — GRTS

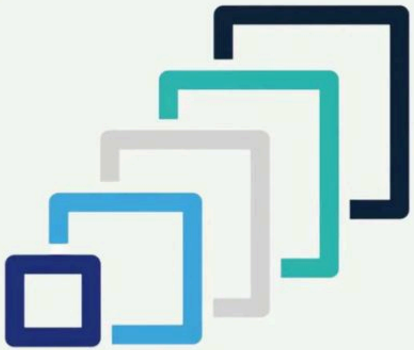


Multi-level stratification

Ecological zones and land-use types. Improves accuracy across diverse landscapes.

Probability sampling (GRTS)

Spatially balanced, known inclusion probabilities. Minimizes bias, ensures representativeness.



Scalable design

Sequential ordered sample — expand or reduce sites without redesign. Cost-effective across countries.

Multi-level stratification — four hierarchical levels

The landscape is progressively subdivided into units more homogeneous in biomass dynamics and field feasibility. Final strata are the intersection of all four levels.

Level 1

Road proximity

Accessibility / logistics (OSM)

Level 2

Land-use strata

Grassland & pasture type (GPW)

Level 3

Annual biomass strata

Derived from GPP as a proxy for biomass

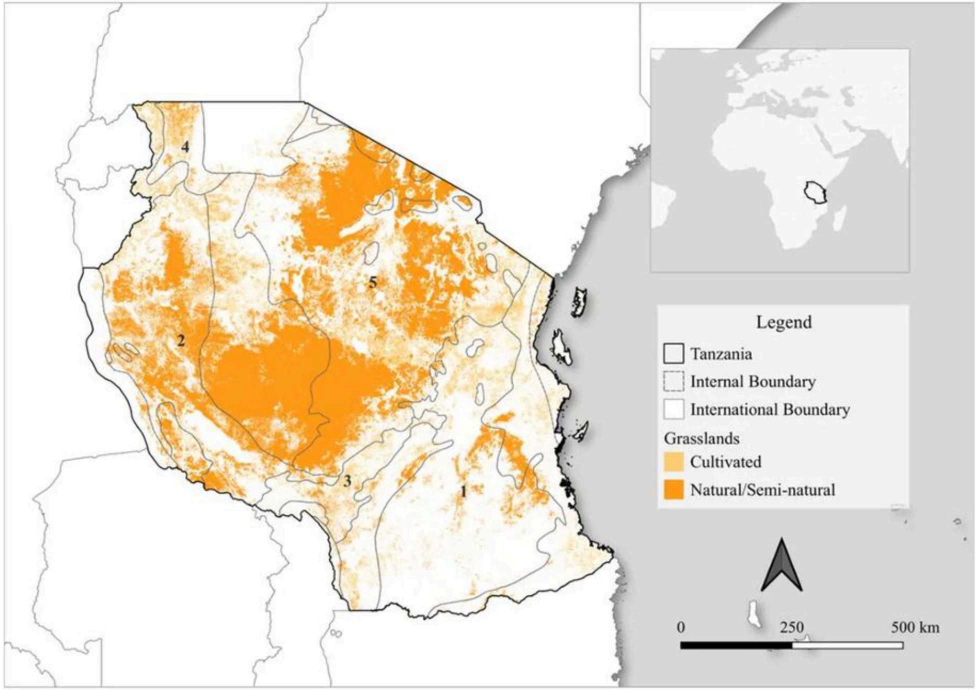
Level 4

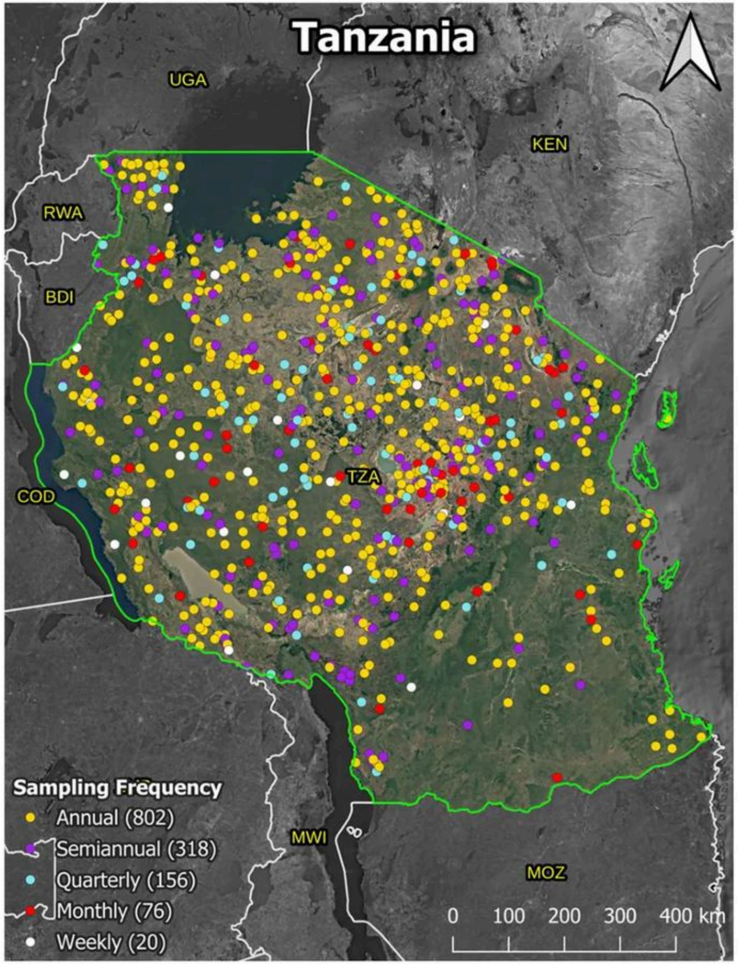
Ecological strata

WWF ecoregions

Proposed Sampling Design

Operational Logistics - Adapting to local realities





FIELD DATA MOBILIZATION PLAN

Temporal sampling hierarchy — nested revisit frequencies

The annual base sample captures spatial variability; nested subsets are revisited more frequently to capture regrowth dynamics. Higher-frequency tiers are always subsets of lower ones.

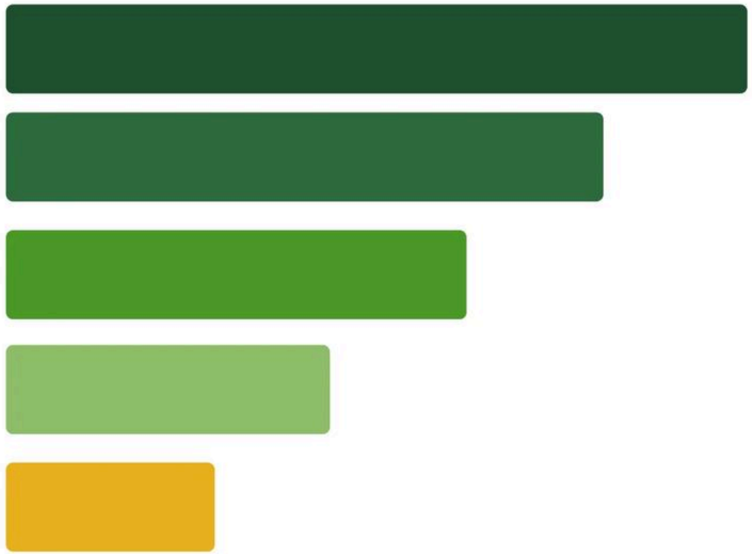
A1 · Annual
full probability sample · ≥ 1×/year

A2 · Semi-annual
~70% of sites · 2×/year

A3 · Quarterly
~50% of sites · 4×/year

A4 · Monthly
small subset · high-temporal curves

A5 · Weekly
smallest subset · fine-scale validation



Design parameters

Confidence interval
95%

Maximum error
10%

Stratification
4 levels

Selection
GRTS, spatially balanced

Reserve list
for lost sites

FIELD DATA MOBILIZATION PLAN

Roadmap: From global design to local execution

Country-Level Refinement

a) Review GRTS points

b) Filter for security risks and specific regions

c) Adjust for local accessibility

Budget Alignment

Input local cost variables into the tiered framework

LIVING DOCUMENT!

We want your local knowledge to finalize it.

LAPIG's Field Procol

FIELD PROTOCOL

LAPIG's *in situ* grassland and pastures protocol

Five components proposed as the technical starting point.

Landscape assessment

Field sheet, land-tenure & management notes, nadir photo (~1.5 m) before/after clipping, and landscape photos N·S·E·W.

Aboveground biomass

The "square method" — fresh weight in situ; sub-sample for lab dry matter and, where feasible, leaf / stem / dead separation.

Woody layer

10 m × 10 m plot: trees (DBH > 5 cm) get DBH + height; shrubs (DBH < 5 cm) get basal diameter + crown area.

Cover & degradation

Line-Point Intercept along a 100 m transect, every 4 m (~25 points) → PV / NPV / Bare-Soil fractions.

Soil sampling

Optional nested layer: 5–8 sub-samples within 3 m, composited; 30 cm depth; texture + fertility.

FIELD PROTOCOL

Ground-data collection workflow







1. **Species identification**
2. **Height measurement**
3. **Visual assessment**
4. **Ground photos**
5. **Drone imagery**
6. **Forage sampling**
7. **Soil sampling**

Each sampling point combines non-destructive assessment (identification, visual scoring, photography) with destructive sampling (forage clipping, soil)

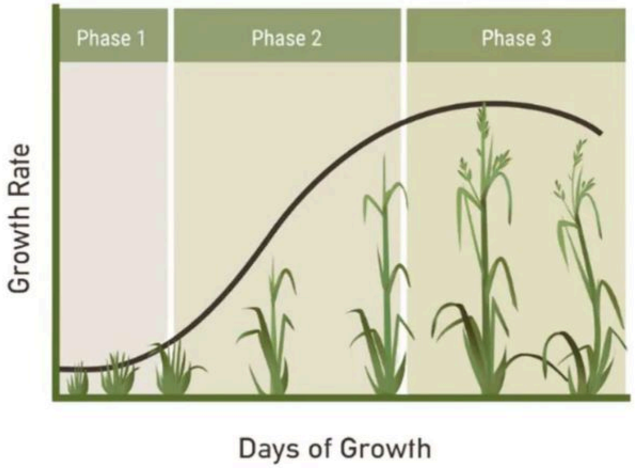
FIELD PROTOCOL

Visual Assessment

Development stage

Vegetative - Reproductive - Mature

Evaluation of the plant's growth phase, and overall development stage.



Score	Growth Phase	Description
1	Early Vegetative	Absence of senescent leaves, seedling emergence, rapid leaf area development, and a high proportion of expanding green leaves
2	Vegetative	Predominance of green leaves and thin stems. Initial tillering.
3	Vegetative	Good leaf-to-stem ratio; elongation phase begins with high green leaf presence.
4	Late Vegetative	Initial stem elongation; increasing stem proportion (<50%) and minor senescent leaf presence. Rapid growth.
5	Reproductive (Pre-Flowering)	Leaf senescence increases; stem elongation continues; flag leaf appears, and inflorescence begins forming. One-fourth to one-third of the plant's mature size
6	Reproductive (Flowering)	High presence of inflorescences; increasing senescent leaf proportion and lower leaf-to-stem ratio.
7	Maturation	Seed production stage; predominance of senescent and dead material; "dry pasture" aspect.

FIELD PROTOCOL

Visual Assessment

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FIELD PROTOCOL

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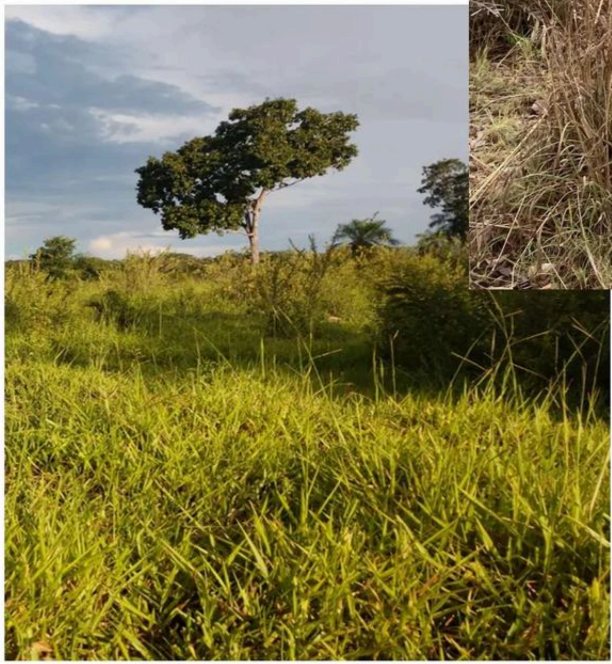
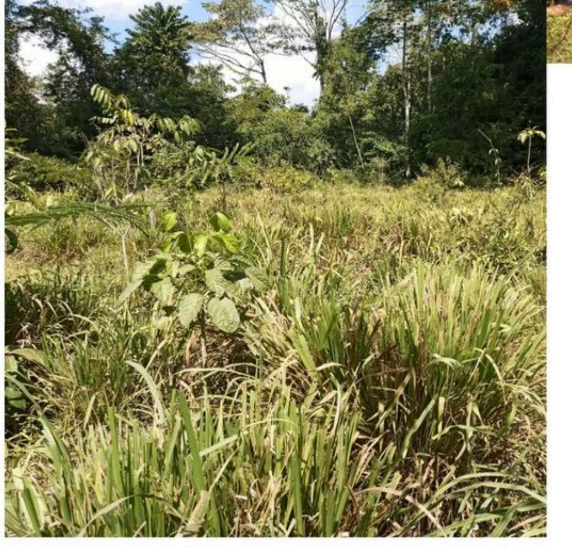


Visual Assessment

Weeds

Percentage of the pasture covered by weeds

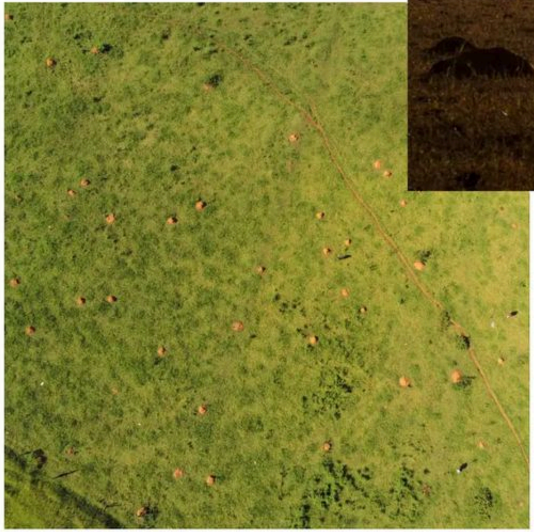


FIELD PROTOCOL

Visual Assessment

Termites' incidence

Count of mound building termites in the area



FIELD PROTOCOL

Visual Assessment

Soil coverage

Percentage of the area covered by vegetation, including forage and invasive species.

FIELD PROTOCOL

Visual Assessment

Forage availability

Estimation of forage production in kg ha^{-1}

FIELD PROTOCOL

Visual Assessment

Current condition

Present state of the sward

FIELD PROTOCOL

Visual Assessment

Productive potential

Expected productivity of the site. It reflects the pasture's ability to recover and sustain forage production based on available forage mass, tiller density, and grazing pressure.

FIELD PROTOCOL

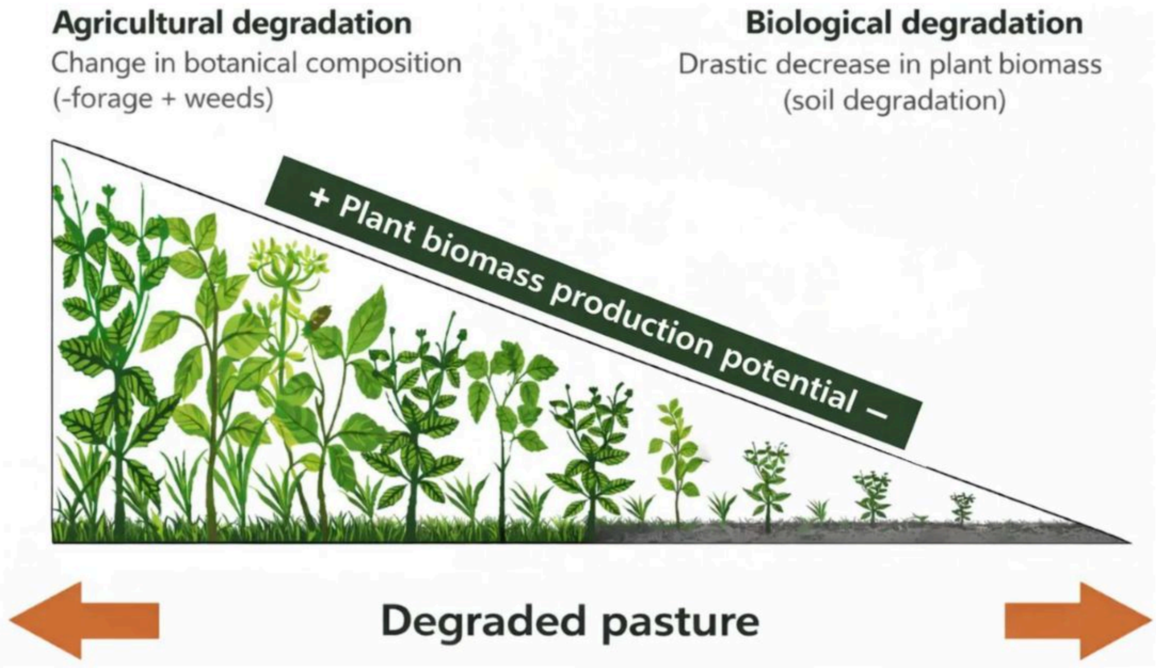
Cover, Structure & Degradation assessment

Cultivated pastures

Degradation — significant and continuous drop in pasture productivity (carrying capacity) over time.

Two main pathways:

Source: Moacir Dias-Filho



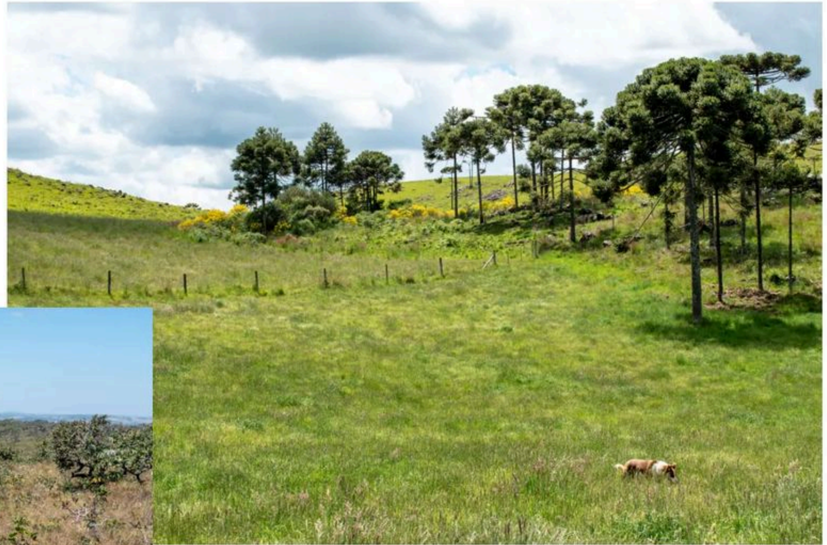
NT1

FIELD PROTOCOL

Cover, Structure & Degradation assessment

Natural ecosystems

Degradation — a deviation from a "reference state", usually a system in equilibrium with historical management

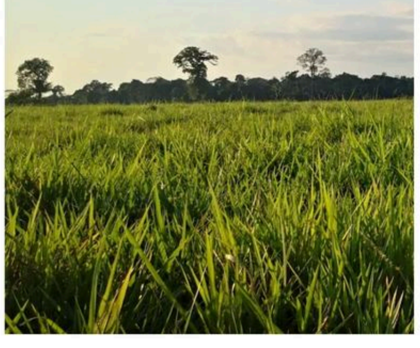


Cover, Structure & Degradation assessment

Degradation — 3 classes / 4 severity levels

Classified from weed and bare-soil cover thresholds, together with forage coverage and vigor.

< 10 % bare soil / weeds	**10 – 40 %** bare soil / weeds	**> 40 %** bare soil / weeds
Non-degraded	**Low → Moderate**	**Severe**



Cover, Structure & Degradation assessment

Biological Degradation

Agronomic Degradation

Source: Dias-Filho (2011).
Field animation: LAPIG

Cover, Structure & Degradation assessment

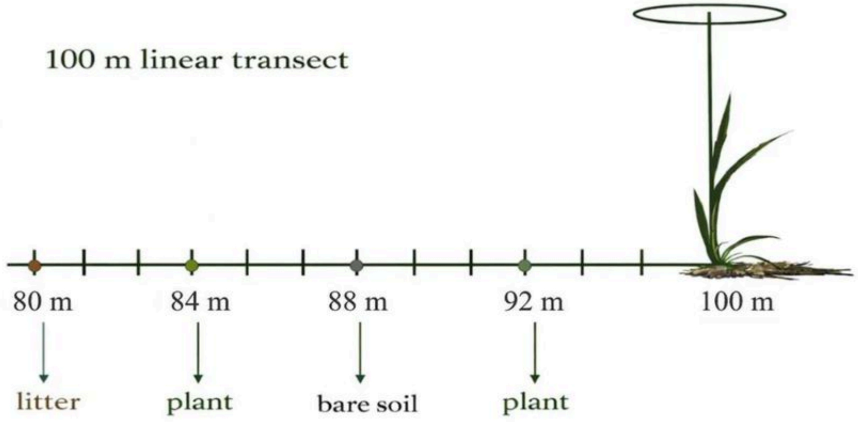
Line-Point Intercept (LPI)

A 100 m transect from plot centre, recorded every 4 m (~25 points). Each point is classified into Photosynthetic Vegetation, Non-Photosynthetic Vegetation, or Bare Soil.

PV — green cover

NPV — dry / litter

Bare soil



FIELD PROTOCOL

Biomass sampling — square method

Destructive forage sampling with fixed quadrats, cut close to soil.

Class	Quadrat	Cut height	Min. samples
Cultivated pastures (homogeneous)	0.25 m²	1–2 cm	5 / point
Natural grasslands (heterogeneous)	1.0 m²	1–2 cm	10 / point

Cut height 1–2 cm

Close-cut keeps kg DM/ha comparable across teams.

Dry matter

Fresh weight in situ; sub-sample oven-dried for DM.

Morphological separation

Where feasible: leaf, stem+sheath, dead material.

Litter

Not collected – but can be harvested and weighted separately

FIELD PROTOCOL

Soil sampling — optional

Compositing

5–8 sub-samples within a 3 m radius, composited into one sample per point.

Depth

0–30 cm.

Analyses

Texture and fertility (pH, organic matter, macro nutrients).

Soil sampling is optional. With repeated measures collected only once per site — it may helps characterize edaphic controls on biomass.

FIELD PROTOCOL

Photographic documentation — nadir & landscape

Nadir photo (~1.5 m)

Taken before and after clipping.

Landscape photos

Four cardinal directions (N · S · E · W) per point.

FIELD PROTOCOL

Drone imagery

FIELD PROTOCOL

Laboratory analysis

Bromatological analysis

Dry matter, mineral matter, crude protein and fiber content

Soil physical-chemical

Texture (sand · silt · clay) and soil fertility

Forage production

Estimation of forage dry matter and crude protein production (kg ha^{-1})

Laboratory outputs anchor the field scores to qualitative and quantitative reference values

Amazon "Gate"

Unmanaged planted pasture (abandoned pasture), with secondary vegetation

Cerrado

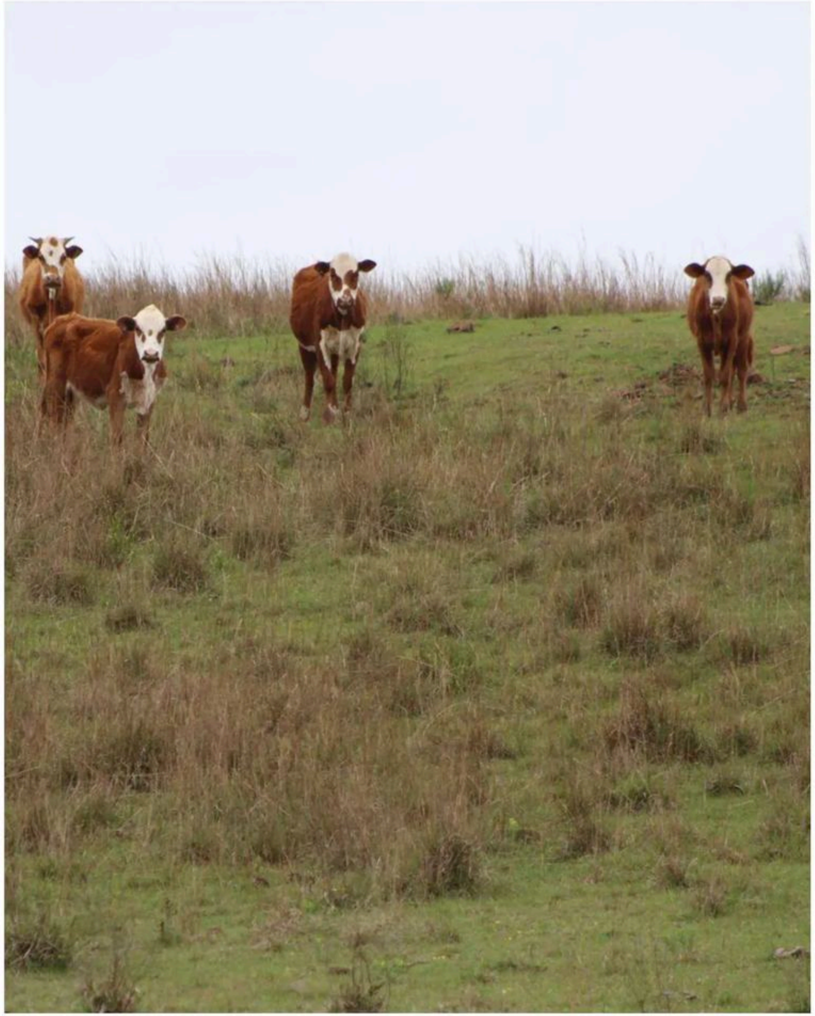
Goiás, 2022

Cultivated pasture, improved / highly productive

Cerrado

Goiás, 2019

Cultivated pastures; extensive grazing systems



Pampa

Alegrete, RS (2019)

Native grassland

Pampa

Alegrete, RS (2019)

Annual grass (*Lolium multiflorum* - winter ryegrass)

Santa Catarina

São Joaquim, 2026

Improved Natural fields (with clover and ryegrass); extensive grazing systems

Santa Catarina

São Joaquim, 2026

Extensive Natural Fields.

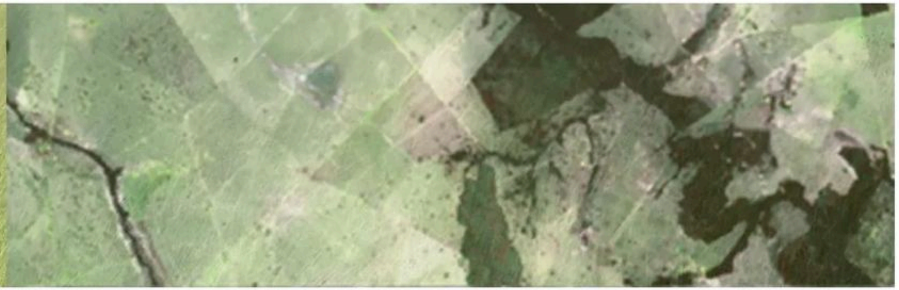
Invasives species presence.

FIELD PROTOCOL

From field to model — integrating ground & satellite data

Field measurements and lab results feed the calibration and validation of remote-sensing models.

Establish thresholds | **Validation points** | **Ground truth or training** | **Inverse modeling** | **Data assimilation**



Field Procol Alignment — open discussion

OPEN DISCUSSION

Field protocol alignment

This protocol reflects LAPIG's experience in Brazilian grasslands. On-the-ground realities — forage species, grazing systems, seasonality, access, lab capacity — vary across countries. We want to align it with your practice.

01

Learn your methods

How each team currently samples biomass and assesses grassland productivity.

02

Compare analyses

Which objective, quantitative analyses are common in your projects and should be considered.

03

Keep it comparable

Identify what must stay standardized across countries, and what can remain locally defined.

Notes captured live on the flipchart and recording

An informal discussion — no votes, no fixed outputs. We record what each team does and needs, to refine the protocol afterward.

OPEN DISCUSSION

Two modules for today’s discussion

ON THE TABLE TODAY

Biomass Sampling

Cut height, dry matter, quadrats, litter

Cover / Degradation

LPI vs visual scores, thresholds, parameters

These two modules are what the biomass model might consume — so this is where alignment pays off first.

ASYNCHRONOUS FOLLOW-UP

Socio-economic / DST survey

Household survey layer

Full soil protocol

Depth, handling, analytical detail

Important, but handled bilaterally with each country team after the workshop.

OPEN DISCUSSION

Questions to guide the discussion

01
On biomass

- What protocol do your teams use to sample biomass and assess grassland productivity?
- Do you cut and weigh forage, use rising-plate / visual estimates, or another method?
- How many quadrats per point is realistic in a working day?
- Do you sample litter separately?

02
On cover / degradation

- How do you assess cover and degradation?
- Do your degradation categories differ from the classes shown here?
- Is a 100 m LPI transect feasible — or is a visual % / ordinal score more realistic?
- If methods differ, what is the honest relationship to % bare-soil, so we can build a conversion?

03
Other

- What in our protocol simply would not work in your country, and why?
- What does your protocol already do well that we should adopt?
- Which quantitative analyses are most common in your projects (biomass, DM, soil, other)?
- What constraints shape feasibility — species, seasonality, access, security, staffing?

OPEN DISCUSSION

Next Steps

01	**Consolidate notes**	Compiles the discussion into a per-country summary of methods and constraints.	during / after event
02	**Refine the protocol**	Adjust the field plan and protocol to local realities while preserving cross-country comparability.	following months
03	**Bilateral follow-up**	Continue alignment with each country team on open points.	ongoing
04	**Circulate v2**	Share the updated protocol and adaptation notes with all partners.	next phase

Thank you

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