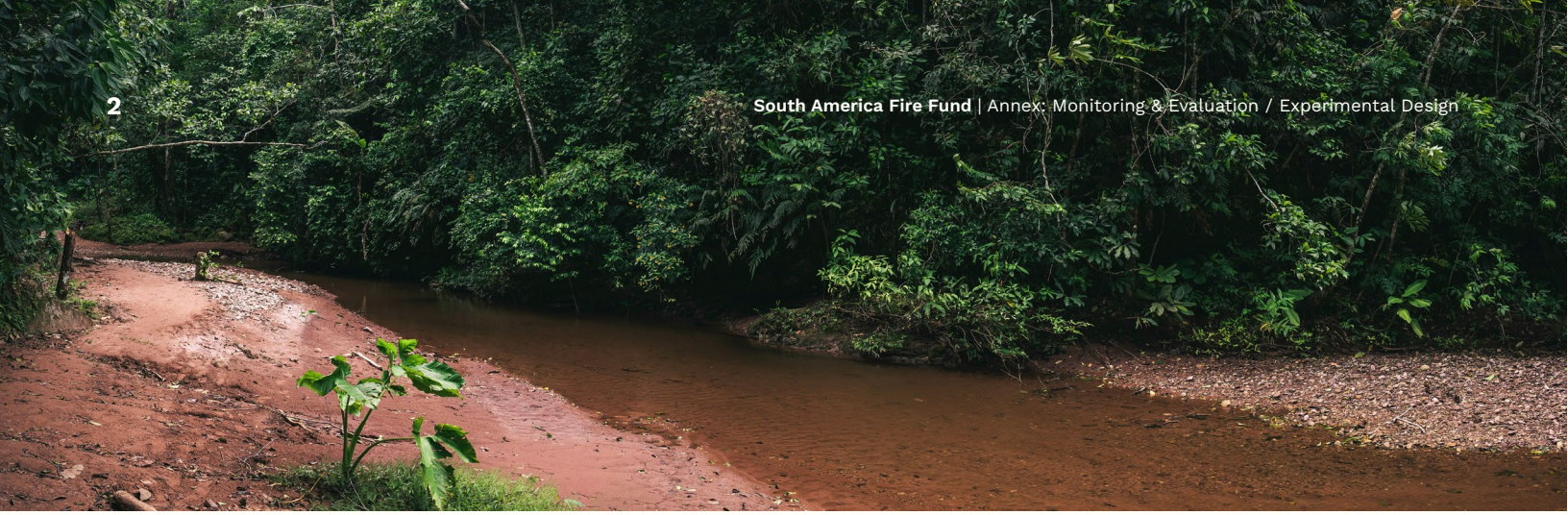
South America Fire Fund

ANNEX: Monitoring & Evaluation / Experimental Design

Renaissance Philanthropy

MARCH 2026



ANNEX: Monitoring & Evaluation / Experimental Design

Executive Summary

Key Findings

The Fund's approach to evidence generation has two components with separate but related goals. The Monitoring and Evaluation (M&E) plan ensures accountability across all strategies — tracking what the Fund is doing and whether it is working. The experimental design goes further, applying scientific methods to establish why it is working and how the results can be generalized to other landscapes and governance contexts.

Proposed M&E Framework

Five cross cutting indicators were selected as universal indicators to be measured across all LIFTs, while additional indicators are applicable across more than one LIFT. All targets are pending verification by implementing partners with additional consultation. All indicators will have targets verified following Year 1 baseline data collection.

South America Fire Fund — Indicators Framework				
Indicator	Methods	Generalized Baseline / Current Status	3-Year Target	LIFTs Applicable
Strategy 1: Fire Prevention & Resilient Stewardship				
Objective 1: **Number of escaped fires in target areas**	Historical data 10–15 yrs of remote sensing data for target areas	Historical baseline of number of escaped fires from 10–15 yrs of remote sensing data for target areas. Corumbá: 72 priority fires (2024). Iñapari: SERFOR/MapBiomas 2013–2024. Paragominas: 10–15 yr remote sensing baseline. Roboré, Cruzeiro do Sul, Santarem: Year 1 baseline	20-30% reduction OR specific amount of hectares Corumba: −50% annually. Inapari and Paragominas: reduction from historical baseline. Other LIFTs: reduction from Year 1 baseline.	Paragominas, Inapari, Corumba
Objective 2: **Number of land users in target areas utilizing fire-free/fire-smart land management tools and practices**	Grantee reports, interviews, behavioral assessments (i.e. KAP survey)	LIFT-specific assessment based on current available tools practices	% of targeted land owners and managers using fire-smart tools and practices	-
Objective 3: **Number of hectares under fire-free/fire-smart land management**	Grantee reports, interviews, behavioral assessments, remote sensing data	200 hectares (Santarém, Cruzeiro do Sul) or less currently under fire-free management	At least 200 hectares additional per applicable LIFT consolidated under fire-free production systems	Cruzeiro do Sul, Santarém
Objective 4: **Hectares of post-fire area stewarded for resilience**	Satellite monitoring, field sensor data grantee reports	Active restoration activities in all LIFTs are <100 ha (zero in many) and not using science-based accelerated restoration methodologies.	Pilot areas applying accelerated restoration techniques and channeling innovative finance to scale. At least 100 ha under active restoration.	Cruzeiro do Sul, Santarém

South America Fire Fund — Indicators Framework				
Indicator	Methods	Generalized Baseline / Current Status	3-Year Target	LIFTs Applicable
Strategy 2: Enhanced Detection & Coordinated Rapid Response				
Objective 1: **Number of fire brigades per LIFT that achieve Brigade Capacity Level 1+ or 2 and Monitoring Level 2**	Readiness level determined by LIFT level brigade assessment. Brigade and Monitoring Levels described in Technology Annex	LIFT-specific readiness assessment	At least one 14-person brigade per LIFT at Brigade Level 1+/2 and Monitoring Level 2	-
Objective 2: **Response time to priority fires**	Incident reports, grantee reports	Baseline response time ranges: Roboré 7 hours Corumbá 36 hours	Reduction of 20-50% depending on LIFT-specific conditions	Roboré, Corumbá
Objective 3: **Hectares burned in biodiverse and/ or high-risk target areas**	Satellite imagery, incident reports, grantee reports	5-year average burned area per LIFT, clipped to pre-mapped priority ecological zones. Historical series available for all LIFTs from 1985 (MapBiomas). Santarem: 14,000 ha/yr Paragominas: 31,000 ha/yr Corumbá: 424,000 ha/yr Roboré: 40,143	Specific targets set based on priority areas selected with LIFT consortia and calibrated for annual climatic variance. Indicative range: Iñapari: 20–30% reduction over 3 years Corumbá: 50% reduction annually	Santarém, Paragominas, Corumbá, Roboré

South America Fire Fund — Indicators Framework				
Indicator	Methods	Generalized Baseline / Current Status	3-Year Target	LIFTs Applicable
Strategy 3: Integrated Fire Information & Decision Systems				
Objective 1: **Detection of understory and difficult to detect fires**	Research on modeling, AI, sensors, satellite or other remote/ in-situ detection methods	Current methods are still inadequate for detection of low-intensity, under canopy fires.	Validated methodology demonstrates improvement in detection capacity for under canopy fires	-
Objective 3: **Reduction in ignitions during high-risk periods**	Remotely-sensed hot pixel data overlaid on target land areas and properties during high-risk or no-burn periods	Historical data by LIFT	50% percent reduction in ignitions during high-risk periods.	-
Objective 4: **Number of target agencies and brigades effectively using integrated decision support tools**	Grantee reports	Baseline ranges from 0 (Iñapari) to 9 (Corumbá) organizations effectively using standardized tools	50% increase in organizations effectively using tools across all LIFTs, with a minimum of five in each LIFT.	Santarém, Corumbá, Iñapari

South America Fire Fund — Indicators Framework				
Indicator	Methods	Generalized Baseline / Current Status	3-Year Target	LIFTs Applicable
Cross cutting Strategies: Monitoring, Evaluation, and a Validated Strategy for Scaling the South America				
Objective 2: **Funding unlocked to ensure durability of interventions beyond outcome scoped for this grant**	Grantee reports	Baseline of 0	$20-$50 million leveraged through financial and insurance products	-
Objective 3: **Resource partners collaborate to advance future Fund objectives**	Funding collaborations	No additional funding secured	$70 million additional funding supporting the South America Fire Fund strategy	-

South America Fire Fund — Indicators Framework				
Green = Tier 1 (Universal) · Amber = Tier 2 (Multi-LIFT)				
Indicator	Strategy	Generalized Baseline / Current Status	3-Year Target	LIFTs Applicable
TIER 1 — Universal Indicators (applicable to all primary LIFTs)				
Hectares burned in biodiverse and/or high-risk target areas	S1/S2/S3	5-year average burned area per LIFT, clipped to pre-mapped priority ecological zones. Historical series available for all LIFTs from 1985 (MapBiomas).	Specific targets set based on priority areas selected with LIFT consortia and calibrated for annual climatic variance.	All primary LIFTs
Response time to priority fires	S2/S3	Baseline response time ranges from 7 (Roboré) to 36 (Corumbá) hours across LIFTS.	Reduction of 20-50% depending on LIFT-specific conditions	All primary LIFTs (phased baselines)
Number of escaped fires in target areas	S1/S2	Historical baseline of number of escaped fires from 10–15 yrs of remote sensing data for target areas.	50% reduced	All primary LIFTs (definition harmonized Year 1)
Number of organizations using standardized decision-support tools	S1/S2/S3	Baseline ranges from 0 (Tahuamanu) to 9 (Corumbá) organizations effectively using standardized tools.	50% increase in organizations effectively using tools across all LIFTs, with a minimum of five in each LIFT.	All primary LIFTs
Reduction in ignitions during high-risk periods	S1	Remotely-sensed hot pixel data overlaid on land designations and properties during high-risk or no-burn periods.	50% percent reduction in ignitions during high-risk periods.	Selected by Brazil and Bolivia LIFTs. Potentially add Peru LIFTs.
TIER 2 — Multi-LIFT Indicators (applicable to several LIFTs)				
Hectares of post-fire area applying science-based accelerated restoration approaches	S1	Active restoration activities in all LIFTs are <100 ha and not using science-based accelerated restoration methodologies.	Pilot areas applying accelerated restoration techniques and channeling innovative finance to scale.	Corumbá, Cruzeiro do Sul & Santarém
Detection of understory and difficult-to-detect fires	S3	Current methods still inadequate for detection of low-intensity, under canopy fires in Amazon.	Validated methodology demonstrates improvement in detection capacity for under canopy fires in the Amazon.	Research & university partners

* Partner-Selected | [TBD] targets to be finalized after Year 1 baseline data, stratified by ecoregion.

The five indicators presented here are the Fund's overarching, cross-cutting measures of success and are the headline results against which the Fund will report to the funder. However, a complete M&E plan requires an additional layer: process indicators for each objective under each strategy, which track implementation progress and the intermediate steps that lead to outcomes. These output-level indicators will need to be further developed in collaboration with each LIFT and technical working group prior to project launch. The M&E plan is designed to integrate directly with data collection efforts across the Fund's four workstreams — Behavior Change, Technology and Innovation, Accelerated Restoration, and Financial Innovation — ensuring that monitoring activities within each workstream feed into the overarching indicator framework rather than operating in parallel. This integration will be coordinated by the Fund's M&E expert in collaboration with each technical team, reducing duplicative data collection and building a unified evidence base across the full portfolio.

Experimental Design Approach

The experimental design is a rigorous but feasible scientific evaluation intended to support causal inference about the impact of Fund interventions. In the first year, the focus is foundational: defining and locking site boundaries, calculating the variability across sites within each LIFT using historical data, establishing baselines, and pre-registering the study design before any interventions begin. This phase should be understood as exploratory because the current configuration of six LIFTs and twelve study sites is underpowered for formal hypothesis testing; however, it is designed with sufficient rigor to generate credible effect size estimates and the site-level variability data needed to plan the next phase. Over the first three years, the Fund will implement an appropriate experimental design, such as a Before-After Control Impact (BACI) quasi-experimental design across LIFTs, complemented by a statistical matching analysis, conduct a mid-term evaluation, and use emerging CV and effect size data to determine whether a formally powered confirmatory study is feasible and what it would require. At full ten-year scale, corresponding to the $100M scenario, the Fund anticipates a formally powered, multi-LIFT confirmatory study with sufficient replication to disaggregate the effects of individual interventions from the systemic package, support cluster analyses across LIFTs, and produce peer-reviewed findings that generalize across the Amazon, Pantanal, and Chiquitania ecosystems.

Key Partners and Stakeholders

- **Academic Partners:** Remote sensing lead; multi-year contract for satellite data collection and analysis across all 12 study sites. Critical to Track 1 credibility.
- **LIFT Orchestrators:** Responsible for operational data collection using standardized templates; each operates one intervention and one comparison site.
- **Fund M&E Expert (to be hired):** Trilingual (English/Spanish/Portuguese); Fund-employed; responsible for indicator finalization, template development, data system management.
- **Fund M&E Support Staff (to be hired):** Trilingual staff reporting to Lead M&E Expert and coordinating directly with technical team leads to develop, oversee, and report on M&E framework.
- **External Evaluator (to be hired):** Fund-employed and independent of LIFTs; validates experimental design, spot-checks Track 2 data, leads mixed-methods assessment, and conducts formal evaluations.

- **Experimental Design Lead (to be identified):** Fund-employed and independent of LIFTs; validates experimental design, spot-checks partner-reported data, leads mixed-methods assessment, and conducts formal evaluations.

Strategic Relevance

The M&E plan embodies the Fund's four operating principles:

- **Adaptive, Iterative & Evidence-Based:** Pre-planned 18-month learning reviews allow mid-course strategy adjustment. The exploratory first phase is explicitly designed to generate effect size estimates that power a more rigorous second phase. Pre-registration ensures analytical decisions are made before — not after — results are available.
- **Flexibility for Accelerated Execution:** The two-track measurement architecture separates independent remote sensing (which can proceed autonomously) from operational data collection (which requires partner coordination), allowing both tracks to advance in parallel without bottlenecks.
- **Force Multiplier:** Academic partnerships leverage world-class scientific capacity that no single LIFT could access independently. The AI-enabled causal inference tool, currently in development, will position the Fund as a contributor to a cutting-edge methodological advance in conservation science.
- **Regional Legitimacy and Co-Design:** Indicators were selected by implementing partners themselves and draft Indicator definitions are being developed through partner consultation. The M&E expert and support staff will be trilingual and fluent in translating M&E frameworks for local partner use.

1. Technical Analysis

This section presents the analytical foundation for the Grant's M&E approach and experimental design choices, drawing on evaluation practice from comparable large-scale conservation programs, statistical feasibility analysis, and preliminary data from implementing partners.

1.1 Key Findings

Two-Track Measurement Architecture

The most important design decision in this M&E plan is the separation of indicators into two measurement tracks based on data source and independence. This distinction directly affects funder credibility: Track 1 (independent remote sensing) produces findings that are replicable and independently verifiable without any reliance on partner-reported data; Track 2 (standardized partner reporting) produces operational data that is essential for understanding implementation but requires a disciplined verification approach to be credible.

Statistical Power and Study Design

Preliminary power analyses — using conservative estimates of variability and minimum detectable effect sizes — indicate that 14 to 98 study sites over three fire seasons are needed to achieve 80% statistical power for formal hypothesis testing. The current 12-site configuration falls below this range. The key unknown is the coefficient of variation (CV) across sites within each LIFT: the lower bound (14 sites) assumes low variability; the upper bound (98 sites) assumes high variability.

This finding does not undermine the value of the current design. It refines the framing: the initial phase should be treated as exploratory and hypothesis-generating, not confirmatory. A rigorously executed exploratory study — with pre-registration, randomization where feasible, and transparent analysis — generates the effect size estimates and CV data needed to power a formally confirmatory second phase.

1.2 Comparative Insights and Case Examples

Several large-scale conservation and fire management evaluation programs inform this design:

- **BACI designs in tropical forest conservation (e.g., REDD+ evaluations):** Experience from REDD+ programs, particularly those using MapBiomas and satellite-based deforestation monitoring, demonstrates that independent remote sensing combined with matched comparison sites can produce credible, peer-reviewed impact estimates even in complex multi-actor landscapes.
- **3ie development impact evaluations:** The Registry of International Development Impact Evaluations (RIDIE) has catalogued numerous multi-site conservation and natural resource management studies that employ quasi-experimental designs with contribution analysis. Common lesson: pre-registration and locked definitions are the most cost-effective credibility investments available.

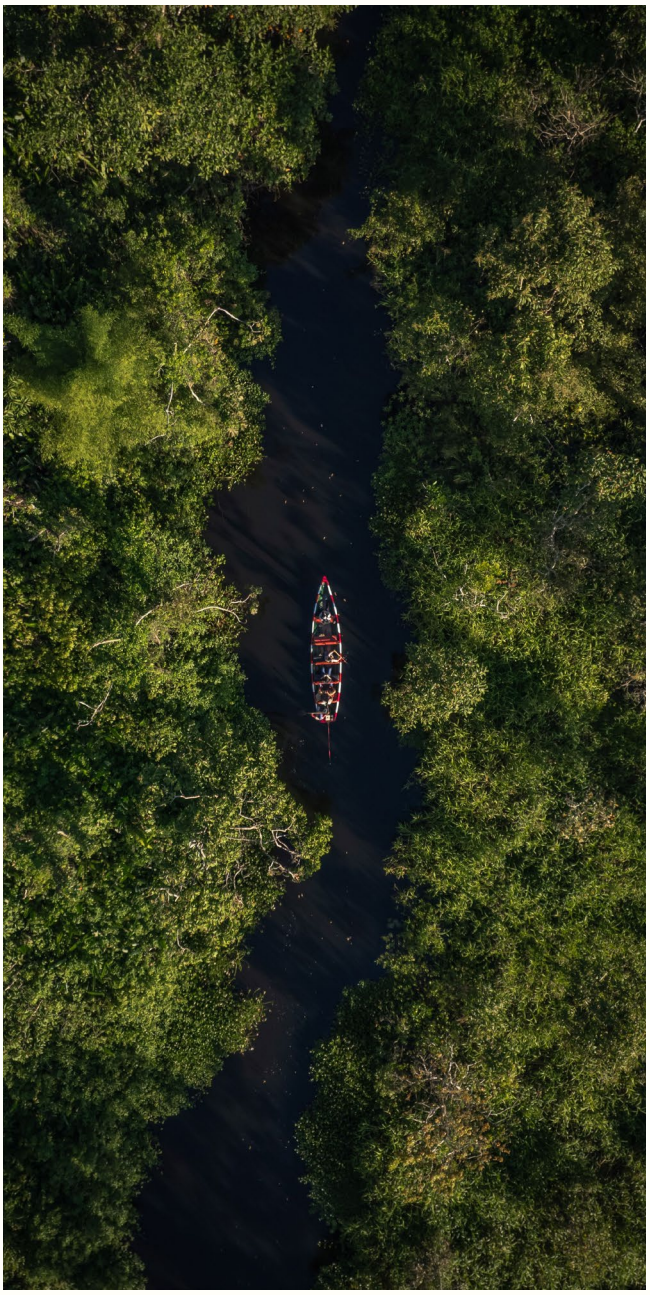
1.3 Gaps and Risks

Data Gaps

- **CV unknown for most LIFTs:** Without the coefficient of variation for fire outcomes across sites within each LIFT, it is not possible to give a precise power estimate. This gap will be addressed using historical data in Year 1.
- **Operational baselines absent for some LIFTs:** Response time, suppression rate, and tool adoption baselines are not available for most LIFTs. Year 1 data collection is designed to fill this gap before intervention effects accumulate.
- **FireSat not yet deployed:** Understory fire detection is contingent on FireSat availability, anticipated from Year 2. This indicator is included but explicitly flagged as aspirational for Year 1.

Risks and Mitigations

- **Risk:** Site boundary changes undermine measurement consistency. **Mitigation:** Boundaries are locked before intervention begins and formally documented. The external evaluator reviews and confirms boundary definitions as part of design validation.
- **Risk:** Post-hoc analytical decisions undermine credibility. **Mitigation:** Pre-registration of hypotheses, design, and analysis plan before data collection begins. Open Science Framework (OSF) and/or Registry for International Development Impact Evaluations (RIDIE) registration recommended.
- **Risk:** Partner-reported Track 2 data is inconsistent across LIFTs. **Mitigation:** Standardized templates developed and deployed by the Fund M&E expert; definitions locked a priori; periodic spot-checking by external evaluators.
- **Risk:** Spillover from intervention sites to comparison sites. **Mitigation:** Spillover effects will be monitored and documented as part of the evaluation protocol; the external evaluator will assess spillover during mid-term evaluation.
- **Risk:** Attribution challenged by climate variability and external drivers. **Mitigation:** Contribution analysis framework used rather than strict impact attribution; confounders documented transparently in all reporting.



2. Proposed M&E and Experimental Design Strategy

2.1 Core Activities by Scenario

The M&E plan and experimental design are two distinct efforts with different goals, staffing, and resource requirements. They are presented in separate tables below. The M&E plan is an ongoing accountability and learning system that runs for the full life of the Grant. The experimental design is a time-bounded scientific evaluation that builds on the same data infrastructure but requires additional analytical capacity and discipline to support causal inference.

Monitoring & Evaluation Plan

The M&E plan tracks implementation progress and outcomes across all Grant strategies and LIFTs. It is the basis for funder reporting and adaptive management throughout the project. At $30M, it covers six LIFTs with the full complement of seven overarching indicators, standardized partner reporting, and annual reporting to the funder. At $100M, the same system scales with the expanded LIFT portfolio.

2.2 Experimental Design

Design Logic

The Fund treats each LIFT as the unit of study — essentially running a separate experiment within each LIFT. Within-LIFT comparisons are scientifically defensible because intervention and comparison areas share key contextual drivers (governance, capacity, biophysical conditions). Cross-LIFT conclusions are framed as comparative learning — what worked in which contexts — not a single pooled attribution claim.

The treatment is the systemic package of coordinated actions across all three strategies: capacity building, governance support, prevention, suppression readiness, and decision-support tools. The design estimates the effect of this bundle in each LIFT context, not the effect of individual components.

Dependent Variable

The primary continuous dependent variable, compares potential burnable area to actual burned area for each study site. This approach requires: (1) a biomass map for each region; (2) a fuel continuity map based on land cover; (3) a potential burnable area map; (4) comparison of potential to actual burned area; and (5) comparison of this ratio across intervention and comparison sites within each LIFT.

Pre-registration

The Fund will pre-register its evaluation design on OSF (Open Science Framework), RIDIE, or AsPredicted.org before interventions begin. Pre-registration elements to be resolved: research question and hypotheses; number of units per LIFT; timeline; randomization approach; primary and secondary outcomes; statistical methods; nested structure; covariates; missing data handling; minimum detectable effect size; and protocol deviation procedures.

2.3 Implementation Model

Adaptive, Iterative & Evidence-Based

The Fund's learning reviews synthesize evidence across all six LIFTs, identify what is working, and update the portfolio strategy without compromising longitudinal trend data. The exploratory first phase is explicitly designed to generate the effect size estimates and CV data needed to power a formally confirmatory second phase. Pre-registration ensures analytical decisions precede results.

Flexibility for Accelerated Execution

The two-track architecture allows remote sensing (Track 1) to advance autonomously — unaffected by partner coordination bottlenecks — while Track 2 operational data collection proceeds in parallel. This separation prevents delays in one track from blocking the other.

Regional Legitimacy and Co-Design

Indicators were selected by implementing partners. Definitions are being developed through active partner consultation. The M&E expert will be trilingual and capable of translating M&E frameworks for local partner use in Spanish and Portuguese. Comparison sites will be selected in partnership with LIFTs and independently validated.

2.4 Key Stakeholders

- **Government agencies (INPE, SERFOR, national fire management authorities):** Data sources for operational baselines; key audiences for decision-support tool adoption.
- **Research institutions:** Scientific partners for remote sensing and causal inference.
- **Technology providers (detection systems, decision-support platform developers):** Critical to Track 1 detection capability and Track 2 tool adoption measurement.
- **Local communities and landowners:** Subjects of behavioral and landowner surveys; co-design partners for fire-smart land management indicators.
- **3ie and the development evaluation community:** RIDIE registration and peer engagement with the impact evaluation community strengthens Fund credibility.

3. Budget and Resource Requirements

3.1 Sustainability

The M&E and experimental design infrastructure built in this phase has value beyond the initial fund cycle.

Specifically:

- The remote sensing methodology, once established and documented, creates a replicable monitoring system that can be extended to additional LIFTs and landscapes at low marginal cost — a critical ingredient for the $100M scale scenario.
- Pre-registration and publication of findings in peer-reviewed outlets builds scientific credibility that attracts future research partnerships and co-financing.
- The CV and effect size data generated in this phase are essential inputs for securing funding for a larger, confirmatory second phase, making this exploratory investment a precondition for the larger program's financial sustainability.

3.2 Leveraging Opportunities

- University collaboration may catalyze additional academic partnerships and in-kind technical contributions to causal analysis.
- Pre-registered and published findings can be submitted to RIDIE and referenced in future multilateral (GEF, GCF) funding applications, positioning the Fund as a methodological leader in fire management evaluation.
- A particular university partnership creates opportunities to embed the Fund's study sites within broader Amazon and tropical forest monitoring initiatives, potentially unlocking shared infrastructure costs.
- The data management system and standardized templates, once developed, can be licensed or shared with other fire fund geographies at minimal cost, creating reputational leverage..