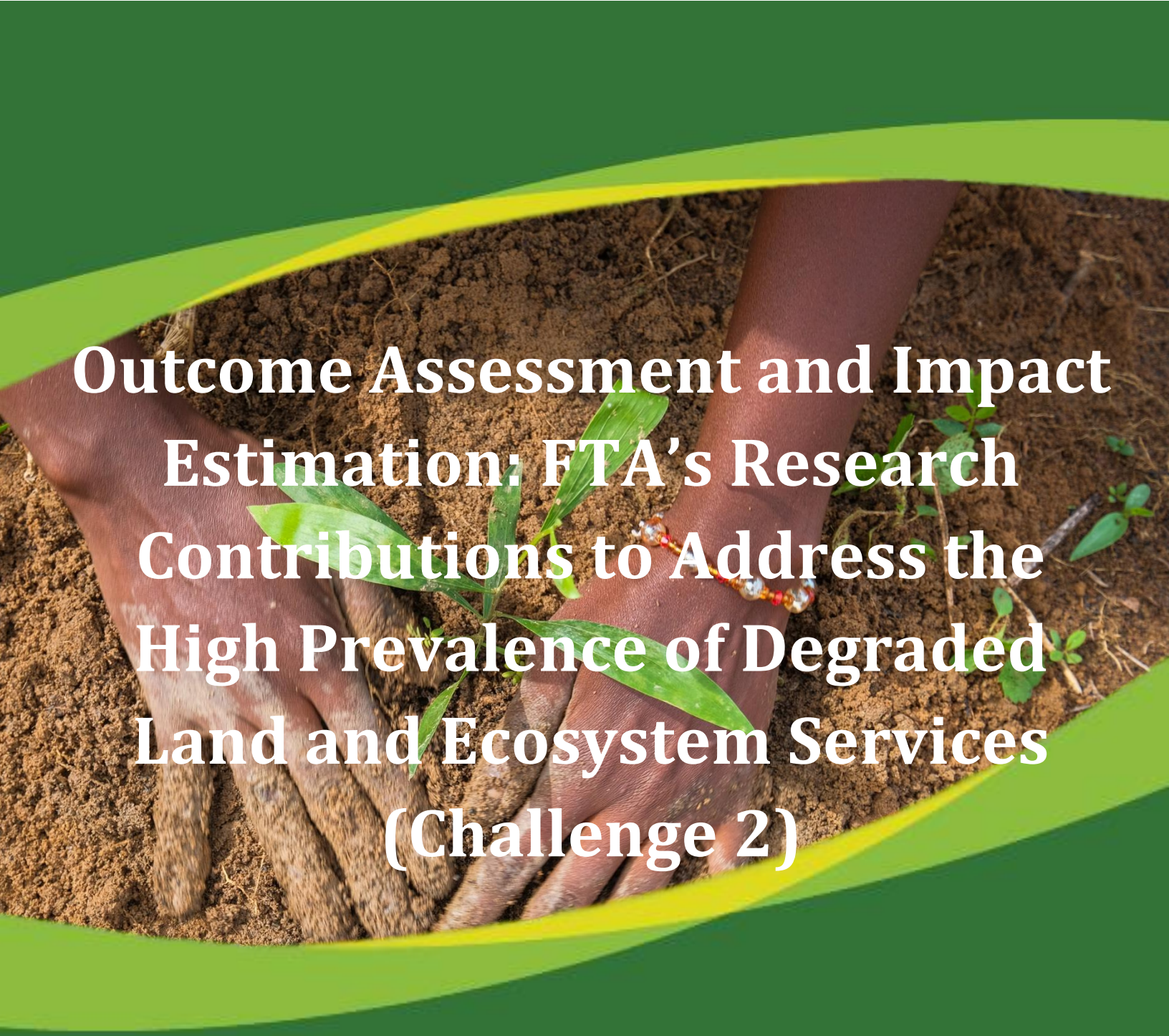

Outcome Assessment and Impact Estimation: FTA's Research Contributions to Address the High Prevalence of Degraded Land and Ecosystem Services (Challenge 2)

An Integrative Study of the Forests, Trees and Agroforestry Research Program (2010-2021)

CGIAR RESEARCH PROGRAM ON Forests, Trees and Agroforestry

CIFOR | World Agroforestry | Alliance Bioversity International | CIAT International Center for Tropical Agriculture Since 1967 Science to cultivate change | Royal Roads University

Cover photo: April 2021 acacia plantation near the village of Moussa, Yangambi - DRC Photo: Axel Fassios/CIFOR

This evaluation features research undertaken as part of the FTA program, led by FTA partner institutions (Center for International Forestry Research (CIFOR), World Agroforestry (ICRAF), Bioversity International, the French Agricultural Research Centre for International Development (CIRAD), the Tropical Agricultural Research and Higher Education Center (CATIE), the International Network for Bamboo and Rattan (INBAR), and Tropenbos International) and/or other international and national partners. The evaluation uses the term 'FTA' to represent the collective contributions of partners and/or the particular organization that led the work.

Any views expressed in this publication are those of the authors. They do not necessarily represent the views of CIFOR, ICRAF, Bioversity International, the CGIAR Research Program on Forests, Trees and Agroforestry, the editors, authors' institutions or financial sponsors.

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This evaluation was carried out as part of the as part of the CGIAR Research Program on Forests, Trees and Agroforestry (FTA). FTA is the world's largest research for development program to enhance the role of forests, trees and agroforestry in sustainable development and food security and to address climate change. CIFOR leads FTA in partnership with ICRAF, the Alliance of Bioversity International and CIAT, CATIE, CIRAD, INBAR and TBI.

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3E	Effective, Efficient, Equitable
AFC	Agroforestry concession
BRG	Peatland Restoration Agency (Indonesia)
BSO	Breeding Seedling Orchard
C	Carbon
CATIE	*Centro Agronómico Tropical de Investigación y Enseñanza* (Tropical Agricultural Research and Higher Education Center)
CBD	Convention on Biological Diversity
CCCMC	Chinese Chamber of Commerce of Metals, Minerals and Chemicals Importers and Exporters
CGIAR	Consultative Group on International Agricultural Research
CIFOR	Center for International Forestry Research
CIRAD	*Centre de coopération internationale en recherche agronomique pour le développement* (French Agricultural Research Centre for International Development)
CO_2	Carbon dioxide
COP	Conference of Parties
CRP	CGIAR Research Program
CSO	Civil society organization
D4R	Diversity4Restoration
DFID	Department for International Development (United Kingdom)
DRC	Democratic Republic of Congo
EU	European Union
FAO	Food and Agriculture Organization
FCCC	Forests and Climate Change in Congo Project
FCM	Forest Concession Moratorium
FMNR	Farmer Managed Natural Regeneration
FORETS	Formation, Recherche, Environnement dans la Tshopo Project
FORSIBU	Forum of Haze-Free Country (Indonesia)
FP	Flagship Program
FREL	Forest Reference Emission Level
FTA	Forests, Trees and Agroforestry
GCS	Global Comparative Study
GGGI	Global Green Growth Institute
GHG	Greenhouse gas
GLF	Global Landscapes Forum
GoI	Government of the Republic of Indonesia
GoN	Government of the Kingdom of Norway
GoP	Government of Peru
Gt	Gigaton
ha	hectare
ICCN	*Institut Congolais pour la Conservation de la Nature* (Congolese Institute for Nature Conservation)
ICRAF	World Agroforestry
IDO	Intermediate Development Outcome
INBAR	International Network for Bamboo and Rattan
INCAS	Indonesia National Carbon Accounting System
INDC	Intended Nationally Determined Contributions
INREMP	Integrated Natural Resource and Environmental Management
IUCN	International Union for Conservation of Nature
IWMA	Integrated Watershed Management Approach
LDSF	Land Degradation Surveillance Framework
LUWES	Land-Use Planning for Low Emission Developing Strategies
m	Meter

MARD	Vietnamese Ministry of Agriculture and Rural Development
M&E	Monitoring & Evaluation
MECNT	Ministry of Environment, Nature Conservation and Tourism (Democratic Republic of Congo)
MELIA	Monitoring, Evaluation, Learning and Impact Assessment
MINAM	*Ministero del Ambiente* (Peruvian Ministry of Environment)
MINEPDEP	Ministry of Environment, Nature Protection and Sustainable Development (Cameroon)
MLG	From Climate Research to Action under Multilevel Governance: Building Knowledge and Capacity at Landscape Scale Project
M(M)RV	Monitoring (Measurement), Reporting, and Verification
MoU	Memorandum of Understanding
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
NWAP	National Watershed Agroforestry Multistakeholder Platform
PARA	Piloting Approaches to Rural Advisory Services in Support of Scaling of the Agroforestry Concessions Scheme in Peru Project
PERDA	*Peraturan Daerah* (Indonesian Provincial Regulation)
PFES	Payment for Forest Environmental Services
PGIS	Participatory Geographic Information Systems
RBP	Results-based Payment
RPP	Readiness Preparation Proposal
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REFORCO	*Appui à la politique Nationale de conservation et gestion des forêts et de la biodiversité en République Démocratique du Congo* (Support for the National Policy for the Conservation and Management of Forests and Biodiversity in the Democratic Republic of Congo Project)
RES	Rewards for Ecosystem Services
RSPB	Royal Society for the Protection of Birds (Thailand)
RUPES	Rewarding Upland Poor for Environmental Services
SERFOR	*Servicio Nacional Forestal y de Fauna Silvestre* (National Forest and Wildlife Service of Peru)
SLO	System-level Outcome
SME	Small and medium enterprise
SOP	Standard Operating Procedure
SPDA	*Sociedad Peruana de Derecho Ambiental* (Peruvian Society of Environmental Law)
SRE	Sustainability Research Effectiveness
SUCCESS	Support to the Development of Agroforestry Concessions in Peru Project
t	Tonnes
ToC	Theory of Change
TEEB	Forest Trends, and The Economics of Ecosystem and Biodiversity Initiative
TPP	Transformative Partnership Platform (on agroecological transitions)
UNFCCC	United Nations Framework Convention on Climate Change
UNIKIS	University of Kisangani
USAID	United States Agency for International Development
USD	United States Dollar
VND	Vietnamese đồng
VNFF	Vietnam Fund for Forest Protection and Development
VNFOREST	Vietnam Forestry Administration
WWF	World Wildlife Fund

Executive Summary

Introduction

Productive land is vital to sustain life. Approximately 25 percent of the global land area was degraded by 2016 and the trend has been worsening. Some projections estimate 95 percent of Earth's land mass could be degraded by 2050 (Sutton et al., 2016). The value of lost ecosystem services as a result of land and forest degradation is estimated to be between USD $6.3– 10.6 trillion/year (Kaija, 2021; ELD, 2015). The impact of this trend is felt most by natural resource-based communities. Restoring land to be productive again has been a focal area of global collective action. Ambitious restoration targets have been set worldwide (e.g. Bonn Challenge, AFR100), and global plans to conserve genetic resources (e.g. FAO's Global Plan of Action on Forest Genetic Resources) to incentivize the reversal of land and ecosystem degradation at scale.

The Forests, Trees and Agroforestry (FTA) CGIAR Research Program (CRP) represents a substantial investment of 850 million USD over the past ten years. Its research agenda aimed to develop solutions to key global challenges, including the high prevalence of degraded land and ecosystem services. The purpose of this report is to provide an account of FTA's research, and the extent and nature of its contributions to outcomes and impacts on restoring degraded land and ecosystem services, according to the following targets FTA set in response to the CGIAR (Phase II proposal):

- 30 million hectares (ha) of degraded land restored;
- agricultural greenhouse gas emissions reduced by 0.2 Gigatonnes (Gt)/year; and
- 0.225% increase in water and nutrient (inorganic, biological) use efficiency in agroecosystems, including through recycling and reuse

Method

FTA's contributions to reversing land and ecosystem degradation were assessed by:

- Mapping of projects and initiatives addressing the challenge: The team carried out multiple interviews with project scientists and managers, and desk reviews, to define research clusters by theme and geography that were relevant to the challenge. The projects included in the review required a focal point on restoration to be included in this analysis.
- Developing composite Theories of Change (ToC)s: All available information was used to develop and document composite ToCs (i.e., combining ToCs for related programs/projects), to determine how FTA's activities and outputs were expected to contribute to outcomes and impacts for FTA's program to address the high prevalence of land and ecosystem service degradation.
- Assessing outcomes for each cluster of research: Available evidence was collected and synthesized to test each element in the ToCs; critical data and knowledge gaps were also identified during this process. Additional data was collected as needed and possible to assess outcomes, estimate impacts using projections from available documentation and evidence, and make plausible connections between FTA contributions to outcomes and the likelihood for potential impacts to be realized in the future.
- Deep dive selection and analyses: A preliminary prioritization based on the evidence appraisal indicated that some clusters demonstrated high potential for impact and could be pursued at low cost for supplementary data collection. It was clear from an initial review of available project documents that FTA had contributed to the design, implementation, and adoption of context-appropriate agroforestry practices that support restoration in many contexts, and that FTA had developed useful decision-support tools to assist program implementers with restoration initiatives. To illustrate these contributions more clearly and explore the pathways to impact in more detail, two "deep dive" case studies were designed and implemented: 1) a case study in Ethiopia, to investigate the effects of agroforestry scaling interventions (using options by context), and 2) further analysis of the applications of the Diversity4Restoration tool. (decision-support tool which generates species combinations considering climate scenarios, links with seed suppliers, and suggests propagation and management techniques to meet user-defined restoration objectives).

- Impact Estimation: A review of project and program level documentation was undertaken to estimate plausible ranges of potential impact resulting from the chain of events to which FTA's research has contributed. Individual FTA projects defined and reported the actual or potential adoption, use, and impact of their work in diverse ways and units of measure. High and low end estimates were derived through the document review in the following metrics: 1) hectares of land under restoration as a result of collective processes to which FTA's research and engagement contributed; and 2) amount of carbon dioxide (CO_2) emissions in tons, which are being sequestered as a result of FTA's contribution to landscape restoration. We also consider additional metrics that quantify effects on biodiversity (% increase), water (m3) and soil (t) conservation, where available to address the use efficiency target.

Challenge 2 Theory of Change

FTA research aimed to tackle the key drivers of land and ecosystem service degradation, such as unsustainable agricultural practices (e.g. over tilling, poor water management, excessive use of inorganic fertilizers and pesticides). To do so, FTA co-generated knowledge to frames issues, developed decision support tools to guide restoration in various contexts, provided data to understand current conditions of land degradation and trends over time, developed policy solutions and innovations, offering guidance and support for implementation, and social process contributions via training, capacity-building, and targeted engagement to multiple actor groups to facilitate uptake. FTA's research and engagement efforts aimed to contribute to land restoration by informing and influencing a wide range of actors, from researchers to government policymakers, NGOs, and farming community members. FTA aimed to contribute to restoration of land and ecosystem services (e.g. soil and water health, biodiversity, provision) through:

- supporting scaling efforts for widespread adoption of context-sensitive agroforestry practices
- promoting the use of improved varieties of cacao and supporting other climate-resilient seed systems to restore drylands
- contributing to better and more integrated policies, reward and incentive mechanisms to facilitate adoption of more sustainable land use and management practices that support land health
- curbing the overexploitation of key genetic resources (e.g. coconut, cacao) through conservation and sustainable use
- advancing and aligning restoration, climate, and biodiversity initiatives to promote tree-based restoration
- establishing and developing bio-energy markets (e.g. bamboo, nyamplung) that simultaneously support land and ecosystem service restoration.

Results: Outcome Evaluation

The assessment indicates that FTA has influenced practices, policies and further research that have contributed to sustainable landscape and ecosystem service restoration (Table 1). FTA's influence on policy supported the enabling environment for land restoration across Latin America, Africa, and Asia (e.g. rewards for environmental services, development of bamboo, agroforestry concessions, green growth, low-emissions development and land-use plans), and globally (e.g. COP12 decision to consider genetics in restoration). Policy influence was achieved through their representation on technical working groups, directly supporting policy development (white paper preparations), and participating in policy dialogues and events. FTA's influence on farmer practices was achieved through the implementation of demonstration trials, trainings to support to seed system infrastructure development, nursery establishment, management, and the introduction of resilient and context-adapted species. FTA supported the development of necessary capacities for variable farmer adoption of improved land management practices worldwide. Barriers and feasibility considerations for sustained adoption (e.g. lack of market linkages and extension) are of utmost importance for future research programs to address in developing their research agendas. FTA's influence on restoration program design, implementation and financing was achieved through the development of decision-support tools and modeling, testing, and promotion of co-investment schemes. Lastly, FTA's influence on research trajectories was achieved through its academic rapport, broad networks, mutually beneficial partnerships, and opportunities for local research capacity building.

Table 1 Key outcomes realized by FTA research and engagement

Type of influence	***Scale of influence (geography)***			
Key policies influenced	**Global**	**Latin America**	**Asia**	**Africa**
• Convention on Biodiversity (CBD) decision at COP12 to consider genetics in restoration	✓ (196 countries)			
• UNFCC decision 2011 for stepwise approach in setting, measuring and reporting forest reference emission levels (FREL)	✓ (197 countries)			
• Agroforestry concession implementation stipulating soil and water conservation practices, and tree planting		✓ (Peru)		
• National bamboo strategies and action plans, national product standards to facilitate planting on degraded lands				✓ (Ethiopia, Ghana, Kenya, Uganda, Tanzania, Madagascar, Cameroon)
• Green Growth Action Plan			✓ (Lam Dong)	
• National and provincial policy frameworks to support agroforestry solutions and son tra development			✓ (Dien Bien, Yen Bei, Vietnam)	
• Co-development of rewards for ecosystem service policy mechanisms			✓ (Vietnam, Indonesia)	
• Priority area for restoration identified, compulsory replanting directive in licensed planted forest areas and increased levy for timber from swamp and hill forests to generate funds for rehabilitation of rehabilitation of logged areas			✓ (Sarawak, Malaysia)	
• Tree seed legislation to include agroforestry seed		✓ (Ethiopia, Malawi)		
• Fire prevention policies			✓ (Indonesia)	
• Local development plan				✓ (Yangambi reserve - DRC)
Key practices influenced				
• Cryopreservation protocol for coconut (patent pending)	✓ (7 coconut producing countries)			
• Trait measurement of cacao physiology established and available for use	✓			
• Restoration program implementers using FTA decision-support tools		✓ (Colombia, Peru)		✓ (Madagascar, Cameroon, Kenya)
• Farmers trained in and adopting various agroforestry practices (e.g. FMNR, intercropping, options by context)			✓ (Indonesia, Vietnam, China, Laos, Myanmar, Thailand)	✓ (Ethiopia, Kenya, Somalia, Mali, Niger, Burkina Faso, Rwanda, Ghana, Malawi)
• Nurseries and seed production areas established, practicing promoted sustainable techniques			✓	✓
• Application of green alternatives to rubber monocultures (e.g. understorey enrichment and herbicide cessation use)			✓ (China, Laos, Myanmar, Thailand)	
• Policymakers applying LUWES tool to inform low-emission development		✓ (Peru)	✓ (Indonesia, Vietnam)	✓ (Cameroon)

FTA Outcome Assessment and Impact Estimation: Challenge 2 (High Prevalence of Land and Ecosystem Service Degradation)

Key influence on research				
• 305 students (at Bachelor's, Master's and PhD levels) trained and gained experience through FTA research to address land and ecosystem service degradation	✓			
• 1,461 published articles with a total of 40,831 citations of FTA research to address land and ecosystem service degradation	✓			
• Global Strategic Cocoa Collective established with FTA representation	✓			
• SAFORGEN established with FTA representation to coordinate restoration efforts			✓ (Africa South of the Sahara)	
• Sustainable rubber platform for rubber industry guidance established with FTA representation and contribution	✓			
• Global tree knowledge platform, resources for global tree planting	✓			

Results: Impact Estimation

Of the 54 projects assessed, 32 measured and reported on the indicators of interest over the project contexts. Based on the available data, we estimate that 2.1 million ha is currently under restoration, and 34.4 million ha of land has potential to be under restoration as a result of collective processes to which FTA research and engagement contributed. Corresponding potential CO_2 sequestration from active planting is estimated at 1.4 million tons, with potential of up to 511.5 million tons. Only one project reported projected biodiversity increases (up to 15% in forest biodiversity over the implemented area), and water conservation (36-97 million m^3) as a result of successful implementation of FTA-informed policy in Lam Dong Vietnam (Green Growth Action Plan), and soil conservation effect potential (130,000 tonnes/year) as a result of assumed FTA innovation uptake in Ethiopia (locally adapted seed portfolios).

Impact estimates rely on several assumptions, unique to each project's context, but which can be broadly characterized as:

- FTA outputs influence the design of policies and programs and those policies and programs are effectively implemented to reach their objectives
- FTA scaling and training efforts are sufficient to influence changes in practice that generate benefits for farmers and ecosystems
- Areas that experience FTA innovation or uptake of innovation experience net positive gain of ecosystem services
- Estimates of benefits provided in project reports and evaluations are correct

Limitations

The limitations encountered during the evaluative process informed a set of lessons to improve future MELIA practices and research-for-development. Interpretation of the results should consider the following limitations:

1. Variable data quality and availability: data on research interventions, and their outcomes and impacts, were variable and inconsistently reported.
2. Risk of double counting: the variability in reporting, and the lack of clear method descriptions and geographic disaggregation in the areas and effects reported to have benefited from FTA interventions made it extremely difficult to discern whether there was geographical overlap in reported numbers. This was followed up where possible, but returned uncertain responses in most cases.
3. Fuzzy boundaries on the scope of the challenge: the breadth of the ecosystem services concept posed difficulties in determining which research initiatives should be included in the analysis.
4. Practical considerations on the scope of the study: the impact of staff turnover, and the COVID19 pandemic on research activities created delays and hampered progress.

Conclusions

We conclude with the following lessons learned and recommendations for future research for development program design, implementation, and monitoring to address the high prevalence of land and ecosystem service degradation:

Lessons Learned for Research with the Purpose of Restoring Land and Ecosystem Services

1. *Long term engagement and working in partnership is key for achieving influence:* Overall, when FTA engaged in successful partnership with its target audiences, actively contributed to policy development, and filled key capacity gaps regarding planting, genetic conservation, and sustainable management, interventions were successful at realizing outcomes, and demonstrate potential for restoration impact. While FTA has a wide range of geographic reach through its activities, its influence is most pronounced in high-activity countries (e.g. Vietnam, Indonesia, Peru, Ethiopia) and/or where interventions on certain topics have been well-established (e.g. agroforestry options by context, bamboo bioenergy, REDD+). This allowed research activities to meaningfully build on each other, and develop and maintain rapport with key stakeholders through a legacy of partnership.

2. *Geographic and topical alignment supports sustained engagement with partners:* There was some diffusion of research and engagement efforts across geographies and research topics across the program. We observe a broad range of outcome contributions, rather than sustained investment in transformative change (with a few exceptions: e.g. REDD+, agroforestry in African countries, Agroforestry concessions in Peru, and RES in Vietnam). While FTA made significant contributions to addressing this challenge, a more cohesive strategy across research efforts, topics, and geographies would have enhanced contributions.
3. *Context-sensitivity essential in research for restoration:* FTA research the advancement of restoration toward context sensitivity, by developing tools, co-generating knowledge, and building capacities to implement practices that restore land and ecosystem services. Adoption rates of new practices were variable, depending on many contextual factors. Adequate incentive and market links, sustained extension, and resilience to external shocks are essential for restoration at scale. Researchers should explicitly consider contingencies, facilitating factors, and barriers to uptake of practices that support land and ecosystem health, and their implications for the research agenda.

Recommendations for Enhanced MELIA

1. *Aim for continuous monitoring and evaluation through systematic and consistent documentation of projects' outcomes and influence.* Implement a transparent monitoring and evaluation process from start to finish for all research projects or programs. Aim to quantify and report targeted intended outcomes and impacts at both the project and program-level (e.g., flagship-level).
2. *Strive for consistency in the application of monitoring and evaluation concepts.* We recommend enhanced capacity-building for FTA researchers on MELIA concepts and approaches, to promote consistent understanding, use, and application.
3. *Use nested ToCs to support challenge-centric program and strategy design.* Researchers and program managers should fully utilize ToC as a dynamic process. ToC should be a core element of strategic project planning and adaptive management to guide program management and support the collection of outcome and impact data for evaluation. Future research-for-development programs should be guided by the value offer of purpose-driven central coordination for impact, which can be informed by explicit and well-developed ToCs.

Introduction

Research for development programs intervene in complex systems. FTA is an integrative research program with five distinct research themes, or Flagship Programs (FPs), and each FP comprises multiple projects, most of which are funded bilaterally. Moreover, FTA has a set of 25 demand-driven operational priorities focused on different areas of the program. Therefore, FTA can be characterized as an umbrella for several distinct, albeit inter-related, research initiatives. As with Challenge Programs and other large transdisciplinary research programs, FTA is expected to devise solutions to pressing societal problems and, in turn, contribute to tangible developmental and environmental impacts on a large scale. These expectations (Table 2) are manifested in a set of objectives and targets contributing to the ambitious targets (set in 2016) that the CGIAR is expected to deliver by 2022:

- 31 million more farm households have adopted improved varieties, breeds or trees, and/or improved management practices
- 19 million people, of which 50% are women, helped to exit poverty
- Improve the rate of yield increase for major food staples by 0.1845%/year
- 17 million more people, of which 50% are women, meeting minimum dietary energy requirements
- 0.225% increase in water and nutrient (inorganic, biological) use efficiency in agroecosystems, including through recycling and reuse (same target)
- Reduce agricultural-related greenhouse gas emissions by 0.2 Gt CO_2^{-e} yr compared with business-as-usual scenario in 2022
- 30 million ha degraded land area restored
- 2.5 million ha of forest saved from deforestation

Table 2: FTA's Expected Results (FTA's Phase II Proposal)[1]

End of Program Outcomes	Intermediary Development Outcomes (IDOs)	System-level Outcome (SLO) Target	FTA Target Contribution
1. 25 countries improve governance mechanisms, institutions & tools for a) safeguarding forests/tree diversity and b) equitably managing forests & trees within mosaic landscapes	Improved ecological integrity, equitable mgt. & protection of forests & non-forest-based tree resources (IDOs 3.1 & 3.3) 1. Enhanced ecosystem service provision (e.g., carbon storage, nutrient cycling, water filtration & soil health) (IDOs 2.3 & 3.2) 2. Increased resilience of female, male & poor smallholders & other forest/tree users to climate change & other shocks (IDO 1.1) 3. Productivity, food & nutritional security & incomes for female, male & poor smallholders & other forest/tree users (IDOs 1.2-1.4, 2.1)	1. 100 million more farm households have adopted improved varieties, breeds or trees, and/or improved management practices 2. 30 million people, of which 50% are women, helped to exit poverty 3. Improve the rate of yield increase for major food staples from current <1% to 1.2-1.5% per year 4. 30 million more people, of which 50% are women, meet minimum dietary energy requirements 5. 5% increase in water and nutrient (inorganic, biological) use efficiency in agroecosystems, including through recycling and reuse (target same) 6. Reduce agricultural-related GHG emissions by 0.2 Gt CO_2^{-e} yr^{-1} (5%) compared with business-as-usual scenario in 2022 7. 55 million ha degraded land area restored 8. 2.5 million ha of forest saved from deforestation	1. 31 million 2. 19 million 3. 0.1845% 4. 17 million 5. 0.225% 6. 0.2 Gt CO_2^{-e} yr^{-1} 7. 30 million 8. 2.5 million
2. About 20 multinational companies and 500 private sector actors pursue models & investments for a) improved mgt. & safeguarding of forest & tree resources and b) enhancement of inclusive landscape-based livelihoods & ecosystem services			
3. National and sub-national public & private sector actors in 25 countries deliver more effective & equitable tree related breeding, delivery, extension & pedagogical services			
4. At least 40 million smallholders & other users access more productive tree planting material & uptake higher performing, context appropriate & inclusive AF & small-scale forestry mgt. option			

[1] Original targets were crafted by the CGIAR in a top-down manner for the whole portfolio, and then distributed to different CRPs, but without a clear quantitative approach and method.

The causal links between research and impact are long and complex. To generate evidence of contributions to these targets, an integrated impact estimation strategy was developed. This strategy considers that FTA addresses five challenges:

- Challenge 1: Accelerating rates of deforestation and forest degradation;
- Challenge 2: High prevalence of degraded land and ecosystem services;
- Challenge 3: Unsustainable land use practices widespread;
- Challenge 4: Persistent rural poverty with increasing levels of vulnerability; and
- Challenge 5: Rising demand and need for nutritious food for both current and future generations

This study examined whether and how FTA contributed to changes in governmental (subnational, national, and inter-national) and organizational policy and development practice that would influence social and environmental change in the contexts where FTA's research operates and beyond. The assessment uses a theory-based evaluation approach (Belcher, Davel, & Claus, 2020) to model collective FTA activities and outputs, as well as intended outcomes and impacts, and to estimate (potential) FTA contributions to the aforementioned impact targets (Table 1). The assessment is guided by the following questions:

1. Research Outcome Evaluation: To what extent and how did FTA's research portfolio realize outcomes in each of the five challenges?

i. What is the evidence that outcomes have been realized?
ii. Were the ToC assumptions valid?

2. Impact Estimation: What is the scope and scale of impacts to which FTA's research portfolio has contributed in each of the five challenges?

i. What is the spatial location and extent where the impact is (likely to be) realized?
ii. What plausible ranges of effects have and are likely to manifest (e.g., tons of carbon sequestered, ha of land under restoration)?
iii. What key assumptions are required to estimate the impact?

The assessment uses a set of composite ToCs as analytical frameworks. A ToC is a set of projected causal relations, hypotheses, and assumptions that describe and model how and why a project or program is expected to contribute to a change process. The ToC details the main activities and outputs, identifies key actors involved in the change process, specifies their actions as a sequence of steps or stages (i.e., outcomes) in the process, and exposes the theoretical reasoning for the expected changes (Earl, Carden, & Smutylo, 2001; Vogel et al., 2007). The ToC aims to explain who (i.e., individuals and organizations) is expected to do what differently and why as a result of FTA's research and engagement. Given that FTA's work is diverse and comprises numerous individual research-for-development projects, efforts were made to systematically document what work has and is being undertaken vis-à-vis each challenge to explore how a sum of projects contribute to potential impacts.

This report focuses on outcome evidencing and impact estimation for Challenge 2 (High Prevalence of Degraded Land and Ecosystem Services). We conceptualize land degradation broadly, according to the Food and Agriculture Organization's (FAO) (2021) definition: all negative changes in the capacity of the ecosystem to provide goods and services. Goods and services are benefits that serve humankind and sustain ecosystem function, some examples include extreme weather mitigation, water cycling, soil health, medicine, food, and income derived from natural environments. To that end, within this report, we assess FTA's potential impact in terms of hectares of land considered under restoration (i.e., any positive change in the land that supports the capacity of the ecosystem to provide goods and services) as a result of collective processes to which FTA's research and engagement contributed. We estimate potential impacts in terms of resulting positive effects for ecosystem services associated with such restoration with the following proxies: 1) climate regulating services: CO2 sequestration (tons), 2) supporting/regulating soil quality: soil conservation (tons), 3) supporting water cycling: water conservation (m3), 4) all services: biodiversity increases (%).

Owing to the diversity of the approaches FTA takes to address land and ecosystem service degradation, and the variable range of available evidence for each of the clusters as identified in Table 3, we selected two case studies for further analysis.

As a multi-regional cluster, it is not possible to investigate all of FTA's interventions on scaling agroforestry within the respective countries owing to time and resource constraints of this study. Through an in-depth review of relevant documentation, it was decided to focus on FTA's contribution to influencing the adoption of agroforestry practices and establishment of breeding seedling orchards with superior seeds through the PATSPO project. We also considered flagship, institutional, and partner representation in the integrative studies, to ensure that the deep dives feature a broader scope of the means by which FTA influences land and ecosystem service restoration. The Diversity4Restoration (D4R) tool was therefore selected for follow up analyses, as the preliminary evidence review, and a survey conducted in 2020 indicated high interest as well as actual and perceived utility of the tool across global restoration contexts. D4R is a decision-support tool which generates species combinations considering climate scenarios, links with seed suppliers, and suggests propagation and management techniques to meet user-defined restoration objectives.

We begin by describing the methods and process for outcome assessment and impact estimation. We then present the overarching Theory of Change (ToC) for how FTA research addresses land and ecosystem service degradation. We then report on results for each of the 13 clusters of research. The results lead into a set of conclusions regarding future design and implementation of research programs with integrated monitoring and evaluation for impact.

Method

Step 1. Mapping projects to frame FTA contributions to addressing the five challenges

As an overarching FTA-level ToC did not exist to guide FTA's programs for each of the specific challenges. The first step was to retrospectively map a selection of FTA-funded projects to the five challenges. Many projects could contribute to meeting more than one of the five challenges, so primary and secondary challenge categories were mapped by project when possible. This first step defined preliminary research clusters by theme and geography. 54 projects were mapped to Challenge 2.

Step 2. Documenting composite overarching and sub-ToCs per challenge – the case of Challenge 2

The evaluation team undertook a desk review of project materials mapped to Challenge 2 and consulted with scientists and Flagship leaders to guide the development of the composite ToCs. Some projects had explicit ToCs documented, but most had only implicit or very general (i.e, unevaluable) ToCs available. Key ToC components were mapped in a database to collate key activities, outputs, outcomes, and impacts at the project-level. Population of the database through the mapping exercise enabled the evaluation team to first organize ToC components by project and then group similar projects by topic and/or geography into distinct clusters within the database. For example, clusters of projects addressing specific topics related to land and ecosystem service restoration (e.g., scaling agroforestry practices, and reward and incentive schemes) were identified through this process. Clusters could also be specified by the location of the research and engagement and by the intended application domain; that is, where the intended outcomes and impacts were expected to manifest. For example, extensive research efforts on conservation and sustainable use of genetic resources have been supported by FTA, but in different geographies across Asia, and Africa, each focusing on different commodities, and aiming to influence different actor groups and processes specific to each region.

13 clusters were identified for Challenge 2. Following the clustering of projects, ToC components were aggregated to conceptualize the key activities, knowledge and social process contributions, outcomes, and impacts for each cluster, resulting in a cluster-level sub-ToCs. Cluster-level sub-ToCs were sufficiently broad to convey the logic of the challenge, with specific project-level details mapped within each component (Appendix 1). Further aggregating the cluster sub-ToCs, it was possible to derive an overarching ToC and narrative for the challenge (see Miro). This was an iterative process, which enabled subsequent identification, integration, and/or removal of projects (and clusters) that needed to be mapped to each challenge. This analytical framework provided

the structure for a review of available evaluation reports, project documents, and other data to collate evidence to test the ToCs and to identify gaps to inform supplementary data collection.

Step 3. Reviewing existing evidence by cluster to assess outcomes, project impacts and identify gaps

Over the last decade, FTA has commissioned theory-based evaluations and impact assessments of several of its projects, which provided an initial base of evidence that could be built upon in this study. In order to identify where the existing evidence base was strong and where additional evidence needed to be collected to fill gaps, we mapped the available evaluation evidence (i.e., use/uptake of outputs, outcomes, impacts) and systematically reviewed and appraised evidence for each project against its cluster ToC. In cases where external evaluations were not available, other documents were reviewed (e.g., annual reports, outcome stories, midterm/quarterly reports, final reports, peer-reviewed articles, theses, briefs, etc.).

Evaluation data sources for Challenge 2 included:

- 13 evaluation reports (5 internal, 8 external)
- 5 FTA annual reports
- 5 CIFOR annual reports
- 2 Bioversity International annual reports
- 6 INBAR annual reports
- 3 ICRAF annual reports
- 24 interim reports
- 31 final reports
- 8 peer-reviewed articles
- 4 briefs
- 10 project webpages
- 14 internal news/blogs
- 2 e-mails
- 5 external press releases
- 3 donor reports
- 2 conference papers/presentations
- 1 technical offering
- 6 external webpages
- 1 policy/government document
- 11 outcome stories
- 4 videos
- 1 working paper

Data sources were then assessed for their reliability and confidence. The reliability of data sources was determined by an assessment of whether the source was internally produced with no external validation or explanation of method to derive claims of outcomes and impact, (lower reliability) or conducted by an external evaluation which had a clear method description, collected primary data from research users, or was peer-reviewed (higher reliability). It was assumed that reports containing a degree of external validation (e.g. research user testimonials, ground truthing) provide an additional level of quality control of the evidence. The confidence of data sources was determined by an assessment of the quality of the data source (criteria included whether the source specified a method).

This exercise highlighted which clusters (and projects within those clusters) have: i) strong and likely sufficient data to make a reliable assessment; ii) key gaps that could be filled at low cost; and iii) key gaps that would be too time- and resource-intensive to fill. An overview of the cluster appraisal during the evaluation exercise is presented in Table 3 below. The full table can be found in Appendix 2.

Table 3: Summary Cluster-level Appraisal Process of Evidence for Challenge 2

Cluster (number of projects associated with the cluster)	Total Number and Assessment[2] of Data Sources	Pathways with Strong Outcome Evidence	Pathways with Weak Outcome Evidence	Feasibility of Cluster Impact Estimation Assessment	Prioritization of Cluster for Additional Evidence Collection[3]
Climate Resilient Cacao (2 projects)	5 internal sources (1 outcome story, 3 internal reports, 1 Bioversity Annual report) • *Reliability:* low (all internal sources, outcomes not the focal point) • *Confidence:* low (all internal sources, outcomes not the focal point of reporting)	• **Research pathway** (preliminary evidence around partnerships and sustained investment is promising)	• **Policy pathway** (have indication standardized protocols have been influenced, but no specificity or external validation) • **Practice pathway** (adoption of improved varieties influence on cacao farmers not available)	Potential quantification of area only available (hectares and farmers impacted) for Colombia.	***Priority:*** **low -medium** • Small investment (<$1m) • Evidence is quite limited, but may be straightforward to obtain • Impact potential overlaps with challenge 4 (access to improved varieties to reduce vulnerability to climate change) • Representative of Bioversity research and engagement
Scaling of context-specific agroforestry for restoration (9 projects)	6 external sources (1 evaluation, 4 peer reviewed papers, 1 OICR) 34 internal sources (1 outcome story, 3 FTA annual reports, 3 ICRAF annual reports, 11 final project reports, 4 blogs, 1 project webpage, 2 internal evaluations, 1 project log, 1 ex ante impact assessment, 1 project brief, 2 midterm reports, 1 technical report, 1 project annual report, 1 project plan)	• **Practice pathway** (strong for farmers, requires more detail and validation for NGO/extension agents and seed suppliers in some cases)	• **Government policy pathway** (indications of potential outcome realization requiring external validation – strong for AFLI projects) • **Research pathway** (not a central pathway, but bibliometrics could be collected)	Feasible: Quantifications are available for hectares of land under restoration are provided in terms of targets and reach, require external validation and updating/ further collection of outcome evidence.	***Priority:*** **high** • Substantial investment (>$50m) • Indications that there is more evidence available on outcomes and impacts. • Impact potential overlaps with challenge 4 (via improved and more diversified yields) • Representative of ICRAF research and engagement

[2] The reliability of evidence sources was determined by an assessment of whether the source was internally produced (lower reliability) or conducted by an external evaluation (higher reliability). It was thought that external reports are providing an additional level of quality control of the evidence. The confidence of evidence sources was determined by an assessment of the quality of the evidence source (criteria included methodological approach (e.g., theory-based evaluation, quasi-experimental design), primary versus secondary/tertiary data collection, level of detail, indications versus clear realization, triangulation of evidence, etc.).

[3] A set of criteria was used to inform the prioritization assessment to enable strategic selection of clusters (and/or projects within a cluster) for additional evidence collection. These criteria include: potential overlap of cluster/project(s) for other challenges; geographic overlap and representation; pathway overlap; proportion of FTA investment of cluster/project (i.e., prioritizing clusters/projects with larger budgets); likelihood for availability of outcome evidence; and likelihood for availability and/or feasibility to assess and quantify the scale of impact. Representation of centres was also taken into account considering the entire study (i.e. to ensure that case studies do not only reflect the work of one centre).

	• *Reliability:* moderate-high (heavy reliance on internal sources) • *Confidence:* moderate-high (variable triangulation, derivation method, and reporting of outcomes and impacts)				
Forest Landscape Restoration (Global) (4 projects)	8 internal sources (1 news release, 1 CIFOR annual report, 5 project reports, 1 outcome story) 2 external sources (2 websites)	• **Policy pathway** (strong for 2 projects, requires more qualification of FTA contributions and external validation to strengthen) • **Practice pathway** (strong for 2 projects, requires more qualification of FTA contributions and external validation to strengthen)	• None	Possible to draw on policy targets.	***Priority:*** **low-medium** • Moderate investment (collective cluster budget < $5m) • Internal reporting of outcomes indicates some potential, but key gaps remain for external validation • Possible if one project is selected (e.g. Opportunities for tropical forest and landscape restoration in Malaysia) • Impact estimations are possible for one project (derivation from policies may be possible for others), but require supporting evidence of outcome realization and projects' contributions to achievement of policy targets (assumptions must be explicit) • Representative of CIFOR research and engagement
Bioeconomy development to restore degraded land (5 projects)	1 external source (1 evaluation) 20 internal sources (9 INBAR final reports, 1 presentation, 1 FTA news article, 1 project brochure, 1 OICR, 4 project websites, 3 technical reports)	• **Practice pathway** (requires more qualification of contributions and external validation) • **Policy pathway** (requires more qualification of contributions and external validation)	• **Research partnership pathway** – not central nor explicitly intended, but indications of influence	Feasible: Quantifications are available for hectares of land under restoration are provided in terms of targets and reach, require external validation and updating/ further collection of outcome evidence. Indications that	***Priority:*** **medium-high** • Unknown representation of investment (budgets unavailable) • Internal reporting of outcomes indicates potential, but key gaps

	• *Reliability:* moderate (need external validation) • *Confidence:* moderate (internal sources triangulate claims)			effects of bamboo on water retention, soil fertility and carbon sequestration are also possible.	remain for external validation • Representative of INBAR (partner) research and engagement
REDD+ Policy Mechanism (Global) (9 projects)	26 sources (3 external evaluations, 1 masters thesis focused on evaluation, 2 annual reports, 5 case study reports, 4 flagship outcome stories, 4 midterm/final reports, 9 articles, 7 interviews with key informants) • *Reliability:* moderate for internal reports; high for external evaluations • *Confidence:* moderate for internal reports; high for external evaluations	• **Research pathway** (sufficient evidence for all GCS REDD+ project Phase 1, Phase 2, Phase 3 (half), and Benefit sharing mechanism project; other projects only identify expected outcomes. Update would strengthen) • **National government pathway** (as above) • **International government pathway** (as above)	• **Partner/ally pathway** (have indications of potential outcome realization) • **Community pathway** (have indications of potential outcome realization)	Some country-specific quantifications are listed and available; possibility to draw on policy targets	***Priority: N/A* pursued for deep dive for Challenge 1.**
Innovation for Resilient Landscape Restoration (Latin America) (3 projects)	5 internal sources (1 evaluation report, 3 outcome stories, 2 project reports, 2 blogs) • *Reliability:* low-moderate (need external validation) • *Confidence:* low-moderate (need external validation)	• **Practice pathway** (indications of utility of tools; preliminary evidence promising)	• **Policy pathway** (no preliminary evidence, would benefit from primary data collection and for more detail, particularly at outcome level) • **Smallholder pathway** (no preliminary evidence)	Possibly feasible for 2 of the projects (Laying the foundations for climate smart restoration: a toolkit for Peru's tropical dry forest & Associar recursos, capacidades y competencias tecnicas y cientificas para el diseno de protocols de restaruacion ecologia del bosce seco tropical)	***Priority:* medium - high** • Representative of Bioversity's work • Lower investment (collective cluster budget <$1m) • Impacts reported indicate more evidence is available.
Agroforestry Concessions in Peru (3 projects)	7 external sources (1 outcome evaluation, 3 press releases, 1 peer reviewed article) • *Reliability:* low-moderate (need external validation) • *Confidence:* low-moderate (need external validation)	• **Policy pathway** (sufficient evidence, though update would strengthen) • **Practice pathway** (sufficient evidence, though update would strengthen) • **Research pathway** (sufficient evidence, though update would strengthen)	• **Smallholder capacity pathway** (low preliminary evidence, external validation via primary data collection would strengthen)	Feasible, have preliminary figures	***Priority: N/A* Pursued for deep dive in Challenge 3.**
Research Capacity Building for	11 internal sources (4 CIFOR annual reports, 5	• **Research/capacity development pathway**	• **Policy pathway** (indication of	Possibly, concentrated in one geographic area (continuity	***Priority:* high**

Sustainable Forest and Agricultural Land Management and Restoration in the DRC (Africa) (3 projects)	project reports, 1 webpage, 1 FTA annual report) • *Reliability:* moderate • *Confidence:* moderate		influence but requires detail and validation) • **Community development pathway** (requires external validation to corroborate claims of influence, and specify contributions)	of interventions), only requires outcome evidencing	• Substantial investment (collective cluster budget >$30m) • Some gaps, but feasible to follow up as the projects built on each other • Preliminary impact estimates provided for land under restoration and carbon sequestration, might be possible to determine soil, water and biodiversity effects • Representative of CIFOR research and engagement
Conservation and Sustainable Use of Genetic Resources (Africa) (3 projects)	3 internal sources (1 workshop report, 2 internal news reports)	• None	• All	Not feasible	***Priority*: low** • Lower investment (collective cluster budget <$1m) • Substantial gaps in evidence • Representative of Bioversity research and engagement
Fire & Haze in Indonesia (3 projects)	2 external sources (1 performance report with primary data collection, 1 peer reviewed article based on findings of evaluation) 8 internal sources (3 CIFOR annual reports, 1 FTA annual report, 2 outcome stories, 2 final project reports) • *Reliability:* low for internal reports; high for external assessments • *Confidence:* medium for internal reports; high for external assessments	• **Government pathway** (sufficient evidence; update would strengthen) • **NGO pathway** (sufficient evidence; update would strengthen) • **Private sector pathway** (sufficient evidence; update would strengthen) • Researcher pathway (sufficient evidence; update would strengthen)	• **Public pathway** (need more detail, update would strengthen) • **Smallholder pathway** (very limited preliminary evidence)	Feasible, preliminary figures are available.	***Priority:* low to medium** • Relatively small budget (collective cluster budget ~$1m) • Preliminary outcome evidence for projects is substantial, but key gaps remain or require updated evidence • Impact estimations are possible, but require supporting evidence of outcome realization and projects' contributions to restoration goals (assumptions must be explicit) • Representative of CIFOR research and engagement

Conservation and Sustainable Use of Genetic Resources (Asia) (3 projects)	4 internal sources (1 email, 1 website, 1 Bioversity Annual Report, 1 final report) 3 reviewed sources (1 technology offering, 1 conference paper, 1 publication) • *Reliability:* low • *Confidence:* low	• None	• **Research pathway** • **Policy pathway** (indications of protocols and methods developed for application, but require further evidence) • **Practice pathway** (indications of training and new methods, but require further evidence)	Possibly	***Priority:* medium** • Representative of Bioversity's work • Moderate investment (collective cluster budget >$1m) • Preliminary evidence suggests promising innovations for outcomes and impacts • Representative of Bioversity research and engagement
Green Growth (Asia) (2 projects)	3 internal sources (1 blog, 1 technical report, 2 final reports, 2 external sources (1 external website, 1 policy decision) • *Reliability:* low • *Confidence:* low	• None	• **Policy pathway** (indicates promising influence, but requires detail on implementation of plan and exact project contributions) • **Smallholder pathway** has (no evidence)	Feasible: Have some potential projections for 1 project (Green Growth Action Plan)	***Priority:* low-medium** • Lower investment (collective cluster budget ~$1m) • Current evidence base points to potential impacts only, substantial gaps in outcome evidence • Representative of ICRAF research and engagement
Incentives for Sustainable Agricultural Practices (Asia) (5 projects)	13 internal sources (1 FTA annual report, 6 project reports, 1 video, 1 brief, 2 webpages, 1 blog, 1 publication) 2 external sources (2 donor reports) • *Reliability:* moderate • *Confidence:* moderate	• **Policy pathway** (indicates subnational and national policy influence by a variety of methods, triangulation and specificity would strengthen.) • **Practice pathway** indicates influence on students, NGOs, communities, but triangulation and specificity would strengthen.	• **Community development pathway**	Possibly feasible dependent on policy target availability. Projection reported for 1 project.	***Priority:* medium** • Moderate investment (collective cluster budget >$4m) • Preliminary outcome evidence is promising for 4 projects (e.g., Integrated Watershed Management, INREMP, RUPES 2, climate smart tre-based co-investment), but notable gaps exist • Impact estimations are possible, but require supporting evidence of outcome realization (assumptions must be explicit)

					• Geographic overlap for possible case study in Indonesia, Vietnam or Phillippines (most evidence in Vietnam and Indonesia) • Representative of ICRAF research and engagement

Step 4. Assessing FTA contributions to outcomes

The cluster ToCs, corresponding outcomes, and underlying assumptions were tested using data identified through the mapping process, further desk research of project documents and reporting, and follow-up discussions with key scientists. Key scientists and project staff also provided insight on other sources of data to test the realization of cluster outcomes. When possible, bibliometrics were collected (September 2021) to assess uptake and use of FTA outputs to supplement the evidence base for outcome realization in the research pathway.

Step 5: Deep dive analyses

It was clear from an initial review of available project documents that FTA contributed to land and ecosystem restoration efforts through the development of tools (D4R) and through influencing the adoption of agroforestry practices and establishment of breeding seedling orchards to provide quality planting material. Two case studies were selected for further investigation. A decision support tool that generates species combination suggestions to inform specific restoration objectives and site conditions, and a project in Ethiopia aiming to improve tree genetic resources and seed delivery systems were selected. Both cases demonstrated high likelihood for global impact, and represented two of the ways in which FTA is supporting the informed restoration of degraded land and ecosystem services (e.g. decision-support to restoration programs, and distribution of quality seeds). There was recent and ongoing evaluation work on each of the respective case studies which could be mobilized and built upon.

Step 6. Impact estimation

We define impacts as a change in state or a change in flow resulting in whole or in part from a chain of events to which research has contributed (Belcher, Davel, & Claus, 2020). The outcome assessment qualified how, where, and what impact potential could be expected as a result of outcomes achieved. The emphasis was on evidencing the links between project contributions and outcomes, and how those outcomes lead to potential impact. Impact estimates are derived from the review of existing evaluation data (±100 documents) of the 54 projects mapped to Challenge 2. 32 of these projects documented estimates that could be used as (either) low- and(/or) high-end impact potential.. In cases where a high end estimate was not available, the low-end estimate was considered to be the high-end estimate.

32 individual FTA projects defined and reported the actual or potential adoption, use, and impact of their work in many ways and in many different units of measure, including:

1. Impact assessments of specific technologies under trial conditions (i.e., area and effects of innovation trials)
2. Results of adoption studies (i.e., measures of uptake/use/scaling of FTA outputs across landscapes)
3. Study/trial areas where innovations have been or are planned to be applied
4. Model-based projections of uptake/use/impact
5. Reach (i.e. area where FTA outputs are available for uptake and use)
6. Application domain (i.e. area where FTA outputs could be applied)
7. Policy targets (i.e., area affected by a policy that has been influenced by FTA)

As evident from this list, some estimates focus on more immediate outcomes and impacts that may have already been fully or partially realized. Others focus on longer-term potential outcomes and impacts that have not yet been (or may never be) realized. These different points of focus were used to approximate the low and high extremes of the ranges of potential impact of FTA's work.

We took the following steps to estimate the potential impact:

1. Available impact data for each project reviewed were classified as either a low-end (i.e., realized) or high-end (i.e., potential) estimate. Note that some projects might report both kinds of data, one kind of data, and some projects report neither.

2. Carbon sequestration effects were converted to standard units of measure (e.g., tons of CO_2 sequestered), using context-appropriate conversion factors.

3. Project-level data were summed to produce low-end and high-end impact estimates.

While some low-end estimates may still not have been realized (some projects are still incomplete; additional time is needed for full realization), many projects did not report impact, so the aggregate low-end estimates are conservative estimates.

Many of the individual high-end estimates are based on optimistic (and sometimes unrealistic) assumptions about uptake, use and scaling of FTA outputs. For land to be effectively restored, application of informed practices promoted by FTA must continue following project conclusion. For policy targets to be realized, policies must be formed or reformed and implemented effectively. Moreover, the long lag times inherent to forests, trees, and agroforestry, and to some of the impact pathways considered, the high-end estimates are highly uncertain.

Limitations

The results of the study should consider the implications of the following limitations:

1. *Variability in data availability and reliability:* Data on research interventions, and their outcomes and impacts, were variable and inconsistently reported. Baseline data was scarce. There were also limitations with the data available and some clusters did not present expected or potential outcomes and/or impact figures, and the methodology for some figures presented and their context were unclear (see Table 2 for the discussion of document reliability assessment).
2. *Risk of double counting:* The variability in reporting, and the lack of clear method descriptions and geographic disaggregation in the areas and effects reported to have benefited from FTA interventions made it extremely difficult to discern whether there was geographical overlap in reported numbers. This was followed up where possible, but returned uncertain responses in most cases.
3. *Risk of under reporting:* Disparities in project and program level documentation and reporting against targets, and variability of selected targets that are reported on caused issues with achieving consistency in units, and introduced possible under reporting (particularly with respect to ecosystem service effect proxies: CO2 sequestration potential, soil and water conservation, and biodiversity).
4. *Fuzzy boundaries on the scope of the challenge:* the breadth of the ecosystem services concept posed difficulties in determining which research initiatives should be included in the analysis. Technically, all clusters of FTA's work address the high prevalence of degraded land and ecosystem services in some capacity, as an artefact of the breadth of the ecosystem service concept. We acknowledge the strong implications that preservation of forests from deforestation and forest degradation have on regulating and supporting ecosystem services, and we acknowledge the strong effects that land and ecosystem service degradation have on provision ecosystem services (i.e., to exacerbate poverty and food insecurity). To make the assessment manageable, we needed to apply more exclusive criteria for inclusion in the report for Challenge 2: the project needed a focal point on land or ecosystem service restoration.
5. *Practical limitations on the scope of the study:* Access to supplementary primary data proved challenging overall owing to internal resource constraints and external factors out of the control of the evaluation team. For example, the team planned to collect additional data in the field (e.g., to support the deep dives), but was unable to collect further information due to time constraints to complete the study (e.g. spillover delays caused by research activity restrictions and the COVID-19 pandemic). The deep dive analyses therefore relied more heavily on existing data sources (past and current evaluations), rather than collecting supplementary primary data solely for the purpose of the study.

Challenge 2 Theory of Change

Land and ecosystem service degradation is a key focal area of research for FTA. Productive land is vital to sustain life. Approximately 25 percent of the global land area was degraded by 2016 and the trend is worsening; if unsustainable natural resource management and land use continues, 95 percent of Earth's land mass could be degraded by 2050 (Sutton et al., 2016). Current estimates value lost ecosystem services as a result of land and forest degradation between $6.3– 10.6 trillion/year (Kaija, 2021; ELD, 2015).

Global efforts are underway, in recognition that land restoration is critical for supporting and regulating services necessary for ecosystem functioning as well as sustaining both provision and cultural ecosystem services to support development and sustainable livelihoods. Under the Bonn Challenge, signatory countries have committed to restore 350 million hectares of land by 2030. In Africa alone, the Africa Forest restoration Initiative (AFR100) has guided countries to pledge the restoration of 125 million hectares. These goals have paved the way for research investment. Furthermore, in recognition of declining genetic diversity in forests, and corresponding ecosystem degradation, the Global Action Plan on Forest Genetic Resources initiated by FAO in 2013 aims to improve the availability of, and access to, information on forest genetic resources; in situ and ex situ conservation of forest genetic resources; sustainable use, development and management of forest genetic resources; and policies, institutions and capacity building.

Possible solutions to the integrated challenge of land degradation and loss of ecosystem services include:

1. Scaling of agroforestry practices: Agroforestry techniques and practices mitigate climate change through carbon sequestration, support biodiversity conservation and enhancement, enrich soils, and improve water quality. Research, including policy research, has a key role to play in supporting communities to scale up adoption of agroforestry practices that are context-sensitive.
2. Contextually appropriate restoration of degraded land: Improving the biophysical conditions of landscapes and ecosystems (e.g., increasing ecosystem resilience through greater biodiversity, improved soil fertility, increased productivity, etc.). Research, including policy research, has a key role to play in supplying knowledge, decision-support tools and building the necessary capacities to ensure appropriate species are planted in the right place to optimize ecosystem services. Research of this kind aims to ensure context-appropriate restoration strategies are implemented to benefit ecosystems and the communities that rely on them.
3. Preservation of land from degradation: Sustainable use and management (e.g., soil and water conservation) practices to preserve intact and productive ecosystems from becoming degraded. Research helps demonstrate the value of these ecosystems and can inform sustainable harvesting and management practices.
4. Genetic and ecosystem conservation: Ensuring that key genetic resources and superior germplasm are developed, maintained, and widely distributed. Research has a key role to play in assessing biological conditions suitable for and characteristics of germplasm to inform policy and practice that facilitates access to quality planting material, and conserves genetic diversity.

FTA has conducted research that supports science-based and context-appropriate conservation and land restoration programs to ensure optimal ecosystem functioning and services. Moreover, FTA has indirectly addressed the causes of land degradation through its research to reduce deforestation (see Challenge 1), and improve land use management (see Challenge 3) to preserve land from degradation.

FTA research addresses the lack of knowledge capacity, and training on context-appropriate restoration strategies, sustainable land use, and conservation to yield optimal socio-ecological outcomes that underpin the following root causes and drivers of land degradation:

1. Unsustainable agricultural practices (e.g. over tilling, poor irrigation and water management techniques, excessive use of inorganic fertilizer and pesticides)
2. Overexploitation of natural resources

3. Diminishing stocks of resilient and diverse tree genetic resources
4. Expansion of monocultures
5. Deforestation
6. Climate change

FTA research and engagement addresses the following effects of land degradation:

1. Soil erosion and water scarcity
2. Loss of biodiversity
3. Poor ecosystem function
4. Loss of provisioning ecosystem services to sustain livelihoods.

FTA is addressing these inter-related aspects of land and ecosystem service degradation by co-developing knowledge that frames issues; generating data, tools and, methods to support contextually appropriate restoration; co-designing, and proposing policy options at different scales (local to global), proposing practice solutions and innovations; providing training and building capacities; and offering guidance and support for policy development, implementation, and practice. Collectively, FTA's activities and outputs aim to contribute to:

1. Restoring degraded lands to improve ecosystem services and land productivity by means of:
    a. Scaling context sensitive agroforestry practices on farm (e.g., intercropping, soil and water conservation)
    b. Establishing productive plantations on degraded land for restoration and service provision (e.g., bamboo)
    c. Informing what species should be planted where using participatory prioritization methods with communities, spatial analyses, suitability maps, and other decision support tools
2. Conservation and sustainable use of critical forest genetic resources (e.g., coconut, cacao) and improving seed resilience and delivery systems
3. Reducing deforestation (Challenge 1) via:
    a. Appropriate policy options and support to reduce the occurrence of anthropogenic fires
    b. Appropriate policy options and support to reduce expansion of the agricultural frontier into natural forest
4. Improving land use and management (Challenge 3) via:
    a. Strengthening institutions
    b. Integrated and improved land use management

There are various pathways to realize these goals, involving the engagement of diverse actor groups and input to multiple processes. FTA's research and engagement aim to influence:

1. Researchers advancing and further aligning restoration agendas, climate agendas, and biodiversity agendas for sustainable land use by improving the knowledge base, building research capacity across the world, and developing partnerships
2. Donors' and international organizations' action plans, coordination, and investments to support contextually appropriate land restoration, align agendas, and scale innovations
3. Government officials and policy-makers developing and revising policies and incentive schemes on forests, conservation, restoration, and land use
4. NGOs, practitioners, partners, and allies to support the implementation of restoration and sustainable management programs through co-developing, testing and scaling FTA solutions

5. The private sector to change their practices to comply with new regulations and commitments, invest in sustainable markets, and adopt more sustainable land use practices
6. Smallholders to change their practices to comply with new regulations, policy mechanisms, and commitments; gain access to superior seed and markets, and build capacities in land restoration activities (e.g., tree planting, agroforestry techniques, intercropping, soil and water conservation, etc.)

Through the realization of the outcomes listed above, it is expected that FTA's research will contribute to restoration of degraded land and ecosystem services through:

1. Widespread adoption of sustainable agroforestry practices to restore land productivity and ecosystem services (Ethiopia, Rwanda, Somalia, Mali, Niger, Ghana, Senegal, Uganda, Kenya, Tanzania, Nigeria, Burkina Faso, Sierra Leone, Mozambique, Malawi, Guinea, India & Peru)
2. Better and integrated policies, reward, and incentive mechanisms to facilitate adoption of more sustainable agricultural, restoration and management practices to improve the state of the world's forests, farmland, peatlands, and wetlands (Malaysia, India, Indonesia, China, Laos, Myanmar, Thailand, Nepal, Philippines, Vietnam, Peru, Bolivia, Guyana, Brazil, Mexico, Tanzania, DRC, Cameroon, Burkina Faso, Ethiopia, Mozambique)
3. Curbing overexploitation of key genetic resources through conservation and sustainable use in Africa & Asia (Korea, Kyrgyzstan, Tajikistan, Uzbekistan, Indonesia, Malaysia, Thailand, Fiji, Samoa, Papua New Guinea, Africa South of the Sahara, Burkina Faso, Cameroon)
4. Promoting the use of improved varieties of cacao and supporting other climate-resilient seed systems to restore drylands (Colombia, Costa Rica, Brazil, Cote D'Ivoire, Ghana, Peru, Mexico, Guatemala, Chile, and Argentina)
5. Advancing and aligning restoration, climate, and biodiversity initiatives to promote tree-based restoration as a viable solution (Ethiopia, Bhutan, China)
6. Establishing and developing bio-energy markets (e.g., bamboo, nyamplung) that simultaneously support land and ecosystem service restoration (China, Ethiopia, Ghana, Tanzania, Madagascar, Kenya, Uganda, Cameroon)

Key assumptions underpinning FTA's contributions to restoring degraded land and ecosystem services to meet the above targets include:

1. FTA holds a credible position in academic and research-for-development realms, and can exert influence over the research agenda on the role of forests, trees and agroforestry in land and ecosystem service restoration.
2. FTA's engagement and training efforts are sufficient to benefit all participants with new knowledge, skills and relationships that stimulate adoption and scaling of new practices.
3. Science-based restoration policies and strategies to which FTA has contributed are successfully implemented.
4. Partnerships create conditions for collective action toward goals of restoring degraded land and ecosystem services.
5. All land that benefits from FTA restoration innovations experiences a net increase in ecosystem goods and services.
6. Information is accessible enough, policies are effective enough, and partnerships are strong enough to create the political pressure necessary to prompt a response from the private sector
7. All assumptions underpinning how FTA research contributes to reducing global deforestation (Challenge 1) and unsustainable land use and management (Challenge 3) are sustained.

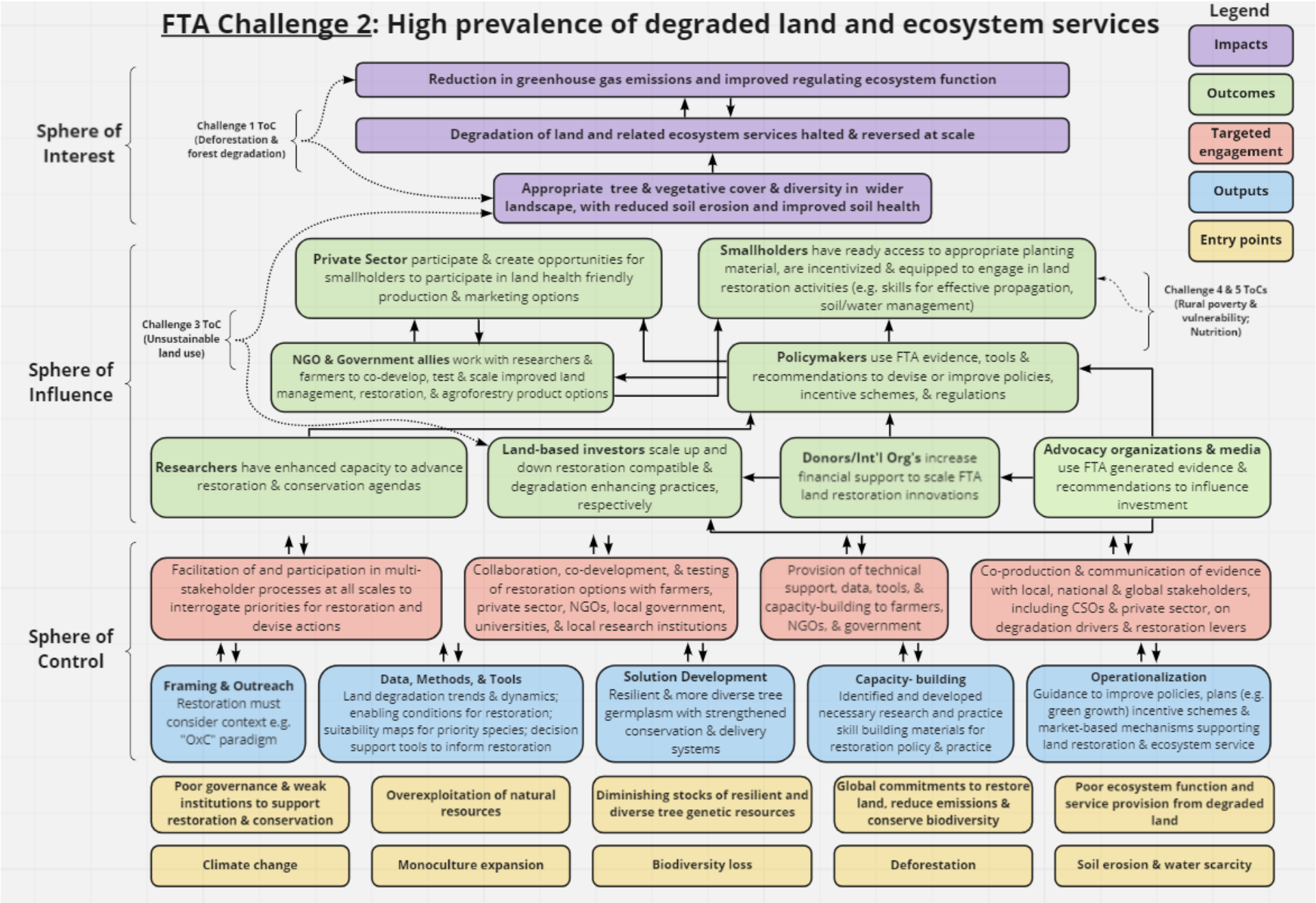


Figure 1: Overarching ToC outlining FTA contributions to addressing Challenge 2 (High prevalence of degraded land and ecosystem services)

Results

Outcome Evaluation

FTA achieved various influence on policy, practice, and research trajectories to support pathways to impact on the restoration of land and ecosystem services worldwide. FTA's influence on policy supported the enabling environment for land restoration across Latin America, Africa, and Asia (e.g. rewards for environmental services, development of bamboo, agroforestry concessions, green growth, low-emissions development and land-use plans), and globally (e.g. CBD COP12 decision to consider genetics in restoration) and was achieved through their representation on technical working groups, directly supporting policy development (white paper preparations), and participating in policy dialogues and events. FTA's influence on farmer practices was achieved through the implementation of demonstration trials, trainings to support to seed system infrastructure development, nursery establishment, management, and the introduction of resilient and context-adapted species, which all built the necessary capacities for variable farmer adoption of improved management practices worldwide. Barriers to adoption (e.g. lack of market linkages, extension services) are of utmost importance for research-for-development programs to address more systematically in the future. FTA's influence on restoration program design, implementation and financing was achieved through the development of decision-support tools and promotion of co-investment schemes. Lastly, FTA's influence on research trajectories focused on the role of forest, trees and agroforestry in restoration was achieved through its academic rapport, broad networks, mutually beneficial partnerships, and opportunities provided for local research capacity building.

Through research and engagement on the topic, FTA positioned itself as a valued and trusted source of evidence-based recommendations for policy and practice change to support more sustainable and context-appropriate restoration to optimize benefits to ecosystems. However, the realization of estimated potential impacts hinges upon successful implementation and enforcement of policies to which FTA contributed, sustained adoption and application of training and new practices promoted, the survival of species planted, and effective management of restoration initiatives. FTA also engaged and collaborated with a wide range of relevant stakeholders to ensure ownership of research outputs, contribute to capacity-building, and ensure future focus on the topic. Progress towards restoration of land and ecosystem services in the countries assessed to date rely on continued collective action by a range of actors including national and international government, NGOs, smallholders and their communities, researchers, and the private sector. Sustained partnerships that co-develop solutions is key to maintaining influence and laying the foundation for systemic transformation.

The projects and corresponding data reviewed indicate FTA influenced at least 68 policies, governance mechanisms, and use of improved tools to safeguard and effectively manage tree diversity and forests to facilitate the restoration of land and ecosystem services across 19 countries. Additionally, FTA has influenced at least 2 international decisions with implications for their 197 signatories. FTA's program to restore land and ecosystem services had less emphasis on private sector influence. Nonetheless, at least 5 national companies, and 5,005 small-medium enterprises across Asia and Africa have been influenced to improve financing of RES schemes and market development of tress grown on degraded lands, respectively. At least 24 countries are equipped to deliver more effective and equitable tree breeding, delivery, extension, and pedagogical services. As a result of FTA research and capacity building, particularly on cacao and coconut germplasm and physiology, farmer managed natural regeneration, and context-adapt agroforestry seeds, extensionists and farmers worldwide have enhanced capacities. FTA fell short in contributing to the achievement of 40 million smallholders & other users accessing more productive tree planting material and adopt options by context. Approximately 90,000 smallholders and other users have been influenced to access improved materials, and adopt better practices that support land and ecosystem service restoration. However, there is potential through various policy mechanisms, and scaling efforts (e.g. agroforestry concessions in Peru are projected to benefit 120,000 smallholder households) for this target to be reached over time. Table 4 reports outcomes realized against intended end of program outcomes.

Table 4. FTA contributions to intended end of program outcomes

End-of-Program Outcome #1
25 countries improve governance mechanisms, institutions & tools for a) safeguarding forests/tree diversity and b) equitably managing forests & trees within mosaic landscapes

Results
At least 19 countries directly influenced, 197 indirectly influenced through contributions to international mechanisms

Contributions to Outcome Achievements

Global **(197 countries)**

- CBD (196 countries) COP12 decision to consider genetics in restoration to safeguard tree diversity
- UNFCC (197 countries) decision 2011 for stepwise approach in setting, measuring and reporting forest reference emission levels (FREL); evidence of uptake limited to Guyana and Ethiopia.

Latin America **(2 countries)**

- Support to the implementation of agroforestry concession mechanism (Peru)
- CIFOR invited to collaborate on legislative proposal and guidelines on forest plantations and policy (Peru)
- Intended Nationally Determined Contributions for climate mitigation (Colombia)
- National Strategy on Forest and Climate Change (Peru)
- MOU signed between ICRAF and MINAM during COP20 to enhance commitments to preservation of forest lands and ecosystems from degradation (Peru)
- Government interested to scale up use of LUWES tool (Peru)
- Law on Multisectoral and Decentralized Management of Wetlands includes peatlands and enhances commitment to formally recognize importance of peatland (Peru)

Africa **(13 countries)**

- Vegetationmap4africa tool scoped as official map of recommendation domains for tree planting (Kenya)
- ICRAF serving as advisor to technical working group for OECD Scheme for Certification of Forest Reproductive Material Moving in International Trade (Kenya, Uganda)
- Supported 9 national policies, plans, and programmes for REDD+ (Ghana, DRC, Cameroon, Ethiopia, Tanzania)
- Established national MRV and safeguards information systems (Ethiopia)
- Enhanced institutional capacity for MMRV (Cameroon, Ethiopia, Guyana)
- Tree seed proclamation (Ethiopia)
- National Watershed and Agroforestry Multistakeholder platform (Ethiopia)
- Agroforestry strategy (Kenya)
- Informed dryland management decisions in 3 national policies and programmes (e.g., Irrigation Act in Kenya; Land Act in Mali; National Regreening Programme in Ethiopia)
- Community action plans developed to improve reforestation and promote sustainable grazing management (Burkina Faso, Ethiopia, Kenya, Mali & Niger)
- Bamboo adopted into national biomass energy policy (Ghana)
- Bamboo included in national development strategy and action plan (Ethiopia)
- Bamboo strategies being developed (Tanzania, Madagascar, Uganda, Ethiopia)
- Working groups convened to develop national product standards for bamboo (Ethiopia, Kenya, Uganda)
- Development and implementation of Climate Resilient Green Growth (Ethiopia)
- Local development plans and integrated development plan for Yangambi Reserve (DRC)
- Threat maps for food tree species developed to support decisions for tree genetic resource safeguarding and management (Burkina Faso)

Asia **(6 countries)**

- Co-development of Strategy and Action Plan for Forest Landscape Restoration in Sarawak, outlining directives, levies, and certification requirements (Malaysia)
- 3E policy to enforce reduce deforestation and generate co-benefits (Indonesia)
- National Planning Board for Development adopted LUWES tool and has been used by 33 provincial governments to plan actions to reduce greenhouse gas emissions (Indonesia)
- Monitoring and Evaluation System for PFES (Vietnam)
- Grand Design for Fire Prevention 2017-2019 (Indonesia)
- Village government allocates 300,000 USD to maintain peatland restoration (Indonesia)
- Standard for Forest Plantation and Land Fires Prevention (Indonesia)
- Regency Provincial Regulation on Fire Management and Prevention (Indonesia)
- PERDA for Fire Prevention in Riau (Indonesia)
- China Chamber of Commerce of Metals Minerals and Chemicals Importers and Exporters co-develops Guidelines for Sustainable Development of Natural Rubber with FTA scientists (China)
- Green Growth Action Plan for Lam Dong (Vietnam)

	• National RES Protocol (Indonesia) • KHLK adopts Integrated Watershed Management Approach mechanism for watershed management and issuance for environmental service use in Nipa-Nipa (Indonesia) • 3 district level decrees on water resources and management (Indonesia) • Decision No.99/2010 and guidelines contributing to the Executive Order on RES (Vietnam) • PFES Monitoring and Evaluation System contributing to decline in violations against forest protection and corresponding decline in area of degraded forests (Vietnam) • 2 district level decisions (Ha Tinh and Quang Binh) on integrated home garden and sloping land scheme (Vietnam) • 2 provincial level policy decisions as part of climate-smart agriculture (Vietnam) • State council and government of Xishuangbanna adopts lessons from RES scheme for grasslands for designing ecological land-use plans (China) • Partner organization informed National Environmental Policy on the role of economic incentives for environmental conservation (India) • Lantapan municipal government acknowledged and supported the co-investment activities of the ALSA farmer group through tree-based farming practices under Resolution No. 2017-067 "A Resolution Adopting the Co-Investment Scheme as Sustainable Financing Mechanism for the Management of the Manupali Watershed through the Adoption of Climate-smart, Tree-based Farming Practices" (Philippines)
End-of-Program Outcome #2 About 20 multinational companies and 500 private sector actors pursue models & investments for a) improved mgt. & safeguarding of forest & tree resources and b) enhancement of inclusive landscape-based livelihoods & ecosystem services	
Results **(At least) 5 national companies, 5,005 private sector actors (including SMEs), 6,500 member enterprises**	
Contributions to Outcome Achievements	Africa **(4,950 private sector actors)** • 3,384 bamboo micro-nurseries established (Ethiopia, Madagascar, Tanzania) • Supported formalization of 1,566 farmer groups (Ethiopia, Ghana, Kenya, Mali, Niger, Burkina Faso, Tanzania, Uganda, Zambia) Asia **(5 national companies; 250 private sector actors)** • TAFOOD signs technological transfer agreement with ICRAF for son tra processing techniques to make tea (Vietnam) • MoU signed between CIFOR-ICRAF and a large palm oil, pulp and paper company to commit to fire prevention (Indonesia) • Established 30 CSOs for NTFP collection and new business ventures (India) • 6,300 member enterprises of China Chamber of Commerce of Metals Minerals and Chemicals Importers and Exporters subject to Guidelines for Sustainable Development of Natural Rubber (China) • 250 smallholders joined tree-farmer learning groups and have been involved in replication of FTA promoted co-investment RES schemes (Indonesia, Philippines, Vietnam) • National Power Corporation provides support to local government of Lantapan to fund rehabilitation, reforestation, and protection of Alanib sub-watershed (Philippines) • Contractual arrangements between communities and ES investors (i.e. parastatal water companies) established (Indonesia) • 1 company defined mitigation actions in annual work plan using FTA's REL calculations (Indonesia) • Private sector commitment to fire prevention through establishment of Fire Free Alliance (Indonesia)
End-of-Program Outcome #3 National and sub-national public & private sector actors in 25 countries deliver more effective & equitable tree related breeding, delivery, extension & pedagogical services	
Results **(At least) 24 countries directly influenced**	
Contributions to Outcome Achievements	Global • Protocol for trait measurement of cacao physiology established • Coconut cryopreservation protocol developed (patent pending to be applicable for 7 coconut producing countries) • D4R tool applied in restoration programs (Kenya, Cameroon, Madagascar, Peru, Colombia, India) Latin America **(2 countries)** • Supporting institutional capacities for implementation of technical guidelines and extension services for agroforestry concessions (Peru) • Government, NGO, and FTA pilots for agroforestry concessions (Peru) Africa **(17 countries)** • 3,384 bamboo micro-nurseries established (Ethiopia, Ghana, Tanzania, Madagascar, Uganda, Cameroon)

	• Seven community production training centres were established to centralize training and long term support to bamboo artisans and entrepreneurs (Ethiopia, Tanzania, Madagascar) • Supported establishment of 30 Breeding Seedling Orchards (BSOs) (Ethiopia) • Isalowe Nursery production capacity will be increased to be able to produce 500,000 seedlings (DRC) • 220 students trained through improved curriculum at UNKIS (DRC) • Enhanced capacity of 600 government, private sector, and extension staff in forest conservation and management (DRC) • Informed WWF and Virunga Foundation tree-planting (DRC) • Enhanced capacity of 3,650 government staff, technical experts, and extensionists in agricultural extension services for improved dryland management (Ethiopia, Kenya, Mali, Niger, Burkina Faso) • 8,500 government and NGO stakeholders engaged to support adoption and scaling of dryland management practices post-project (Ethiopia, Kenya, Mali, Niger, Burkina Faso) • Extension agents (including farmer-to-farmer extension workers) provide enhanced extension services to farmers and scaling locally-relevant regreening options (Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Malawi, Niger, Rwanda, Senegal, Somalia, Tanzania, Uganda, Zambia)
	Asia (**5 countries)**
	• 18 extensionists and partners trained on agroforestry and FMNR through demonstration trials, with commitment to test intercropping practices (Indonesia) • Implementation of collaborative mechanism for management of Nipa-Nipa Forest Watershed (Indonesia) • Local governments pilot a PFES scheme for watershed management (Indonesia) • Bhutan Ecological Society (BES) engaged CIFOR-ICRAF as partners to support one million tree campaign (Bhutan) • Jikalahari, WWF, FORSIBU facilitate implementation of fire prevention activities with communities (sago planting and canal blocking) (Indonesia) • Enhanced capacities of 15,250 government and NGO staff in geomatics, land use planning tools, carbon and biodiversity monitoring, forest law, RES, and/or IWMA (Indonesia) • Sub-national government adopted community-based forest monitoring systems (India) • Co-developed Standard Operating Procedure for monitoring biodiversity and ecosystem standards (Indonesia, Thailand) • Expansion of rewards schemes via Lantapan Incentive-based Policy Programme (Philippines) • Enhanced capacities of 500 NGO staff in community-based monitoring tool (Philippines)
End-of-Program #4 (At least) 40 million smallholders & other users access more productive tree planting material & uptake higher performing, context appropriate & inclusive AF & small-scale forestry mgt. option	
Results **At least 87,708 smallholders and users directly influenced to take up either more productive tree planting material, higher performing, context appropriate and inclusive agroforestry/small scale forestry**	
Contributions to Outcome Achievements	Latin America **(233 smallholders)**
	• 33 concession contracts awarded (Peru) • Enhanced capacities of 200 farmers in sustainable agroforestry practices (Peru)
	Africa **(77,599 smallholders and other users)**
	• 628 smallholders supported to establish improved fruit tree orchards (Malawi) • 11,524 farmers adopted improved agroforestry practices and have enhanced market linkages for agroforestry seed trade (Malawi) • 4,233 households adopted fertilizer tree systems (Malawi) • Enhanced capacities of 2,000 people from SMEs and producer associations in agricultural techniques, business management, forest governance, and monitoring (Cameroon) • 8,500 smallholders supported to scale up terraces, gulley healing using gabions, grass reseeding, FMNR, enrichment planting (Burkina Faso, Ethiopia, Kenya, Mali & Niger) • 800 smallholders planted bamboo (Ethiopia, Kenya, Uganda) • 3000 households set up micro nurseries and trained on bamboo value addition (Ethiopia, Tanzania, Madagascar) • 600 farmers indicated intent to adopt cocoa management models (DRC) • Enhanced capacities of 144,181 households in FMNR and other restoration practices (Ethiopia, Ghana, Kenya, Mali, Niger, Rwanda, Senegal, Somalia) • Enhanced capacities of 10,000 farmers in bamboo cultivation, management, and primary processing of bamboo charcoal (Ghana) • Enhanced capacities of 5,072 women to produce high-quality bamboo-based charcoal for clean household energy (Cameroon, Ghana)

	• Enhanced capacities of 5,000 individuals on bamboo cultivation and community nursery management (Cameroon, Ghana, Kenya, Madagascar, Tanzania, Uganda) • Enhanced capacities of 22,172 individuals on bamboo-planting and use for bioenergy (Cameroon, Ethiopia, Ghana, Madagascar, Tanzania) • 2,686 households adopted bamboo plants for feed, fodder, and biomass (Cameroon, Ghana, Ethiopia, Madagascar) • 3,384 households adopted bamboo micro-nurseries (Ethiopia, Madagascar, Tanzania)
	Asia **(9,876 smallholders and other users)**
	• 1,618 farmers trained in farmer managed natural regeneration, 15 demonstration trials use high quality seedlings of sandalwood, sengon buto, enthocelobium sp., teak, mahogany, annona, soursop, jackfruit, guava, breadfruit, and cashew (Indonesia) • 912 farmers (73% of 1,200 farmers trained in agroforestry) deemed equipped to implement agroforestry on their own (Vietnam) • 700 farmers/producers adopted sustainable harvesting and fuelwood management practices (India) • 386 villagers learn value of ecosystem services and develop interest to plant oak on barren lands (Bhutan) • 110 farmers plan not to use fire (Indonesia) • 300 farmers trained in soil, water, crop management, planted traditional varieties (Kyrgyzstan, Uzbekistan) • 90 smallholders involved in tree-farm learning groups to restore land by planting cacao, durian, nutmeg tress on private degraded land (Indonesia) • 50 households in Huong ha adopt intercropping pomelo and orange with maize (Vietnam) • 250 smallholders joined tree-farmer learning groups and have been involved in replication of FTA promoted co-investment RES schemes (Indonesia, Philippines, Vietnam) • 428 partner CBOs implemented NRM practices in 1,281 sub-projects (Philippines) • 7 community groups support fire prevention and peatland restoration (Indonesia) • 1,200 rural households accessed reliable energy via bamboo power plant (Indonesia) • 3,225 individuals participated in PFES/RES schemes (China, India, Indonesia, Nepal, Philippines, Vietnam) • Enhanced capacity of 600 smallholders on RES and ecosystem service decision-making tools (Bhutan)

Cluster Level Analyses

The following section provides analyses of outcomes realized and discusses impact potential for the 13 clusters of research and engagement to address the high prevalence of degraded land and ecosystem services.

Climate Resilient Cacao (Global) Cluster Results:

To achieve climate resilient cacao, FTA research has demonstrated proof-of-concept for identifying resilience among cocoa genotypes to abiotic stresses across agro-ecological zones in Latin America and Africa, developed standardized protocols for physiological data collection, established a multi-stakeholder knowledge sharing platform, and identified sites for long-term studies in cocoa growing regions. The platform (Global Strategic Cacao Collective) provides a centralized infrastructure for cacao ontology, semantics for allowing annotation for germplasm, phenotypes, plant anatomical structures and developmental stages. The platform has contributed to increased collective action to garner research support and attention to advance climate resilience in cacao. In Colombia, Agrosavia (partner) has been linked with over 40 Colombian germplasm collecting missions and has a wide range of access to valuable diversity, and the Colombian Corporation for Agricultural research has proposed work on cacao drought to be applied to 500 ha and nurseries.

Key results of research and engagement on climate resilient cacao are summarized in table 5 below.

Table 5: Climate Resilient Cacao: Key results to date of outcome realization for impact

Policy Influence	Global: • Protocols for trait measurement of cacao physiology established
Practice Influence	Global: • Multistakeholder knowledge sharing platform established to discuss climate change, cocoa and how to move forward.
Research Influence	• Research collaborations strengthened with target country research institutes. • Sustained research investment supported by engaged research partners, and future studies proposed in trial sites
Potential Impact	**Hectares of land under restoration; High end estimate**

	Research station and nurseries to be established by partners on 500 ha in Colombia

Scaling of Context-Appropriate Agroforestry Systems for Restoration Cluster Results:

To achieve restoration of degraded land through adoption of agroforestry practices and options by context, FTA research and engagement directly supported farmers across Africa and Asia to build capacities necessary to adopt and scale context-specific agroforestry practices, informed policy, trained 12 graduate students, and convened experts (in Kenya) to strengthen the research agenda for agroforestry. FTA provided a wide range of extensive services and training on sustainable agricultural intensification, seed collection and procurement, soil erosion control, water harvesting and conservation structures, soil fertility management, tree and nursery management technologies, tree planting, and farmer managed natural restoration.

Malawi: adopting farmers of FTA promoted practices observed improvements in soil fertility on their farms that improved provision ecosystem services (maize production). FTA research was used to lobby for the inclusion of agroforestry seed in the draft seed Act, and contributed to guidelines for voluntary germplasm certification to guide private nursery operator's practice. FTA researchers also worked with district councils to formulate by-laws to curb bushfires and reduce livestock damage to agroforestry trees.

Ethiopia: FTA provided support to the preparation of Ethiopia's tree seed proclamation, introduced farmers to quality seed portfolios, trained extensionists and established breeding seedling orchards in partnership with regional tree seed centres. FTA has contributed to the facilitation and guidance of a new National Watershed and Agroforestry Multi-Stakeholder Platform (NWAMP) to continue knowledge exchange among various organizations (e.g. relevant government ministries, NGOs, CBOs, donors). FTA implementing partners have been taking FTA lessons forward to this platform to influence the ministry of agriculture's programs and plans.

Kenya: FTA convened stakeholders resulting in an enhanced commitment to data sharing, better coordinating land restoration efforts and initiated the development of an agroforestry strategy.

Burkina Faso, Ethiopia, Mali, Kenya & Niger: FTA supported farmers, local governments and other stakeholders to develop community action plans to improve reforestation and promote sustainable grazing management. More than 8,500 people participated in learning platforms to support widespread adoption and scaling of context appropriate practices, including: i) soil erosion control (terraces, contour ridging, stone lines, contour bunds); ii) water harvesting and conservation structures (infiltration pits, zai pits, half-moons, runoff water collection basins, mulching); iii) soil fertility management practices (composting, micro dosing, crop rotation, organic manure application, bio fertilizers); iv) agroforestry practices (farmer managed natural regeneration (FMNR), tree planting); v) other practices including conservation agriculture, bio-pesticides, improved seeds)

Vietnam: FTA has supported the establishment of exemplary landscapes and farmer demonstration trials over 600ha, supplied seeds, engaged in policy reviews and dialogues, and trained approximately 1200 people (farmers, extensionists, NGOs and government officials) in context specific agroforesty systems, son tra value chains, and nursery management. 73% of trainees were deemed equipped to implement agroforestry independently. In 2015, TAFOOD signed a technological transfer agreement for son tra processing techniques with ICRAF. Through knowledge-sharing and involvement in policy dialogues with provincial policy-makers in Yen Bai province, FTA also influenced the enactment of three provincial policies supporting the implementation of son tra (H'mong apple) development to boost ecosystem services (Decision No.2412/QĐ-UBND); a 6 million VND (USD 260) subsidy for households adopting son tra-based agroforestry in Tram Tau and Mu Cang Chai districts (Resolution No.15/2015/NQ-HĐND); and a subsidy of 1 million VND (USD 45) for each hectare where maize-grass cultivation has been planted along contour lines to reduce soil erosion (Decision No.27/2015/QĐ-UBND).

Indonesia: FTA has supported the establishment of 15 farmer demonstration plots, and trained farmers and extension agents in farmer managed natural regeneration. 1,618 farmers and 18 farmer extensionists and partners have participated in 243 trainings on agroforestry and farmer managed natural regeneration. As a result of their participation, extensionists have committed to testing agricultural practices introduced by the project, including

intercropping leucaena and gliricidia with turmeric to improve soil quality and turmeric yields, fruit tree and cassava vegetative propagation, organic fertilizer and pesticide use, and nursery establishment and management. As a result, 120 ha of land has been rehabilitated through planting of high-quality seedlings in the15 trial plots, and in 21 farmer managed regeneration plots have been established and enriched by intercropping timber with fruit, and turmeric over a total of 420 ha.

Overall, through these contributions, it is estimated FTA has contributed to improved practices that have resulted in 743,839 ha of land being placed under restoration through contextually appropriate agroforestry in Africa (Ethiopia, Mali, Niger, Burkina Faso, Kenya, Rwanda, Somalia, Mozambique, Niger, Ghana & Malawi), and 10,794 ha in Asia (Vietnam & Indonesia). Assuming success is scaled, and progress continues to meet targets, there is the potential for 14,810,669 ha to be under restoration through agroforesty in Africa, and 1,405,000 ha in Asia (Vietnam, Indonesia) under restoration through son tra agroforestry, and farmer managed natural rehabilitation and enrichment planting informed and influenced by FTA interventions.

Box 1. Informing quality and appropriate tree planting in Ethiopia: a deep dive

Many restoration programs fail to reach their potential, because the species selected for planting were poorly suited to the site conditions. Non-native seeds, or poor-quality seeds end up being planted, and can further degrade landscapes and ecosystem services, as trees fail to survive. Ethiopia has set ambitious land restoration targets to achieve by 2030. In response, FTA through the implementation of the Provision of Adequate Tree Seed Portfolios (PATSPO) initiative is supporting Ethiopia's four regional seed centres in Amhara, Ormomia, Tigray and Southern Nations and Nationalities People's Region in Ethiopia to supply quality and locally adapted native seeds. The project is also training farmers in proper seed collection, from trees that are not too young nor too old. FTA has supported the establishment of 30 breeding seedling orchards containing quality tree seeds. Furthermore, the project has developed capacity and networks between private and public seed delivery partners (e.g. forest enterprises) to enhance the overall infrastructure, identified priority landscapes for restoration, and proposed species and techniques to use in restoration the land (e.g. agroforestry, forest and woodland enrichment practices). Scaling successful innovations from the Ethiopian case regionally and inter-continentally hold potential for impact to likewise be scaled.

Availability of knowledge is also a problem. In response, FTA has supported the development of an open access online decision support tool called Global Tree Knowledge Platform, which contains a multitude of tools that help project managers and growers determine what trees to plant where for what purpose, for example by supplying accompanying training manuals, databases, maps and smartphone applications. The Resources for Tree Planting Platform is another source of open access resources to support restoration, afforestation, and conservation to improve the global status of ecosystem services.

Preliminary estimates from ex ante modeling performance simulations over a 40-year period (see van Schoubroeck et al. & Pedercini et al., forthcoming) following PATSPO interventions indicate that over the 152,000 ha land use areas targeted to apply optimal seed, trees will grow faster, have greater survival rates, and greater market value due to their enhanced attributes. If PATSPO is successful to facilitate and inform the restoration over the identified priority landscapes, it is estimated that that up to 17 million ha of land could be restored to potentially sequester 178 million tonnes of CO2, and conserve 130,000 tonnes of soil annually. These estimates assume that improved tree planting material is 50% more productive than planting material that is currently available, and that the scaling efforts are effective thanks to the necessary seed distribution infrastructure supported by the project. In terms of value for money, net present value estimates that once BSO's fully yield after 20 years, PATSPO's initial investment of €9 million, the impacts imply €118 million euro over business as usual (BAU) tree material planted. Benefits after processing (sawing, transporting) and biodiversity values have not been included in the calculations, but would be expected to multiply the benefits.

Key results of the Scaling of Context-Appropriate Agroforestry Systems for Restoration cluster identified to date are summarized in table 6 below.

Table 6: Scaling of Context-Appropriate Agroforestry Systems for Restoration: Key results to date of outcome realization for impact

Policy Influence	Kenya: • Stakeholders commit to data sharing, coordinate land restoration efforts, and initiate the development of agroforestry strategy Ethiopia: • Support to the preparation of a national tree seed proclamation Burkina Faso: Ethiopia, Kenya, Mali, Niger: • Farmers, local government, and other stakeholders developed community action plans to improve reforestation and promote sustainable grazing management Malawi: • Lobby for inclusion of agroforestry seed in draft seed Act. • Contribution to guidelines for voluntary germplasm certification to guide private nursery operators' practice. • District councils supported to formulate by-laws to curb bushfires and reduce livestock damage to agroforestry trees. Vietnam: • Provincial (11 decisions and resolutions in Dien Bien and 9 in Yen Bei) and national policy frameworks have been influenced by FTA through policy dialogues and analyses to support agroforestry solutions and son-tra development • Advisors to 20 different resolutions, decisions and implementation plans. • The Ministry of Agricultural and Rural Development created the first national agroforestry technical working group, with FTA representation. • FTA influenced the enactment of three provincial payment for ecosystem service mechanisms supporting the implementation of son tra (H'mong apple) development (Decision No.2412/QĐ-UBND); a 6 million VND (USD 260) subsidy for households adopting son tra-based agroforestry in Tram Tau and Mu Cang Chai districts (Resolution No.15/2015/NQ-HĐND); and a subsidy of 1 million VND (USD 45) for each hectare where maize-grass cultivation has been planted along contour lines to reduce soil erosion (Decision No.27/2015/QĐ-UBND). • In July 2020, the Vietnamese Prime Minister signed a decision to support agroforestry solutions involving fruit tree development to improve livelihoods and climate change resilience for the north-western region.
Practice Influence	Tanzania, Ethiopia, Zambia: • FTA information on sustainable agricultural intensification was used to design projects, programs, provide extension services and training to farmers. Ethiopia: • Seed processing and testing protocols being followed; farmers trained on seed collection and procurement. • 30 BSOs established Burkina Faso, Ethiopia, Kenya, Mali, Niger: • More than 8,500 people participated in learning platforms to support widespread adoption and scaling of context appropriate agroforestry practices • Farm ponds, wells and springs were transformational technologies. 4,625,878 trees were planted on farm and open lands (72% in Ethiopia). Malawi & Mozambique: • Farmers observed improved soil fertility by applying agroforestry practices and technologies to improve provision ecosystem services (i.e. maize production) Malawi: • 2,962 farmers trained in fruit and fodder tree and nursery management technologies. Burkina Faso: • 50 farmers trained in: setting up and managing a nursery, propagating local tree species, techniques to recuperate degraded lands, identify forest restoration actions Vietnam: • Exemplary landscapes and farmer demonstration trials were established over a total of 600 ha.

	• Approximately 1,200 participants comprising farmers, extensionists, local government officials, and researchers learned about context-appropriate agroforestry systems, son tra value chains, and on-farm tree nursery management. • In 2015, Tay Bac Tea and Special Food Company Limited (TAFOOD) signed a technological transfer agreement for son tra processing techniques with ICRAF. Indonesia: • 18 farmer extensionists and partners have committed to testing agricultural practices introduced by the project • 15 farmer demonstration trials were established and managed by extensionists. These demonstration plots cover 120 ha and have been rehabilitated through planting 24,671 high quality seedlings of sandalwood, sengon buto, enthocelobium sp., teak, mahogany, annona, soursop, jackfruit, guava, breadfruit, and cashew. • Extensionists intercropped trees with grafted cassava, shallots, peanuts, maize, and green leafy vegetables.
Research Influence	• Convening of experts in Kenya to influence and coordinate land restoration agenda • 12 students trained (2 Bachelor; 8 Master; 2 PhD) • >80 publications produced and disseminated • 10 publications on nutrition sensitive restoration with 6 citations and 185 downloads.
Potential Impact	**Hectares of land under restoration: High end estimate** 16,215,669 ha (total) Ethiopia: 8,542,650 ha (system level target) Ethiopia, Mali, Niger, Burkina Faso, Kenya: 265,902 ha No upper limit target available. Kenya, Ethiopia, Rwanda, Somalia, Mali, Niger, Ghana: 1,000,000 ha. Expected outcome for the project is that evergreen agricultural practices are adopted by at least 500,000 households over an area of at least 1 million ha. Burkina Faso: 5,000,000 ha Burkina Faso commitment to AFR100 cited as entry point and intended contribution is to support realization. Malawi: 2,117 ha No upper limit target available. Vietnam: 1,400,000 (target) Indonesia: 5,000 (target)
	Hectares of land under restoration: Low end estimate 754,513 ha (total) Ethiopia: 313,000 ha shrubland, grassland, woodland, forest, cropland restored through quality genetics trees. Ethiopia, Mali, Niger, Burkina Faso, Kenya: 265,902 ha. Area is reported to be restored through options by context approach (122,850 of degraded land rehabilitated, 90,058 ha is under improved management practices, and climate smart practices are adopted on 52,994 ha of farmland) Kenya, Ethiopia, Rwanda, Somalia, Mali, Niger, Ghana: 442,179.1 ha Area is reported to be under restoration by options by context. Burkina Faso: 3 ha Project participant in Manefyam, displays his skills and experience restoring three hectares of degraded lands through fencing to protect the natural regeneration of trees, selectively tilling, and sowing or selectively planting trees.

	Malawi: 2,117 ha benefited from restoration measures. Fertilizer tree systems promoted were found to have low adoption, but those who adopted reported practicing FTS on at least half of their fields. Considering these conditions, 2,117 ha were considered to have benefitted from restoration measures. Vietnam: 10,254 ha. 6,200 ha have been planted with son tra in Yen Bei; 3820 existing plantations have been rehabilitated; 3 new exemplary landscapes of 50 ha each have been established and put under management, monitoring, and evaluation; forest rehabilitation research in Dien Bien and Son La has led to enrichment planting in 16 ha, planting NTFPs on 8ha and assisted natural regeneration being established over 60 ha. Indonesia: 540 ha. 21 sites for farmer managed natural regeneration and intercropping have been established, each between 20-25 ha. 15 demonstration plots have been planted with high quality seedlings over a total of 120 ha.
	Soil effects: High end estimate 130,000 tonnes of soil conserved/year through the effect of quality seeds applied over targeted area.

Forest Landscape Restoration (Global) Results:

To improve restoration and land management policy and practice in Malaysia, Bhutan, India, Peru, Mexico, Brazil, and Colombia, FTA produced policy relevant research on forest plantations, ecosystem services, and supported communities to increase their understanding and awareness of ecosystem services, establish nurseries, and begin restoration.

Malaysia: to influence policy, FTA hosted a public forum to co-develop a series of recommendations, and a Strategy and Action Plan for Forest and Landscape Restoration for Sarawak State. As a result of these contributions, the Forest Department (2019) issued a directive for compulsory replanting in the licensed Planted Forest Areas and increased the levy for timber from swamp and hill forests to generate funds for the rehabilitation of logged forests. 200,000 ha of land in Sarawak was identified as a priority area for restoration. From June 2019 and December 2020, the Sarawak government has supported the planting of 10 million trees of over 50 species over the priority area covering 9,732 ha. Furthermore, in 2021, the state government earmarked 62 million MYR (equivalent of USD $14.79 million) for meeting FLR targets. Through the adoption of FTA recommendations, 6 forest tree nurseries and 27 seed production areas have been established since 2018.

Peru: to influence policy FTA researchers were invited to collaborate in the development of a legislative proposal and contribute to the development of guidelines on forestry plantations and policy. This resulted from FTA's historical analysis, which provided insights on incentives and land tenure conflicts. These insights gave national governments new understandings of the complexity involved to meet the restoration-plantation challenge which aims to reach a goal of 2 million ha of planted forest. To influence policy in Mexico, FTA informed the National Commission on Biodiversity (the agency responsible for drafting Mexico's restoration plan) of its findings. However, there is no indication of which findings were shared, or what influence resulted from this engagement. To influence policy in Colombia, it is indicated that FTA's policy relevant work assisted government agencies in charge of implementing biodiversity offsets through ecological restoration.

India: a draft overarching toolkit manual was developed to describe the process, tools and steps needed for effective community biodiversity management for forests, this was shared with communities, but uptake has not been assessed. FTA also engaged in water storage capacity improvement by supporting the deepening of wells in Bahmni and Kandra tree nurseries, where 2,641 saplings were sold to Narmada River Rehabilitation Program in the Mandla landscape. Additionally, a nursery in Vanalli started growing wild nutmeg seedlings on FTA's recommendation.

Bhutan: FTA developed key recommendations to policymakers and supplied their partner (UWICER), who continued engagement with policymakers and shared the recommendations at multiple forums. Following

collaborations with UWICER, the Bhutan Ecological Society (BES) engaged CIFOR-ICRAF as partners to support their one million tree campaign. FTA advanced understanding of ecosystem services derived from multiple forest types. 386 villagers were engaged to increase their understanding about the diversity and types of goods and services of forests. These sessions were noted to have raised awareness of ecosystem service decline, and result in community interest to plant oak on barren lands and engage in restoration activities to restore oak forests. Beyond this renewed partnership, commitment and interest, there is no clear evidence of outcomes and impacts.

Key results of research and engagement on Forest Landscape Restoration are detailed in table 7 below.

Table 7. Forest Landscape Restoration: Key results to date of outcome realization for impact, as well as policy, and practice impact pathways

Policy Influence	Malaysia (Sarawak): • Directive for compulsory replanting in the licensed Planted Forest Areas to be issued by the Forest Department (2019), (DF Circular No. 2/2019) and an increased levy for timber from swamp and hill forests to generate funds for rehabilitation of logged areas (DF Circular No. 10/2018) Mexico: • Project outputs feed into the National Commission on Biodiversity, the agency in charge of drafting Mexico's national restoration plan Peru: • Invitation to collaborate in the development of a legislative proposal and contribute to the development of guidelines on forestry plantations and policy Colombia: • assisted government agencies in charge of implementing biodiversity offsets through ecological restoration
Practice Influence	Malaysia (Sarawak): • 6 forest tree nurseries and 27 seed production areas have been established since 2018 on recommendations co-developed by FTA • Implementation of Strategy and Action Plan for Forest and Ladnscape Restoration is ongoing, Sarawak government has allocated funding to support planting of 10 million trees over 9,732 ha India: • Draft overarching toolkit manual was developed describing the process, steps, tools and methods for community biodiversity management for forests; well deepening to improve water storage capacity was installed in Bahmni and Kandra tree nurseries Bhutan • 386 villagers engaged to increase understanding about the diversity and types of goods and services of forests, and raise awareness of ecosystem service decline, resulting in community interest to plant oak on barren lands and restore oak forests.
Research Influence	• 20 blogs with 27,857 reads • 25 published works (working papers, book chapters, journal articles, reports) with 260 citations and 22,792 downloads • 5 videos with 906 views
Impact	**Hectares of land under restoration; High end estimate** Total: 2,200,000 ha Malaysia (Sarawak): 200,000 ha identified as priority area for restoration Peru: 2 million ha planted forest Project analyses made government actors aware that much work is still needed in order to reach the goal of 2 million ha of planted forest, offering insights on complex issues including incentives and land tenure conflicts
	Hectares of land under restoration; Low end estimate Malaysia (Sarawak): 9,732 ha

Bioeconomy Development to Restore Degraded Land (Asia & Africa) Cluster Results:

To restore degraded lands and develop the bioenergy economy, FTA supported policy relevant research and technical training on the potential of bamboo to support restoration and serve communities as a sustainable economic endeavor, and trialed nyamplung to restore peatlands. FTA research demonstrated the calorific value of bamboo over alternative technologies, the lower carbon footprint for charcoal production compared to other products, and co-developed bamboo value chain models for smallholders. Over 17,100 households have been reached through FTA activities to learn about the diverse use of bamboo, and receive training required to become bamboo producers. As a result of farmer field schools and training centres, 3,384 micro-nurseries were established by participating communities, which has facilitated the planting of bamboo on degraded lands and reduce soil erosion. FTA researchers engaged with policymakers in dialogues and by supporting policy reviews to raise awareness of bamboo's socio-environmental potential for climate mitigation, livelihood provision, soil erosion control, water recharge, and soil quality. As a result of these initiatives, national authorities in Ethiopia recognized bamboo as a suitable biomass energy source, and Ghana's national government adopted bamboo into its national biomass energy policy. Overall, through these direct contributions, it is estimated that FTA has contributed to restoring 1682.86 ha of land by supporting communities to plant bamboo across Africa. We estimate potential for up to 5 million ha resulting from policy support to national plans and initiatives that will progress in the coming decade across INBAR member states. FTA also demonstrated the potential for Nyamplung as a suitable species to restore peatland over 17 ha in Indonesia, showing a 95% survival rate in high salinity, waterlogged environments. Planting bamboo on degraded land also has positive implications for carbon sequestration. Applying INBAR's carbon sequestration conversion ratios (INBAR, 2015) for planting bamboo on degraded land, it is estimated that the bamboo planted to date has resulted in between 17,434.43 and 24,283.67 tons of carbon dioxide (CO_2) sequestration, with the potential of up to 72,150,000 tons of CO_2 sequestration if national plans and initiatives are successful in restoration with bamboo. Ranges account for variable sequestration contingent on the species of bamboo selected for planting, and assume proper management.

Key results of research and engagement on the development of the bioeconomy to restore degraded land are detailed in table 8 below.

Table 8. Bamboo Bioeconomy Development to Restore Degraded Land: Key results to date of outcome realization for impact

Policy Influence	Ghana: • National government has adopted bamboo into national biomass energy policy and commissioned INBAR to support development of strategic plan for bamboo 2020-2024) Ethiopia: • National government included bamboo into its national development strategy and action plan for 2019-2030) Ethiopia, Tanzania & Madagascar: • As a direct result of the projects, governments are all in the final stages of developing bamboo strategies China, Ethiopia, Kenya, Uganda: • Convened working groups to development of national product standards Ethiopia, Kenya, Uganda: • INBAR supported national governments to produce bamboo strategy and action plan
Practice Influence	Overall: • 3,384 micro-nurseries were established by participating communities • Over 17,100 households have been reached through FTA activities to learn about the diverse use of bamboo, and receive training required to become bamboo producers Ethiopia & Ghana: • Facilitated establishment of 216 micro and small enterprises to produce bamboo charcoal and reduce stress on trees; and the use of 441,800 energy-saving stoves facilitating the use of bamboo for fuel among 10,000 households Ethiopia, Tanzania & Madagascar: • Over 3000 households setup micro-nurseries and were trained how to use bamboo as a source of food, fodder, and income through value addition.

	• Seven community production training centres were established to centralize training and long-term support to bamboo artisans and entrepreneurs. Ethiopia, Kenya, Uganda: • Projects mobilized Dutch and Chinese bamboo expertise to provide training courses on how to establish bamboo microenterprise, value chain management, sustainable management of bamboo resources (e.g. in plantations, and nurseries); as a result, 24 bamboo nurseries were established for the government and private sector to supply bamboo for sectoral development, and over 800 smallholders planted bamboo. Cameroon, Ethiopia, Ghana & Madagascar: • 2300 people were trained in bamboo propagation, management, treatment, product creation and value addition Indonesia: • Nyamplung demonstrated potential as species suitable for peatland restoration
Research Influence	• Global Assessment of Bamboo and Rattan for Green Development launched
Potential Impact	**Hectares of land under restoration; High end estimate** INBAR member states set a target in 2014 to restore **5 million hectares** of degraded land with bamboo as part of the Bonn Challenge, and have since developed plans.
	Hectares of land under restoration; Low end estimate Total: 1,699.86 ha Ethiopia: bamboo planted on 625 ha of degraded land Tanzania, Ethiopia, Madagascar: bamboo planted on 357.86 ha of degraded land Kenya, Uganda, Ethiopia: bamboo planted on 700 ha of degraded land Indonesia: Nyamplung demonstration trial established over 17 ha
	CO_2 sequestration potential; High end estimate 721,500,000 t CO_2
	CO_2 sequestration potential; Low end estimate 17,434.43 t CO_2

REDD+ Policy Mechanism (Global) Cluster Results:

Forests supply critical ecosystem services. Reliable data and tools are needed to support effective policy mechanism implementation to address the negative effects of deforestation-driven climate change to preserve forest ecosystem services from degradation, and contribute to the development of low-emission land use strategies to thereby enhance forest ecosystem function and capacity. Since 2009, FTA's research and engagement on REDD+ aimed to influence policy at sub-national, national, and international levels. FTA research developed decision-support tools for low emission development planning in support of the preservation and restoration of forest ecosystem services in Cameroon, Indonesia, Peru, Vietnam, and Colombia. By establishing research partnerships with key stakeholders working in climate change and maintaining their active participation in multi-stakeholder platforms to facilitate the dissemination of knowledge outputs, FTA research informed policymakers, governments, and REDD+ practitioners at national and sub-national levels on policy options and guided them on the opportunity and implementation of such changes. In recognition of the utility and applicability of FTA's recommendations, policymakers have taken up and used policy guidelines put forward by FTA to enhance forest management to better maintain ecosystem function. FTA research on REDD+ supported the increased efficiency and effectiveness of national REDD+ policies in several countries with national policymakers promoting FTA research. FTA's contributions to outcomes and impacts via global and national REDD+ policies are described in further detail below.

Global: FTA's expertise contributed to a United Nations Framework Convention on Climate Change (UNFCCC) decision in 2011, recommending a stepwise approach on setting, measuring, and reporting forest reference emission levels (FREL) (UNFCC Decision 12/CP17). The stepwise approach has become the main method used to guide countries to improve capacity to carry out REDD+ programs, mainly in setting their FRELs. Adoption of the stepwise approach gave countries with differing capacities the opportunity to engage with the international REDD+ process. This achievement created a bridge between countries aiming to protect forests and the international REDD+ process, facilitating the production of data on emissions and the potential for payments for ecosystem services.

Cameroon: The Government of Cameroon has expressed high interest in scaling up the use of the LUWES tool (Land-Use Planning for Low Emission Developing Strategies). The Ministry of Environment, Nature Protection and Sustainable Development (MINEPDEP) officially requested FTA support for Land Use Planning for Low Emission Development (LUWES) training in view of the Cameroon REDD+ strategy and the national MRV. On invitation by the MINEPDEP minister, FTA is among the leading institutions in developing the harmonized cover legend for REDD+ MRV in Cameroon which has now become a nationally approved priority as a way forward to improve the performance of REDD+ MRV as outlined in the UN-REDD National Forest Monitoring systems.

Colombia: FTA's contribution to low-emission development strategies in Colombia provided key inputs for the development of Colombia's Intended Nationally Determined Contributions (INDC) to climate change mitigation under the Paris Agreement and the Forestry NAMA. It contributes directly to the improvement of synergies and trade-offs between ecosystem services, such as water resources and resilience under the Convention of Biological Diversity (CBD), to support ecosystems resilience to climate change impacts to consequently contribute to improving capacity of ecosystems to deliver goods and services.

DRC: FTA piloted sustainable intensification of cocoa agroforestry systems in five villages in Efoulan municipality. Following the pilot, over 600 farmers indicated their intent to adopt cocoa management models on 3,000 ha of new farms established on fallow land and secondary forests.

Ethiopia: FTA engagement with government technical staff in Ethiopia resulted in the country adopting FTA's stepwise approach to measurement, reporting, and verification (MRV) of GHG mitigation measures, and continuously improving and adapting the forest and natural resource monitoring capacities. The stepwise approach played a crucial role in advancing Ethiopia's position in the international REDD+ negotiations. Research co-produced by FTA and Ethiopian research partners increased institutional and technical capacity of practitioners. FTA provided information relevant to the development of the national REDD+ strategy and the benefit sharing mechanism of the Oromia Forested Landscape Program. There are indications of uptake of FTA research on exclusion, benefit sharing, and gender in forestry by technical experts for the development and implementation of Ethiopia's Climate Resilient Green Growth.

Indonesia: The National Planning Board for Development adopted FTA's Land Use Planning for Low Emission Developing Strategies (LUWES) tool, and it has been used by 33 provincial governments to plan actions to reduce greenhouse gas emissions. ICRAF conducted a reference emission level calculation for a company in Jambi and the company defined mitigation actions in their annual work plan. FTA's support in the development of sustainable land use plans throughout Jambi province has potential to place 500,000 ha under improved management; to date, implemented sustainable land use plans in Tanjabar cover an additional 714 ha. FTA research contributed directly to high-level policy dialogue on REDD+, increasing the capacity and influencing the behavior of national policymakers and other actors to promote effective, efficient and equitable (3E) REDD+ approaches, supporting the country to become "REDD+ Ready" (Young and Bird, 2015). FTA contributed to the development of the Indonesian National REDD+ Strategy and supported the improvement of Indonesia's FREL through refined greenhouse gas (GHG) accounting in wetlands, including the national measurement, reporting and verification (MRV) system for emissions. FTA also directly supported the establishment of the Indonesia National Carbon Accounting System (INCAS) in 2015 using FTA data. With financial support from Australian Aid, FTA worked to support the technical services of the Forestry and Environmental Research Development and Innovation Agency (FOERDIA) in the Ministry of Environment and

Forestry (KHLK) to assess deforestation using different datasets. By contributing to the design of Indonesian REDD+ policies, establishing good relationships with the Government of Indonesia (GoI) (both personally and institutionally), and promoting and sharing FTA research, data, and recommendations, FTA supported extensive policy change. As a result, national policymakers viewed FTA outputs as a main source of spatial and contextual information to inform REDD+ in Indonesia leading to GHG reduction through 3E policy that enforces reduced deforestation and generates co-benefits. Further details of FTA's contribution to the Forest Moratorium, and equipping the Indonesian Peatland Restoration Agency (BRG) to set REL for peatland restoration, thereby refining GHG accounting in wetlands can be found in the Indonesian deep dive case study in the Challenge 1 report (Box 1).

Peru: FTA's research and engagement contributed to the Peruvian National Strategy on Forest and Climate Change and stimulated the initiation of a national cross-sectorial process for the legal recognition of peatlands. FTA's expertise on peatlands and deep engagement in Peru led to the initiation of a process for the legal recognition of peatlands in the country. FTA contributed 18 pages of comments and recommendations to the National Strategy for Forests and Climate Change, which were publicly endorsed and referenced FTA's research on mitigation-adaptation synergies. The Strategy identifies the major threats to Peru's forests (threatening 78.3 million ha) and lays out a strategy for countering them. FTA also contributed to the development of the INDC in Peru as part of the country's commitment to conserve the national forest to avoid GHG emission and reduce deforestation. In recognition of FTA's prior expertise and perception as a credible source of information on REDD+, the Ministry of Environment (MINAM) requested FTA's assistance to help identify and enhance strategies towards REDD+ benefit sharing. As a result of this engagement, MINAM developed a conceptual framework on benefit sharing to contribute to the national commitment to conserve 54 million ha of tropical forests through climate change mitigation and sustainable development. FTA's reflexive learning tool for multi-stakeholder fora is being adapted with Peru's National Service of Natural Protected Areas (SERNAP) for use with its 75 co-management committees. Following recommendations from the studies conducted by GCS REDD+ on peatlands, the recent Law of Multisectoral and Decentralized Management of Wetlands (November 2020) included Amazonian peatlands (*aguajales*). This reveals the close link between GCS REDD+ Module 3 knowledge sharing activities on peatlands in Peru and the technical research on peatlands and GHG dynamics in undisturbed and degraded palm dominated swamp forests. This led to the acknowledgement by the Government of Peru (GoP) of the need to formally recognize and protect its peatlands. FTA also influenced private sector's capacity. SEDAPAL, a water supply company based in Lima, sought CIFOR's expertise to teach their staff from different departments about ecosystem services and the implications of climate change for watersheds. The Government of Peru has expressed interest in scaling up the use of FTA's LUWES tool. The Ministry of Environment (MINAM) invited members of the SECURED landscape team from ICRAF and CIAT to provide training on the LUWES methodology at a workshop and based up this training, is considering using this methodology in land-use planning processes across the country. A Memorandum of Understanding (MOU) between ICRAF and MINAM was signed during the UNFCCC COP 20. These enhanced commitments to preservation of forest land and ecosystems from degradation under the REDD+ framework, have positive implications for the capacity of forest ecosystems to deliver goods and services.

Vietnam: There are indications that FTA's research and active engagement with government and non-state actors in Vietnam contributed to an effective, efficient, and equitable implementation of a Payment for Environmental Services (PFES) policy through knowledge creation, capacity-building (for implementation and for research), coalition-building, and additional research in the sector. FTA's award-winning research has been instrumental in supporting the development of national PFES policy, which was approved by the government and is being adopted by provinces across the country. Through engagement with key stakeholders, including local policy decision-makers, FTA tailored its research to the government's concerns. As part of the development of the PFES monitoring system, FTA trained 26 officials from various government agencies (e.g., the Ministry for Agriculture and Resource Development (MARD), the Vietnam Forestry Administration (VNFOREST), the Vietnam Forest Protection and Development Fund (VNFF)), research institutes, NGOs, and CSOs in PFES methods and forest monitoring; more detail can be found in the Vietnamese deep dive case study in the Challenge 1 report (Box 2).

101,5760 ha in Son La, Cat Tien, Dak Lak and Thua Thien Hue are monitored by FTA informed Monitoring and Evaluation (M&E) system, for which heads of funds are reporting improvements in forest conditions. Assuming success is scaled to the entire PFES scheme in Vietnam, this contribution has the potential to influence up to 6.5 million ha. Overall, FTA's new knowledge and tools have informed the implementation of the National REDD+ program and specifically engaged policymakers at national and subnational levels (e.g., Provincial People's Committee, Provincial REDD+ Fund) to ensure that lessons learned at the subnational level inform national policy dialogues to reduce deforestation and maintain corresponding ecosystem services. A joint workplan of ICRAF and Vietnam Administration of Forestry (VNFOREST) has been elaborated in 2014 and aims to promote a landscape approach for REDD+ in Vietnam. Incentives for promoting this include: 1) promotion and establishment of community forests to protect and assist natural forest regeneration and 2) promotion and establishment of agroforestry on sloping lands. In Bac Kan province, FTA assisted the piloting of two community-based management schemes – one which placed 212 ha of naturally regenerated forest under a community forest management regime, and the other which established 85 ha of community forest under a land use rights certificate incentive scheme informed by FTA's findings on local preferences of REDD+ benefits.

Assuming that FTA's contributions to improvements in management and REDD+ implementation have positive effects in terms of restoring degraded and/or preserving land and ecosystem services, we estimate that between 1,035,712 and 8,505,925 ha are considered to be under restoration as a result of the collective processes to which FTA contributed with a carbon sequestration potential of up to 6,081,361 t CO_2 (resulting only from the assumed adoption of low-emission development scenarios modeled through LUWES across Peru, Vietnam & Cameroon).

Table 9 provides details of the key policy, practice and research outcomes that have resulted in part from FTA's work on REDD+.

Table 9. REDD+: Key results to date of outcome realization for impact

Policy Influence	Global:
	• FTA recommendations informed international climate negotiations for a global REDD+ agreement, which would support and increase the efficiency and effectiveness of national-level REDD+ policies (e.g., Indonesia, Vietnam, Tanzania, Peru, Brazil, Cameroon)
	• UN-REDD made tenure part of its strategy framework based on FTA research
	• FTA contributed to 6 chapters across the:
	  o 2013 Wetlands Supplement to the 2006 IPCC Guidelines for National GHG Inventories
	  o 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
	  o 2019 Special Report on Climate Change and Land
	Indonesia
	• FTA input to development of 2011 Forest Moratorium (through Inpres No. 10/2011)
	• FTA contributed to the development of the Indonesian National REDD+ Strategy
	• FTA provided direct support to the establishment of the Indonesia National Carbon Accounting System (INCAS)
	• The National Planning Board for Development adopted the Land Use Planning for Low Emission Developing Strategies (LUWES) tool, and it has been used by 33 provincial governments to plan actions to reduce greenhouse gas emissions.
	Vietnam:
	• FTA research informed development of a national PFES policy, which was approved by the government and is being adopted by all provinces in the country
	• CIFOR became part of a National Task Force to help develop Vietnam's Forestry Development Strategy (2020–2030) through 2045
	Peru:
	• FTA contributed to the Peruvian National Strategy on Forest and Climate Change and stimulated the initiation of a national cross-sectorial process for legal recognition of peatlands
	• The Government of Peru has expressed interest in scaling up the use of FTA's LUWES tool. The Ministry of Environment (MINAM) invited members of the SECURED landscape team from ICRAF and CIAT to provide training on the LUWES methodology at a workshop and based up this training, is considering using this methodology in land-use planning processes across the country. A Memorandum of Understanding (MOU) between ICRAF and MINAM was signed during the UNFCCC COP 20.

	DRC: • CIFOR invited by the national REDD+ coordinator to evaluate and support DRC's REDD+ progress and national REDD+ policies Cameroon: • Policymakers promoted FTA research at the national and international levels, some of which has been incorporated in the REDD+ Readiness Preparation Proposal (RPP) • The Government of Cameroon has also expressed high interest in scaling up the use of LUWES tool. The Ministry of Environment, Nature Protection and Sustainable Development (MINEPDEP) officially requested ICRAF Cameroon for LUWES training in view of the Cameroon REDD+ strategy and also national MRV. Ethiopia: • FTA contributed to development of the national REDD+ strategy and the benefit-sharing mechanism of the Oromia Forested Landscape Program
Practice Influence	Global: • FTA expertise contributed to a UNFCCC decision in 2011 recommending a stepwise approach on setting, measuring and reporting reference levels • Support in the development of the Green Climate Fund's (GCF) sectoral guidance for ecosystems, land use and forestry and contributed to GCF's Learning-Oriented Real-Time Impact Assessment (LORTA) initiative • FTA provided support to the European Commission on Transparent Monitoring and REDD+ Finance • FTA supported improved monitoring, measurement, reporting, and verification (MMRV) systems in Indonesia, Vietnam, Guyana, Ethiopia, and Peru Vietnam: • A joint workplan of ICRAF and Vietnam Administration of Forestry (VNFOREST) has been elaborated in 2014 and aims to promote a landscape approach for REDD+ in Vietnam. Incentives for promoting this include: 1) promotion and establishment of community forests to protect and assist natural forest regeneration and 2) promotion and establishment of agroforestry on sloping lands. Peru: • CIFOR's reflexive learning tool for multi-stakeholder fora is being adapted with the National Service of Natural Protected Areas (SERNANP) for use with its 75 co-management committees Indonesia: • FTA supported improvements to the national FREL through refined GHG accounting in wetlands • ICRAF conducted a reference emission level calculation for a company in Jambi and the company defined mitigation actions in their annual work plan. Ethiopia: • Indications of uptake of FTA research on exclusion, benefit sharing, and gender in forestry by technical experts for development and implementation of Ethiopia's Climate Resilient Green Growth Cameroon: • 600 farmers participate in pilot on sustainable practices and landscape management for cocoa farms and intend to adopt models promoted by the project Guyana and Ethiopia: • Indications of uptake of CIFOR's stepwise approach to MRV GHG mitigation
Research Influence	• 1183 publications, 4,928,356 downloads, 37,849 citations • Global: FTA played a role in facilitating learning platforms for REDD to achieve the 3Es (Effective, Efficient, Equitable) • CIFOR is recognized as a REDD+ expert • CIFOR's profile raised on topic of gender, tenure, and climate change and become trust source for training on the topic
Potential Impact	**Hectares of land under restoration: High end estimate** Total: 8,505,925 ha Cameroon, Indonesia, Peru, Vietnam: 2,005,925 ha targeted by SECURED Landscapes programme and LUWES informed land use plans.

	Vietnam: 6,500,000 ha under PFES M&E system; Heads of funds reporting improvements in forest conditions
	Hectares of land under restoration: Low end estimate Total: 1,035,712 ha Indonesia: 740 ha covered by co-developed land use plans using LUWES Vietnam: 212 ha of forest continues to be naturally regenerated under community management regime; 101,5760 ha in Son La, Cat Tien, Dak Lak and Thua Thien Hue are monitored by FTA informed M&E system, for which heads of funds are reporting improvements in forest conditions. Cameroon: 3,000 ha of farms established on fallow and secondary forest adopt cocoa agroforestry Peru: 6,000 ha of forest is placed under sustainable land use management plan DRC: Piloted sustainable landscape management practices over 10,000 ha
	CO_2 sequestration potential: High end estimate SECURED landscapes project total: potential emission reductions over one year: 6,081,361 tCO_2

Innovation for Resilient Landscape Restoration (Global) Cluster Results:

While restoration is promoted worldwide as a viable low-cost solution to address anthropogenic environmental damage and mitigate climate change, experts caution that tree planting is no silver bullet. Restoration done wrong, which may be viable for timber production, can lead to further environmental degradation through the establishment of fast-growing tree monocultures that do not replicate the ecosystem functions of natural forests or forest ecosystems (e.g. soil fertility, water/nutrient cycling, and biodiversity). To address this, FTA has invested in the development of integrative databases (e.g. the Agroforestry Species Switchboard), and decision-support tools that analyze and monitor degradation trends over time (e.g. The Land Degradation Surveillance Framework (LSDF)), and inform selection of suitable indigenous tree species for restoration, forestry, agroforestry, and landscape diversification projects (e.g. vegetationmap4africa, D4R).

The Agroforestry Species Switchboard is a one stop shop for relevant information of over 170,000 agroforestry species. It has been visited over 340,000 times by researchers and practitioners worldwide, and is recognized by the Agroforestry Network as a credible and useful resource for those seeking information on the goods and services of desired species, including biology, value, and ecology necessary to determine suitability for growing to support restoration initiatives. Other FTA tools, including the vegetationmap4africa and its accompanying Africa Tree Finder application integrate information compiled in the Switchboard to inform species selection to support context-appropriate restoration. For example, the vegetationmap4africa promotes restoration program implementers to select tree species expected to be suitable to the environmental conditions of planting sites (based on information on the distribution of vegetation types and species assemblages), select sources of planting materials expected to be suitable to the environmental conditions of planting sites (based on a precautionary approach that avoids transferring planting material between different vegetation types if a species is known to occur in different vegetation types).

The LDSF has been applied in over 30 countries to over 250 sites of 10,000 ha (Gitz et al., 2020). It is one of the largest land-health databases in the world, and provides a field protocol for measuring indicators of the health of an ecosystem, including vegetation cover, structure and floristic composition, historic land use, land degradation, soil characteristics (e.g. soil organic carbon stocks), and serves as a landscape-based monitoring framework to detect changes over time. Thanks to the LDSF, ecosystem health data is available for 2.5m ha, equipping managers and partners of sites with better information on the dynamics and conditions of their landscapes.

To restore dry tropical forests in Latin America, FTA has developed a decision support tool (D4R), to inform context appropriate restoration. In Peru, FTA trained 161 people in the application of the Diversity for Restoration tool in Peru, built local capacity to support nursery establishment, community-led seed harvest and propagation projects, and directly supported community protection of degraded dry tropical forest. As a result of training

workshops provided to restoration program implementers and stakeholders in Peru, participants became better aware of seed saving and sourcing, tree species diversity, and climate mitigation, and perceived the tools useful to support restoration efforts. A new public investment project has indicated it will use the tool to guide restoration across 400,000 ha targeted. Another new restoration project (GEF 7, which began in 2020) led by IUCN, FAO and MINAM is reported to have expressed interest to apply the tool to support the restoration of 2,278 ha. In Colombia, the Department of Antioquia, Empresas Publicas de Medellin (project partner) used the map-based tool to guide species selection to plant over an area where forest had been lost due to the construction of a hydroelectric power dam. Overall, because of these contributions, it is estimated that FTA informed resilient planting for 13,010 ha of degraded land under restoration.

Currently functional in the tropical dry forests of Colombia, the tropical dry forests of northwestern Peru and southern Ecuador, and the countries of Burkina Faso and Cameroon, the tool is being scaled up for application across Latin America, Africa, and Asia in coming years. University partners and restoration practitioners in Peru (e.g. SERFOR), Colombia (e.g. Empresas Publicas de Medellin) Burkina Faso (e.g. Tree Seed Centre), and Malaysia (Malaysia Sabah University) have expressed interest in the tool, but there is no evidence of application at this point in time. A survey conducted in 2020 of D4R users indicated high interest and perceived utility of the tool. Box 2 describes the contributions of the D4R tool in more detail.

Box 2: A restoration decision support tool that supports diversity in research and application: a deep dive

Ecological restoration is a complex process that must consider context to ensure program success. Often, restoration program implementers do not have the information they need to consider species traits, genetics, and future climate scenarios in the selection of the best combination of species to fulfill diverse restoration objectives and ensure survival of species. In order to restore degraded land effectively, comprehensive decision-support tools tailored to the unique needs of the context. The D4R tool facilitates participatory planning of restoration initiatives, taking into consideration the objectives of the restoration program implementer, the site conditions, climate models, linking users with seed suppliers, and propagation techniques to ensure more sustained restoration of land and ecosystem services. The tool holds great potential for donors and restoration program implementers alike to have the information they need to apply a standardized practice to meet context-appropriate restoration objectives that consider the unique needs of stakeholders, and future climate scenarios. Knowledge on seed zones and the suitability of native trees is particularly scarce.

In 2014, FAO commissioned FTA researchers to conduct a thematic study for the State of the World's Genetic Forest Resources. The review (Bozzano et al., 2014) collated experiences from restoration programs, and raised theoretical and practical issues in ecosystem restoration. The review concluded that genetic diversity is the foundation for viable and resilient forest ecosystems, and is under considerable threat due to deforestation, desertification, land degradation, and drought. Furthermore, many restoration programs use exotic species that can have unexpected negative consequences. Unexpectedly, the study was picked up by the Convention on Biological Diversity (CBD) Secretariat, and resulted in CBD COP12 adopting a decision on the importance of genetic diversity to restore ecosystems in 2014 (Gitz et al., 2020).

The tool was developed after the thematic study of the need for restoration programs to include consideration for genetics. While the case for the importance of considering genetic diversity was well recognized, there was an observed lack of practical information, tools, and guidance on how to go about restoration that considers genetics. The tool requests inputs of the prospective user to provide details of their restoration program objectives, and their site conditions, to generate options of species combinations for each unique restoration context. For example, if the restoration program is aiming to improve riverine protection, species with lower canopies and bigger root systems will be suggested. The options contain further data on relative planting densities to ensure survival, where seeds can be sourced, and propagation (collection, storage, transplanting) and management techniques to ensure survival. The tool is purpose driven and can be applied to active planting restoration initiatives to both aid in the selection of species, seed sourcing, propagation

techniques, and monitoring recommendations. In Peru, a workshop was held where 161 people attended to learn about the tool, and how to use it for their restoration program objectives. The workshop focused on knowledge transfer through interactive group exercises that aimed at going through each step of the D4R tool and the importance of each for a more appropriate and/or resilient restoration intervention. Presentations were also done as to give background information on the importance of choosing the appropriate tree species and seed sources (including considering genetic diversity and see transfer zones) in their restoration efforts. Capacity building workshops with The Restoration Initiative (TRI) country partners were hosted to reach FAO and IUCN. From there, substantial interest across the public, private and non-governmental sectors was sparked in application. There are no tools that integrate this combination of practical information on species and seed selection according to specific restoration objectives and site conditions for restoration or forest planners. The tool currently includes biodiversity conservation (birds, pollinators), regulating ecosystem services (e.g. erosion control, carbon sequestration), agroforestry and commercial uses (timber, charcoal), and traditional uses (firewood, food). The integration of restoration objectives into the tool makes explicit links with the compensation activities that, for example, logging companies need to meet based on national laws. Most of the compensation activities are focused on the recovery of biodiversity, with tasks that include protection and creation of national parks, or restoration in specific areas. The tool provides the necessary information on appropriate species combinations to bring these activities to fruition.

Former colleagues who have worked with the tool developers have assumed consultancies with GEF, which funds restoration programs around the world. As ambassadors for the D4R tool, they have succeeded in influencing planned GEF programs to apply the tool over new restoration projects in Peru, in Madagascar (GEF 7 Project FAO), Kenya and Cameroon (GEF IUCN medium sized project), and India (GEF project with UNDP) where the tool will be implemented as part of the national restoration strategy. Furthermore, a Darwin Initiative restoration project is planning to implement the tool in Cameroon. The GEF project in Cameroon and Kenya aims to restore 5,000ha of land, and the mitigation of 39,574 tonnes of CO_2. The GEF projects in Peru and Madagascar aim to restore 2,278 ha and 1,500 ha respectively.2,000 additional ha in Madagascar are targeted to be under improved management to benefit biodiversity. The expected climate mitigation effects for the program in Madagascar are projected at 1,628,044 tonnes CO_2. If commitments to apply the tool are upheld, and the targets are met, FTA has contributed to informing the restoration of these lands by supplying critical planting advice to meet the objectives of the program to benefit landscapes and their ecosystem services.

The tool is dynamic and flexible now becoming a focal integrative area for coalescing colleagues to promote it among their networks, scaling the development of the tool across all contexts where the Bioversity-CIAT Alliance works, and serves as an open platform for researchers to include their research and knowledge to reach a broader spectrum of users. For example, nutritionists have advocated for inclusion of consideration for species that will improve nutrition status, and ensure food supply year-round. The accessibility of the tool to target audiences has also attracted interest among researchers to build new partnerships and build a multidisciplinary coordinated vision to develop the tool along coherent and integrated lines of research. This effort has contributed to facilitating the cohesion and collective action required to mobilize research for future global restoration impact.

Competition is a difficult reality faced by tools to get taken up. Partnership is required. Influencing powerful players like IUCN remains a key barrier without sustained funding, nor buy in to the innovation due to a lack of co-ownership. Future research that aims to influence restoration programs on a global scale should consider co-developing tools with IUCN as a boundary partner to inform global restoration initiatives that influence large areas.

Key results of research and engagement on innovations for resilient landscape restoration are detailed in table 10 below.

Table 10. Innovation for Resilient Landscape Restoration: Key results to date of outcome realization for impact, as well as practice, and research impact pathways

Policy Influence	N/A
Practice Influence	Overall: • Indications that restoration practitioners are interested in being involved in pilots to scale up use of the Diversity4Restoration tool – they find it useful and unique to support decision-making for restoration programs. Specific applications planned for projects in Cameroon,Kenya, Madagascar, India and Peru. Peru: • 266 people learned about restoration considering genetics (60% men 40% women): 10 thesis students, 161 people in toolbox use, 10 facilitators, 55 community members and trainers. • Support to community protection of 10ha of degraded dry forest, the development of a nursery in collaboration with cacao agroforestry sector, and the implementation of 5 community-led seed harvest and propagation projects. • There are indications GEF programs in Peru will use the tool to support restoration planning of 402,278ha. • The NorBosque platform, which includes the regional governments of Tumbes, Lambayeque, La Libertad & Piura have invited Bioversity to assist as technical advisor. Colombia: • Map-based tool guided subsets of species planted by Department of Antioquia, Empresas Publicas de Medellin to restore lost tropical dry forest land due to hydroelectric power dam construction (13,000 ha)
Research Influence	• Partnership established with Colombian national research institute to leverage use of the map-based tool • Planned expansion of the Diversity for Restoration tool in Cameroon, western Ethiopia, northern Thailand, and Sabah State Malaysia – partnerships have been struck with universities to continue collecting data. • 20 publications with 444 citations, 8,151 downloads
Potential Impact	**Hectares of land under restoration; High end estimate** Total: 426,056ha Peru: 400,000 ha ; 2,278 ha use the tool in follow up restoration projects Madagascar: 3,500 ha targeted in GEF project that will apply the tool (1,500 under restoration; additional 2,000 ha under improved management to benefit biodiversity) Cameroon & Kenya: 5,000 ha targeted in GEF project that will apply the tool Colombia: 13,000 ha (No upper limit available)
	Hectares of land under restoration; Low end estimate Total: 13,010 ha Peru: 10 ha community protection of degraded dry forest for natural rehabilitation Colombia: 13,000 ha of forest lost due to hydroelectric dam construction now under restoration informed by the D4R tool.

Agroforestry Concessions in Peru Cluster Results:

In Peru, FTA has provided research and engagement to support the implementation of agroforestry concessions. The interventions have supported identification of eligible areas, implementation challenges and opportunities (particularly for smallholders), and positioned the issue within the climate mitigation agenda by providing estimates of the potential climate mitigation impacts. To date, 33 concession contracts have been awarded covering an area of 193 ha, with 12 more planned to be issued. Increasing trees on farms within agroforestry

concessions and the ecosystem services that follow are expected to yield sufficient livelihood benefits to reduce pressure on natural forests to be cleared for agricultural expansion. Potential impacts are projected in terms of eligible area for concessions to be established: 452,000 ha of forests, and 1 million ha land, totaling 1,452,000 ha. Concession regulations stipulate that at least 20% of the land in a concession must be used for sustainable agroforestry in terms of tree planting, and soil/water conservation. As such, results yield a range of achievement from 38.6 ha to 193 ha that are considered under restoration as a result of FTA research and engagement contributions. Assuming support to the implementation of agroforestry concessions continues and is successful to reach the eligible area, between 290,400 ha and 1.452 million ha could be under restoration. It is estimated that the potential impact of successful implementation of the AFC mechanism would result in coffee and cocoa agroforestry establishment on degraded land to stock approximately 80 tonnes of carbon/ha (Finlayson, 2017). Applying this ratio and conversion factor of 3.7 tonnes co2/tonne carbon, it is estimated that between 11,425.6 and 57,128 tonnes of CO_2 have been sequestered, with potential for between 85,958,400 and 429 792 000 tonnes of CO_2 to become sequestered thanks to FTA support to the implementation of the agroforestry concession mechanism. Furthermore, FTA's contributions to the mechanism and its potential for reducing deforestation (see Challenge 1 report for a detailed account) are expected to have corresponding positive effects on CO_2 sequestration via the preservation of land and ecosystem services.

Key results of research and engagement on agroforestry concessions in Peru are detailed in table 11 below.

Table 11. Agroforestry Concessions in Peru: Key results to date of outcome realization for impact

Policy Influence	• Regional governments (San Martín and Ucayali) better understand AFC implementation options and compliance barriers to smallholders • SERFOR understands the need to distinguish smallholders in policy (i.e., smallholder heterogeneity) • Governments have capacity to identify areas eligible for AFCs using the meso-zoning approach detailed in the technical guidelines • San Martín regional government proceeds with a technical group working on zoning • San Martín regional government develops 14 AFC registration pilots in late 2018 • AFC issue is on the agenda of national forestry and climate change strategies and governments demonstrate interest in agroforestry potential to mitigate climate change
Practice Influence	• 200 participating smallholders learned about AFCs (and opportunities), decision-making, registration, and their territory through discussions with the research team and the PGIS activities • 14 smallholders in San Martín received AFCs as part of a pilot, adopting agroforestry practices and complying with requirements • Enhanced interest on AFCs among NGOs; Some NGOs demonstrated an increased commitment to and action around AFCs • New relationship & mutual interest recognized between ICRAF, GGGI, & SPDA to continue collaborative work • NGOs confirmed adoption and application of micro-zoning (training provided by project) in their projects and AFC pilots in San Martín, which are run in cooperation with regional government authorities
Research Influence	• 8 publications, 33 citations • Research capacities developed among research team, some of whom have continued careers in the Peruvian government in natural resource management/ climate divisions • SUCCESS findings used to develop 2 new research proposals to pursue further gaps • Follow-up projects involve close ongoing collaboration with government and NGO partners
Potential Impact	**Hectares of land under restoration: High end estimate** 290,400 ha -1,452,000 ha (accounting for between 20-100% of the land used for sustainable agroforestry practices)
	Estimated amount of CO_2 emissions sequestration potential: High end estimate 85,958,400 tonnes of CO_2 – 429,792,000 tonnes of CO_2 sequestered

	Hectares of land under enhanced protection; Low end estimate Between 38.6 ha – 193 ha (depending on whether smallholders are going above and beyond minimum stipulated area for soil and water conservation, tree planting) (size of the 33 AFC pilots to which FTA contributed, accounting for between 20-100% of the land used for sustainable agroforestry practices)
	Estimated amount of CO_2 emissions sequestered: Low end estimate Between 57,128 tonnes CO_2 – 35,777.52 tonnes CO_2 sequestered (sequestration potential of 33 AFC pilots to which FTA contributed, accounting for between 20-100% of the land used for sustainable agroforestry practices)

Research Capacity Building for Sustainable Forest and Agricultural Land Management and Restoration in the DRC (Africa):

To build local research capacity to support better management of agricultural and forest lands in the DRC, FTA has worked in partnership with the University of Kisangani to develop curriculums for postgraduate programs in sustainable forestry. As a result of FTA projects, 220 post graduate students have carried out research in various fields related to sustainable land management and the rehabilitation of degraded areas. Graduates have continued careers in forest management for civil society organizations (CSOs), government/administration, the private sector, or academia with enhanced research capacities. FTA also delivered ad hoc training sessions to various NGOs, government officials, park managers, and community members, to introduce rotating models for plantations with fast growing, multi-purpose species to encourage sustainable restoration practices with a positive effect on soil health. FTA contributed to the establishment of two nurseries, and established two demonstration farms to demonstrate effective agricultural settlement, and deliver superior seeds to increase provision ecosystem services (i.e. improve yield of food crops and income). FTA also supported the preparation, finalization, and evaluation of Local Development Plans (Yangambi), and an Integrated Development Plan for the Yangambi Reserve. Under these initiatives, FTA has contributed to the restoration through tree planting of between an estimated 8,053.4 and 407,753.4 ha of land, to sequester 1.4 million tons of CO_2.

Key results of research and capacity building for sustainable forest and agricultural land management in the DRC are detailed in table 12 below.

Table 12. Research Capacity Building for Sustainable Forest and Agricultural Land Management. Key results to date of outcome realization for impact

Policy Influence	• FTA supported the preparation, finalization and evaluation of Local Development Plans, and an integrated development plan for the Yangambi reserve
Practice Influence	• 30 ad hoc trainings were given involving more than 600 participants, but new techniques have not always been applied • NGOs and project partners are raising awareness on relocating encroaching households on Virunga National Park • Gamba Park managers learned about the utility of drones to monitor wildlife from graduate research projects • Agroforestry plantations are being implemented by project partners (Virunga National Park, Virunga Foundation, WWF, and local associations), informed by FTA research that determined appropriate species with positive impact on soil (Acacia mearnsii, Senna siamea, Grevillea robusta and Markhamia lutea), are fast growing, and multi-purpose (charcoal, construction wood) • Restoration and management of degraded forests in the eastern DRC relieves pressure on the Virunga National Park to maintain ecosystems and biodiversity, supplies large towns in North Kivu, and provides jobs • Nurseries have been set up (Isalowe Nursery and North Nursery). Isalowe Nursery production capacity will be increased to be able to produce 500,000 seedlings. • Training and introduction of rotating model with plantations of fast-growing species in fallows were provided to create and maintain nurseries

	• Two pilot farms have been established to show farmers how to settle agriculture, and provide them with improved seeds (through INERA and agro-multipliers) to increase provision ecosystem services – i.e. improve the yield of food crops (and income)
Research Influence	• 220 postgraduate students (Masters and PhD) supported by CIFOR and partners to carry out research • Collaboration and spirit of partnership among CIFOR, UNKIS, ULg, ICCN, INERA, Botanical Gardin of Meise, the VLIR, The CSB, MRAC, JBM, WWF, Cambridge-McGill, University of Liege, IRSNB strengthened. • Curriculum related to sustainable forest management has been developed and applied (expanded from 15-25) to enhance quality of teaching and access to the subject. Post-graduate training met a critical need expressed by Congolese partners and international community. • 67 published works (articles, infographics, flyers, tools) with 262 citations, 16,643 downloads • 41 blogs with 31,932 reads • 32 videos with 29,371 views
Potential Impact	**Hectares of forest under restoration; High end estimate** 407,753.4 ha (sum of targets where available and lower limit where not)
	Hectares of forest under restoration: Low end estimate Total: 8053.4 ha 3153.4 ha trees were planted by WWF (project partner) in agroforestry area, 4,600 ha trees planted for agroforestry by Virunga foundation (project partner). ICRAF provided information to partners on options of species to plant (e.g. trees with positive impact on soil health, fast growing and multi-use).
	Tonnes of CO_2 sequestered: Low end estimate 1.4 million tonnes

Conservation and Sustainable Use of Genetic Resources (Africa) Cluster Results:

To improve the sustainable use and conservation of genetic resources to meet both conservation and development needs, FTA produced: (1) data on land uses, habitat suitability, priority species lists, and the regenerative potentials of species; (2) solutions for ensuring regeneration and maintenance of forest genetic stocks, (3) developed capacity of researchers and natural resource managers, and (4) co-developed work plans and strategies. In Burkina Faso, threat maps for food tree species have been developed to support decisions for tree-genetic resource safeguarding and management. However, there is no clear evidence or indication of uptake and use of these tools. There are indications that as a result of coordinating international workshops with SAFORGEN, that research networks and agendas have become more strengthened and aligned to identify entry points and opportunities to take stock of restoration programs in Africa South of the Sahara, and make the case for a research agenda to advance knowledge on native tree species.

Table 13 outlines the limited results available for this cluster.

Table 13. Conservation and Sustainable Use of Genetic Resources (Africa). Key results to date of outcome realization for impact.

Policy Influence	• No evidence
Practice Influence	• No evidence
Research Influence	• Threat maps for food tree species in Burkina Faso have been developed to support decisions for tree genetic resource safeguarding and management • Research networks strengthened (via SAFORGEN) to coordinate efforts around restoration in Africa South of the Sahara, new entry points identified (e.g. mapping existing restoration projects to identify opportunities) and made the case for the research agenda to enhance knowledge on native tree species • 9 publications with 130 citations, 451 downloads
Potential Impact	**Not reported**

Fire & Haze in Indonesia Cluster Results:

To promote pre-emptive fire management strategies in Indonesia, FTA undertook research and engagement in Riau to investigate the socio-ecological aspects of fire, frame fire management issues and solutions, support

communities to implement community-based fire prevention and restoration models, and develop policy inputs for a national strategy on fire prevention. The research and engagements have achieved policy influence at the national level, effectively shifting policy discourse from fire suppression to fire prevention. Uptake of FTA inputs and findings have influenced the development of the Grand Design for Fire Prevention (2017-2019), which prohibits burning within a target area of 2.4 million ha; the Standard for Forest Plantation and Land Fires Prevention; the Forest and Agricultural Land Fire Control and Prevention as well as regency- and provincial-level regulations on Fire Management and Prevention. These contributions to enhanced forest preservation via fire prevention, have positive effects on ecosystem services in Indonesia. The Indonesian government also used FTA research in national statements on fire causes, a proposal for a World Bank loan to finance fire management, and ISPO discussions on interconnections between fire use and oil palm production. In terms of practice influence, FTA's research and engagement also resulted in private sector forum discussions and commitments to fire prevention. NGO allies used FTA findings as part of their advocacy and community support for fire prevention. Participating communities learned about fire management practices, institutionalized fire prevention and community-based monitoring systems, and applied new preventative fire practices and peatland management (e.g., sago planting, canal blocking, establish ponds, dipwell monitoring, etc.). As a result of these efforts and community engagement, it is reported that 7 ha of peatland in Dompas village was rewetted and planted with sago for restoration, and communities have applied community based restoration models to 11 ha of land in Bengkalis, Riau with the objective to reduce fire. The models have been scaled up and applied to a mangrove area in South Sumatra, and to another district (Siak). Furthermore, the Peatland Restoration Agency (BRG) invited CIFOR to share knowledge and collaborations, and in 2016 used the Dompas canal blocking facilitated by the project as an example of community-based efforts on rewetting peatland (cost and processes). The village government in Dompas has since earmarked 300,000 USD of funding to manage and maintain peatland restored through the project. The policy impact estimation for contribution to degradation prevention rests on the assumption that no fires in the area arise from natural causes, and that the policy is effectively implemented and enforced to incentivize reduced burning on peatlands, thereby degrading them and the ecosystems to which they are a part.

Key results of research and engagement on Fire and Haze in Indonesia are detailed in table 14 below.

Table 14. Fire and Haze in Indonesia: Key results to date of outcome realization for impact

Policy Influence	• FTA research used as input to Grand Design for Fire Prevention for 2017-2019 • Village government confirms allocation of funding (300,000 USD) for maintenance of peatland restoration • Director General on Law Enforcement of KLHK referred to FTA findings on the network of actors of fires and the relation of local politics as a scientific basis to enforce law • FTA contributed to the drafting of the Standard for Forest Plantation and Land Fires Prevention • FTA contributed to the drafting of the Regency Provincial Regulation on Fire management and prevention (based on the academic script prepared by FTA) • Initiated PERDAs (local regulation) for fire prevention (Riau province and Bengkalis District)
Practice Influence	• MoU signed between CIFOR ICRAF and a large palm oil pulp and paper company to commit to fire prevention • NGOs (Jikalahari, FORSIBU, WWF) facilitate implementation of fire prevention activities with communities (e.g., sago planting, canal blocking) • 99% of 110 farmers surveyed in Dompas, Riau plan to not use fire • Community based fire prevention and peatland restoration institutions formalized • Model for peatland restoration in Dompas has been scaled up to Siak District in Riau, and to mangrove area in South Sumatra
Research Influence	• 24 publications, 30,711 downloads, 871 citations • 15 blogs with 13,919 reads • Journalists take interest in science on the topic • CIFOR's profile raised on topic • Partnerships with University of Riau undergraduate students support knowledge sharing, networks, and capacity-building

Potential Impact	**Hectares of peatland under restoration; High end estimate** Total: 85.5 ha (no upper limit available).
	Hectares of peatland under restoration; Low end estimate Total: 85.5 ha Community-based fire models were applied on 11.1 ha of land in Riau; 7 ha of peatland in Dompas village was rewetted and planted with sago; canal blocking was applied over a total of 54 ha over 6 sites.

Conservation and Sustainable Use of Genetic Resources (Asia) Cluster Results:

To conserve and promote the sustainable use of fruit tree genetic resources (e.g. coconut), FTA supported various research and capacity building efforts across Asia. FTA collaborated with Rural Development Administration of Korea to conduct genetic research to preserve *in vitro* coconut shoots, in an effort to enable large scale clonal propagation of coconut palm in an effort to address the worldwide shortage of quality planting material. While a patent is being issued for the technology, with widespread anticipated and potential benefits to coconut breeders and farmers (approximately 10 million people), it is too early to assess how many people have benefited from this technology, as no uptake study has been conducted. 3 letters of agreement were struck between Bioversity and Sunchon National University (Korea), University of Leuven (Belgium), and the Philippine Coconut Authority, indicating strengthened relationships necessary to pursue a more robust research agenda for coconut germplasm, but the effects are not clear. FTA also contributed to research on multilateral germplasm exchange and collection systems and a standardized method to identify, register, and characterize new accessions for coconut across the Asia-Pacific (Papua New Guinea, Samoa & Fiji). It is indicated that Papua New Guinea has moved 12 accessions to its new site, and the gene bank is being upgraded for more effective conservation and use as a result of an FTA project, but it is not clear how. It is also indicated that the project supported Papua New Guinea and Samoa to renew their commitments to coconut conservation and use, but it is unclear how. In Kyrgyzstan and Uzbekistan, FTA conducted training and research with farmers in Kyrgyzstan & Uzbekistan to optimize conservation and sustainable use of resources in fruit orchards. As a result of FTA training of over 300 farmers in soil, water and crop management, on-farm diversity increased in the study areas, and areas that were planted with traditional varieties helped restore degraded land.

Key results of research and engagement on Conservation and Sustainable Use of Genetic Resources in Asia are detailed in table 15 below.

Table 15. Conservation and Sustainable Use of Genetic Resources in Asia: Key results to date of outcome realization for impact.

Policy Influence	Korea (patent applicable for 7 coconut producing countries): • FTA supported research that developed a novel *in vitro* shoot multiplication protocol, currently under patent and has potential for large scale clonal propagation of coconut palm to address the worldwide shortage of quality planting material Papua New Guinea and Samoa: • Renewed commitment to coconut conservation and use
Practice Influence	Korea: • FTA research effectively contributed to the successful cryopreservation of *in vitro* coconut shoots Papua New Guinea, Samoa, Fiji: • 29 participants (17.2% female were trained on the multilateral system of germplasm exchange and on germplasm collection and characterization; the main gene bank in PNG has moved 12 accessions to its new site, and the gene bank is being upgraded for more effective conservation and use of genetic resources Global: • COGENT (39 country members) applies standardized methodology to collect, identify, characterize and register new accessions and hosts on website Kyrgyzstan & Uzbekistan: • 300 farmers trained per year in soil, water and crop management. Areas planted with traditional varieties have helped to restore degraded land

Research Influence	Korea: • Letters of agreement were finalized between Bioversity International and the Sunchon National University, University Leuven & The Philippine Coconut Authority Kyrgyzstan & Uzbekistan: • Research on traditional varieties effects on land restoration are being researched further in new projects in the region Bibliometrics • 2 publications with 3 citations, 22 downloads
Potential Impact	**Not reported**

Green Growth (Asia) Cluster Results:

To support policy and practice change for green growth of cash crop commodities, FTA developed a Land Use Planning tool for Multiple Environmental Services (LUMENS) to provide a comprehensive approach to Green Growth Planning in Vietnam (Lam Dong), and trialled green alternatives to rubber production (Laos, China, Myanmar & Thailand). FTA contributed to the development of the Green Growth Action Plan in Lam Dong. While the LUMENS tool demonstrates positive impact potentials may arise from the implementation of the Green Growth Plan, it is not clear the status of its implementation. If the plan is effectively implemented, it is estimated to have reduced greenhouse gas emissions in the country by 3.9% by 2020, and a net reduction of 1,384,909 tonnes CO_2 per year is expected. If coffee agroforestry follows a green growth scenario, it is expected that 28,300 additional ha of monocultures would be under coffee agroforestry by 2030. If 30% of areas of perennial crops were converted to agroforestry following the plan, water inputs are estimated to be reduced by 36-97 million m^3 per year. Lastly, DIFA Index measurements project that the Green Growth scenario would increase biodiversity in broadleaf forest by 15%; coniferous forest by 3.1%; deciduous forest by 4.8%.

FTA has conducted extensive study in land cover mapping, monitoring, and evaluating impacts, and policy analyses on the topic of rubber monocultures in China, Laos, Myanmar, and Thailand, testing and proposing the adoption of greener alternatives to production. 23 graduate students participated in the Green Rubber project to build research capacity. This research investigated the effects of land-use conversion from rainforest to rubber plantation in soil composition and the effects on ecosystem services, and conducted experimental research over trial plots to assess the impacts of an alternative green rubber management method: understorey regrowth, through cessation of herbicide use. Trials yielded positive results for below ground biodiversity and reducing soil erosion when compared to business-as-usual plots, with no implications on yield on the short term. Another alternative called understorey enrichment with rubber agroforestry was trialled and analyzed, which demonstrated potential; following the trials, Thai farmers selected tree species combinations that were suitable to them for planting to enhance ecosystem services on rubber plantations. It is expected that if green alternatives to rubber are taken to scale through improved policies and practices, soil microbial communities, soil health, and farming outcomes could experience improvements very quickly. It is estimated that soil erosion could be reduced by tenfold, and the diversity and abundance of microorganisms in soil would significantly increase. Furthermore, the Royal Society for the Protection of Birds (RSPB) demonstrated interest in the trials, which formed the basis to co-develop a standard operating procedure (SOP) for monitoring biodiversity and ecosystem services under rubber agroforestry. RSPB has taken the SOP to scale in a new restoration project in the Harapan Rain forest. FTA research and engagement also analyzed policy review in Laos and Myanmar to produce recommendations for governance options for green rubber landscapes, and co-develop with China Chamber of Commerce of Metals, Minerals and Chemicals Importers and Exporters (CCCMC) Guidelines for Sustainable Development of Natural Rubber. While the research provides a compelling case for green options to be legislated and adopted into policy, there is no evidence of this occurring, and there are likely challenges to arise with political will due to the perceived conflict with existing national policy frameworks, particularly in Laos and Myanmar.

Key results of research and engagement on Conservation and Sustainable Use of Genetic Resources in Asia are detailed in table 16 below:

Table 16. Green Growth (Asia): Key results to date of outcome realization for impact.

Policy Influence	Vietnam: • ICRAF supported development of Lam Dong's Green-Growth Action Plan and assessed potential impacts with LUMENS & LEAPS tools comparing green growth with BAU scenarios. • Governments have expressed interest in applying the LUMENS & LEAPS tools.
Practice Influence	Thailand, China, Laos, Myanmar: • Understorey enrichment and herbicide cessation use for understorey regrowth were trailed in rubber plantations and assessed for their effects; training on green rubber concepts and participated in on-farm rubber agroforestry trials. Thailand: • RSPB showed interest in green rubber scheme and agroforestry approach, which stimulated a partnership to co-develop a SOP for monitoring biodiversity and ecosystem services under rubber agroforestry to restore ecosystem services in rubber plantations Indonesia: • RSPB using SOP in Sumatra for a restoration project in the Harapan Rain Forest
Research Influence	• Established a sustainable rubber platform for rubber industry guidance with smallholders and end users • Organized international conference • 23 graduate students built capacity
Potential Impact	**Hectares of land under restoration: High end estimate** 28,300 additional ha of monocultures under coffee agroforestry by 2030. **Projected CO_2 emissions sequestered (of Green Growth Scenario): High end estimate:** 1,384,909 tons CO_2 / year **Projected water conservation effects (of Green Growth Scenario): High end estimate:** 36-97 million m^3/year **Projected effects on biodiversity (of Green Growth Scenario): High end estimate:** DIFA index measurements project biodiversity in broadleaf forest to increase by 15%; coniferous forest to increase by 3.1%; deciduous forest to increase by 4.8%; diversity and abundance of microorganisms in soil significantly increased in understorey regrowth plots **Measured effects on reversing soil erosion:** Soil erosion was up to 10 times higher in the BAU plots compared to the understorey regrowth plots.

Incentives for Sustainable Agricultural Practices (Asia) Cluster Results:

To create evidence-based incentives that effectively curb unsustainable agricultural practices and water management in Asia, FTA supported the initiation and promotion of multiple co-investment and rewards for ecosystem services schemes to restore land, informed policy on rewards for ecosystem services to ensure workable incentives for communities and smallholders, and introduced data and tools for an integrated watershed management approach. In Indonesia, Vietnam, China, India, Philippines and Nepal, FTA supported the establishment of communities of practice on ecosystem services and rewards for ecosystem services, which has built trust among stakeholders involved in rural development and environmental conservation and increased cooperation and advocacy for the bottom-up design and inclusive negotiation and expansion of RES schemes. FTA has played an integral role in shaping policy discourse on incentives for landscape-based restoration of ecosystem services.

Indonesia: the Ministry for Environment and Forestry (KHLK) adopted FTA's Integrated Watershed Management Approach (IWMA). FTA also supported the development of a mechanism for watershed management and permit issuance for ecosystem service use (carbon, water, ecotourism) in Nipa Nipa. FTA's action research and results from learning sites were included in Indonesia's National Reward for Ecosystem Services (RES) protocol. Contractual arrangements between communities and ecosystem service investors (e.g. parastatal water companies) have been established. One example is the River Care RES mechanism which combines direct measurement of soil and water conservation with development activities for rewards (e.g. goat

breeding, nursery development, rattan planting, training farmers in rattan home industries, and coffee demonstration plots. This imitative was noted to reduce sedimentation in the sub watershed by 20%. The Rejoso Kita initiative provided a proof of concept that restoring and maintaining watershed functions can be successful through co-invested performance based incentive schemes. A multistakeholder forum was established to protect and preserve the watershed, and a PES scheme co-investment model was developed and piloted to ensure smallholder inclusion, tree planting, and the adoption of sustainable farming practices. In Buol, the local government adopted the co-investment principle promoted by FTA in the upcoming district regulations on Corporate Social Responsibility and the Village Fund, and replicated project activities in the Mulat Lantika Digo watershed. 90 smallholders were involved in tree-farm learning groups to restore 4 ha of land by planting 4,500 cacao, durian, and nutmeg tress in their private degraded lands.

Vietnam: FTA has supported the development of multiple RES policies and piloted models with communities to incentivize tree planting, and climate smart agriculture. In particular, FTA facilitated the development of a community contract between Ba Be National Park and Leo Keo community to develop a model. In Huong Ha, the community has seen benefits and replicated tree-based models of intercropping pomelo and orange with maize for better provision ecosystem services (maize yields). 50 households are adopting the models as a result of seeing the success. By convening multiple stakeholders, FTA established a working group that contributed to an Executive Order on RES and its guidelines. FTA contributions to the monitoring and evaluation system for PES has contributed to a decline in the area of degraded forests in the country. At the subnational level, FTA's integrated home-garden and sloping-land scheme has been incorporated into policy. In Ha Tinh and Quang Binh, land planting activities have been incorporated into development strategies and policy decisions to support climate-smart agriculture.

China: FTA influenced the Government of Xishuangbanna Prefecture to adopt the lessons from the RES scheme for grasslands, which has been considered in the development of land use plans.

India: FTA worked in partnership with Wetlands International to provide three scenarios of wetlands management to balance human needs with ecological requirements to India's National Environmental Policy on the role of economic incentives for environmental conservation. The details of the exact contribution of FTA is unclear, as is the progress of the policy's implementation.

Philippines: FTA researchers were involved in directly contributing to the Philippine Climate Change Act of 2008, and conducting a final review of the Sustainable Forest Management Act in 2008, though exact contributions are unclear. At the municipal level, the Lantapan government acknowledged and supported the co-investment activities of the ALSA farmer group through tree-based farming practices under Resolution No. 2017-067. Additionally, pursuant to the signing of a memorandum of understanding (MOU) the National Power Corporation will provide support to the local government of Latapan by funding rehabilitation, reforestation and protection of the Alanib sub-watershed. FTA supported the implementation of the Lantapan Incentive-Based Policy Program, by initiating environmental service based organic farming, agroforestry and conservation, and developed an environmental and social safeguard monitoring tool that has been integrated in community based participatory monitoring and evaluation of conservation farming. The INREMP project was particularly successful in facilitating 1,657 subprojects to be implemented in rural infrastructure, natural resources management and livelihood support. The Mindanao Development Authority has expressed interest in allocating $6000USD to support the co-investment schemes promoted by FTA.

Nepal: FTA researchers influenced a policy shift to recognize PES among Hundu Kush Himalayan counties through its partnership with the International Centre for Integrated Mountain Development.

Across Indonesia, the Philippines and Vietnam, 250 smallholders have joined tree-farmer learning groups initiated by the project to receive training, and have been involved in replication of FTA promoted co-investment schemes. FTA also succeeded in influencing research capacities, research agendas, and the financing of its donors. 6 of 33 IFAD projects following FTA's intervention were considering RES in their strategies. 7 follow up research projects in the countries where FTA worked have replicated RES schemes introduced by FTA. 8 undergraduate

students, 24 research assistants, 2 Master's students and 2 PhD students were trained through internship programs enabled through FTA's projects.

Key results of research and engagement on incentives for sustainable agricultural practices in Asia are detailed in table 17 below

Table 17. Research and engagement on incentives for sustainable agricultural practices in Asia: Key results to date of outcome realization for impact.

Policy Influence	Indonesia: • National RES Protocol, (operational document of Law 32/2009 on Environmental Management and Protection), included lessons from FTA action research and learning sites. • KHLK adopted FTA's Integrated Watershed Management Approach (IWMA). Mechanism for watershed management and permit issuance for environmental service use (e.g., water, ecotourism, carbon) initiated in Nipa-Nipa Vietnam: • FTA contributed to the national policy formulation of Decision No. 99/2010 and guidelines by establishing a technical working group which also contributed to the Executive Order on RES. • FTA support to the monitoring and evaluation system of PFES has contributed to a decline in violations against the forest protection and development law (and a corresponding reduction in the area of degraded forests). • District government in Ha Tinh and Quang Binh integrated home-garden and sloping-land scheme into local district decisions (Decision No. 71/QD-HDND on the Expansion of the Coverage of the Home-garden Policy in Huong Khe District of Ha Tinh Province; Decision No. 735/QD-UBND on Funding Support for Pilot Models of Home Gardens in Tuyen Hoa District, Quang Binh Province). • Provincial governments of Ha Tinh and Quang Binh integrated the home garden and sloping land replanting activities into their development strategies as part of climate-smart agriculture, leading to the following policy decisions (Decision No. 819/2016 on Program 135 and the New Rural Development Program, the Local Agricultural Restructuring Program, and particularly on the CSA implementation as a practical example of climate-change mitigation and adaptation ; Decision No. 923/MARD/2017 on Green Agricultural Development) China: • State council and Government of Xishuangbanna Prefecture adopted lessons from an RES scheme for grasslands for designing ecological land-use plans India: • Main partner (Wetlands International India) provided 3 scenarios of wetlands management to balance human needs with ecological requirements to India's National Environmental Policy on the role of economic incentives for environmental conservation Philippines: • Lantapan Municipal Government acknowledged and supported the co-investment activities of the ALSA farmer group through tree-based farming practices under Resolution No.. 2017-067, titled "A Resolution Adopting the Co-Investment Scheme as a Sustainable Financing Mechanism for the Management of the Manupali Watershed through the Adoption of Climate-Smart, Tree-Based Farming Practices". Nepal: • FTA researchers influenced a policy shift in recognition of PES among Hundu Kush Himalayan counties through its partner (International Centre for Integrated Mountain Development)
Practice Influence	Indonesia, Vietnam, China, India, Philippines, Nepal: • Communities of practice and interest on ES and RES were established. This has created a movement that responds to community needs through bottom up to design of RES schemes. • Supported communities by building trust among stakeholders involved in rural development and environmental conservation to increase cooperation and collective action for policy advocacy and renegotiation and expansion of RES schemes. • 23 companies have been informed by the promoted RES schemes. Indonesia, Philippines, Vietnam:

	• 250 smallholders have joined tree-farming learning groups and were involved in replication through co-investment. Philippines: • National Power Corporation will provide support to the local government of Lantapan by funding rehabilitation, reforestation and protection of the Alanib sub-watershed (MOU has been signed). • FTA initiated ES-based organic farming project embracing vegetable farming, agroforestry and conservation in one scheme, while also pioneering facilitating the implementation of the Lantapan Incentive-Based Policy Program. • FTA developed an environmental and social safeguard monitoring tool that was integrated in community based participatory monitoring and evaluation of conservation farming. In total, INREMP project facilitated 1,657 subprojects to be implemented in rural infrastructure, natural resources management, and livelihood support. Mindanao Development Authority has expressed interest in allocating $6000 USD to support the co-investment schemes. Vietnam: • FTA scientists facilitated the development of a community contract between Ba Be National Park as ES beneficiary/forest owner and Leo Keo community as ES provider. The community contract was signed in 2012 and will become a pilot PES model for the 3PAD project. • National PFES policy is increasing community awareness about the role of forests for ecosystem services, leading to the use of PES to establish patrol teams to enhance forest protection (Quang Nam & Dak Nong). • In Huong ha, commune has seen benefits and replicated tree based models (intercropping pomelo and orange with maize for better income), 50 households are adopting the models as a result of seeing successes. Indonesia: • Contractual arrangements between communities and ES investors (i.e. parastatal water companies) established. • River care approach RES mechanism combining direct measurement of soil and water conservation with development activities for rewards (e.g. goat breeding, nursery development, rattan planting, training farmers in rattan home industries, and coffee plantation demonstration plot) contributed to 20% decrease of sedimentation in a sub-watershed. • Cidanau group invested 5% of its PES payments to build a pipeline for clean water to serve 50 households. • Rejoso Kita Initiative provides a proof-of-concept that restoring and maintaining watershed functions can be successful through co-invested, performance-based incentive schemes targeting upstream and midstream smallholders practising tree-based intercropping and agroforestry practices, and water and soil conservation agriculture. • A multistakeholder forum was established as an integrated governance for protection and preservation of the watershed, and a PFES scheme as co-investment model was developed and piloted to ensure smallholder inclusion, tree planting and adoption of sustainable farming practices. • Buol local government adopted the co-investment principle in the upcoming district regulations on Corporate Social Responsibility and the Village Fund, and replicated project activities in Mulat Lantika Digo watershed using development budget. • 90 smallholders were involved in tree-farm learning groups to restore 4 ha land by planting 4,500 cacao, durian, and nutmeg trees in their private degraded lands. FTA research enhanced awareness on the need for IWMA and understanding of water resource management.
Research Influence	• Good practices from FTA project have been published globally by the Food and Agriculture Organization of the United Nations (FAO), Forest Trends, and The Economics of Ecosystem and Biodiversity initiative (TEEB). • 6 of 33 IFAD projects consider RES in their strategies. 7 follow up research projects (4 in Indonesia, 1 in Vietnam, 1 in Philippines) are being pursued replicating the RES schemes introduced by RUPES. • Capacity building: Indonesia: 8 undergraduate students, 24 research assistants, 2 Masters students, 2 PhD students involved in internship programs • 33 publications with 973 citations
Potential Impact	**Hectares under restoration: High end estimate**

	Total: 124,511 ha Philippines: 124,507 ha (reported restoration completed by INREMP facilitated subprojects) Indonesia: 4 ha (no upper limit estimate reported)
	CO_2 emissions sequestration potential: High end estimate Indonesia: 677,777 tonnes of CO_2 could be sequestered annually if trees are planted in Rejoso Watershed
	Hectares under restoration: Low end estimate Total: 8,560 ha Indonesia (Buol): Smallholders participating in the tree-farm learning group convened by the project restored 4 ha of land within the Mulat-Lantika Digo watershed by planting 4,500 cacao, durian, and nutmeg trees. Philippines: 8,556 ha INREMP project reported to have completed its target areas for restoration.

Impact Estimation

Overall, we estimate FTA has directly contributed to placing at least **2.1 million ha** of land under restoration to enhance ecosystem services (e.g. farmer managed natural regeneration, intercropping, active planting on degraded land). We project that if FTA innovations are scaled across landscapes, commitments are upheld, and FTA-informed policies are effective that there is potential for up to **34.4 million ha** to be under restoration as a result of collective processes to which FTA research and engagement contributed.

We estimate the following positive effects associated with more land under restoration[4]:

At least **1.4 million tons of CO_2** sequestration[5] from restoration initiatives facilitated by FTA (e.g. active planting, improved practices). In addition, we project that if FTA innovations are taken to scale, there is potential CO_2 sequestration up to **511.5 million tons of CO_2** to improve regulating ecosystem functions.

130,000 tonnes of soil will be conserved per year in Ethiopia via the effect of planting quality seeds over FTA project target areas[6] to improve supporting ecosystem functions.

Under a successful Green Growth scenario in Vietnam:

It is estimated that water inputs could be reduced by **36-97 million m^3**[5] per year if 30% of perennial crop areas are converted to agroforestry as per the Green Growth Action Plan to improve supporting ecosystem functions.

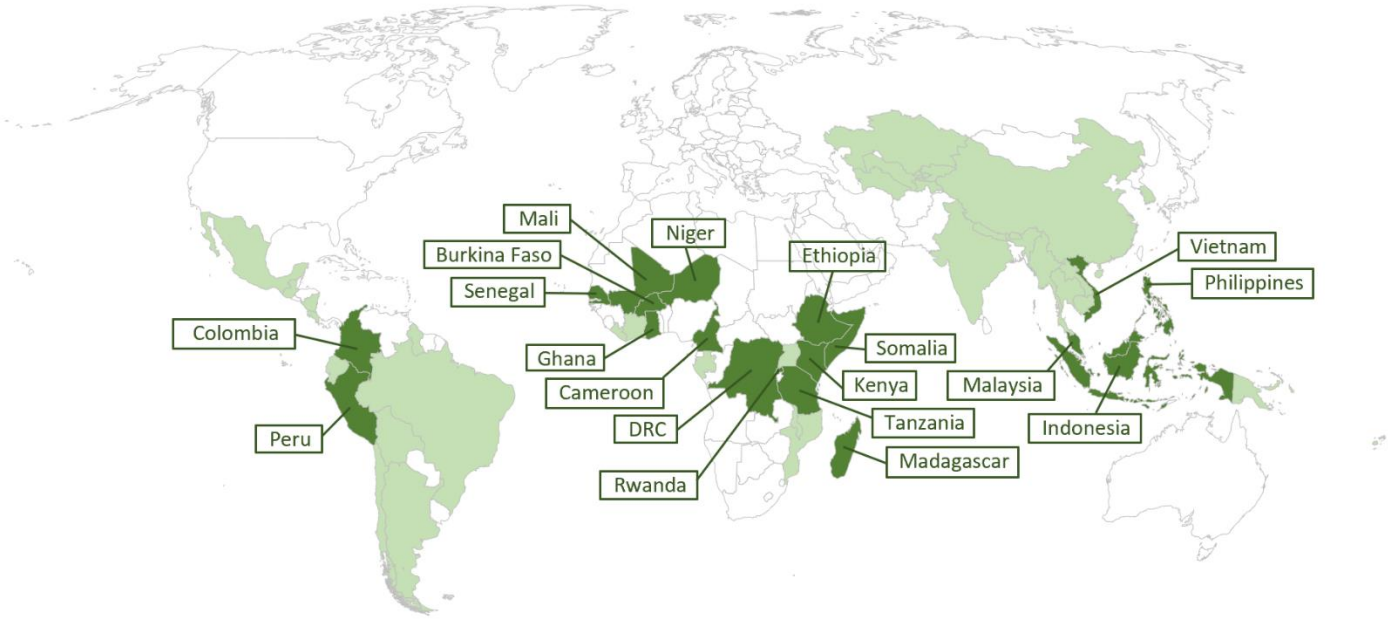
It is estimated that **broadleaf forest biodiversity will increase by 15%**, **coniferous forest biodiversity will increase by 3.1% and deciduous forest biodiversity will increase by 4.8%**[5] to improve provision of all ecosystem services.

See Challenge 4 & Challenge 5 reports for detailed accounts of FTA contributions to provision ecosystem services (food security and income); and Challenge 1 report for a detailed account of FTA contributions to regulating and supporting ecosystem services (via preservation of forest).

[4] Key ecosystem service/function indicators are rarely reported to give a detailed account of the implications of land restoration supported by FTA innovation; therefore these figures remain underreported, but we can assume qualitatively positive effects, when land is under restoration.

[5] Only 5 projects explicitly report on this target

[6] Only 1 project explicitly reports on this target



Countries where FTA has conducted research and engagement on topics relevant to Challenge 2
Countries where such research has been assessed to have achieved, or have potential to achieve land and ecosystem service restoration

Figure 2: Countries where FTA has carried out research that has potential impact on land and ecosystem service restoration

Information contained in project documentation reviewed and through the deep dive analyses have shown that there is promising progress towards FTA's ambitious target contribution to restore 30 million ha of land (Appendix 3). Our results demonstrate that this target was possibly over-ambitious, given contributions to the restoration of land and ecosystem services were documented closer to the 2 million ha mark. However, the implicated preservation of forests from degradation (Challenge 1), and improved management of landscapes (Challenge 3) also make contributions to the status of land and ecosystem services. We can therefore expect that FTA's contributions to addressing other global challenges will yield positive effects for reversing the status of land and ecosystem service degradation experienced globally.

Most of FTA's potential impact on land and ecosystem service restoration is observed in Africa (primarily in Ethiopia, Kenya, Cameroon and the DRC) and Asia (primarily Indonesia, Vietnam, and Malaysia), while less is observed in Latin America (only in Colombia and Peru) (Table 18). Impact potential was more prevalent in countries with a strong presence of FTA through multiple projects and continued research partnership and investment.

Table 18. Total impact estimates by cluster

Cluster	Low-end Impact Estimates	High-end Impact Estimates
Climate Resilient Cacao (Global)	500 ha (Colombia)	500 ha (Colombia)
Scaling Context-Appropriate Agroforestry Systems for Restoration (Global)	1,033,995 ha (Burkina Faso, Mali, Niger, Ethiopia, Kenya, Rwanda, Ghana, Somalia, Malawi, Vietnam, Indonesia)	16,215,669 ha (Burkina Faso, Mali, Niger, Ethiopia, Kenya, Rwanda, Ghana, Somalia, Malawi, Vietnam, Indonesia); soil conservation potential of 130,00 tons per year
Forest Landscape Restoration (Global)	9,732 ha (Malaysia)	2,200,000 ha (Malaysia, Peru)
Bioeconomy Development to Restore Degraded Land (Africa & Asia)	2,675 ha ; 27,535 tons CO_2 sequestered (Tanzania, Uganda, Ethiopia, Madagascar, Kenya, Indonesia)	5,000,000 ha ; sequestration potential of 72,150,000 tons CO_2 (INBAR member countries)
REDD+ Policy Mechanism (Global)	1,035,712 ha (Vietnam, Indonesia, Cameroon, Peru)	8,505,925 ha ; sequestration potential of 6,081,361 tons CO_2

		(Vietnam, Indonesia, Cameroon, Peru, DRC)
Innovation for Resilient Landscape Restoration (Global)	13,010 ha (Peru, Colombia)	426,056 (Peru, Madagascar, Colombia, Kenya, Cameroon)
Agroforestry Concessions in Peru	39 ha ; 11,426 tons CO_2 sequestered (San Martin)	1,452,000 ha ; sequestration potential of 429,792,000 tons CO_2
Research Capacity Building for Sustainable Forestry and Agriculture in DRC	8,053 ha ; 1,400,000 tons CO_2 sequestered	407,753 ha ; 1,4000,000 tons CO_2 sequestered
Conservation and Sustainable Use of Genetic Resources (Africa)	-	-
Fire and Haze in Indonesia	86 ha (Riau)	86 ha (Riau)
Conservation and Sustainable Use of Genetic Resources (Asia)	-	-
Green Growth (Asia)	-	28,300 ha ; sequestration potential of 1,384,909 tons CO_2 ; annual water conservation potential of 36-97 million m^3 ;broadleaf forest biodiversity increase by 15%, coniferous forest biodiversity increase by 3.1% and deciduous forest biodiversity increase by 4.8% (Lam Dong, Vietnam)
Incentives for Sustainable Agricultural Practices (Asia)	8,560 ha (Philippines, Indonesia)	124,511 ha ; sequestration potential of 677,777 tons CO_2 (Philippines, Indonesia)
Total	**2,112,362 ha under restoration** **1,438,961 tons CO_2 sequestered**	**34,360,800 ha under planned restoration** **Sequestration potential of 511,486,047 tons CO_2** **Annual soil conservation potential of 130,000 tons (Ethiopia)** **Annual water conservation potential of 36-97 million m3 (Vietnam);** **Broadleaf forest biodiversity increase by 15%, coniferous forest biodiversity increase by 3.1% and deciduous forest biodiversity increase by 4.8% (Vietnam)**

Not all projects had sufficient information to demonstrate contributions to outcomes and potential impacts – therefore, the evidence base could have been enhanced through continued use of monitoring and evaluation tools. Furthermore, the evaluators acknowledge that trees, when compared with other crops, have variable and in some cases substantial time lags to mature and be fully productive in producing multiple ecosystem services and benefits. Policy research in particular experiences time lags for effects of the policies to become measurable, particularly in terms of ha restored, and ecosystem service enhancement.

Assumptions

There are several key assumptions underpinning FTA's contribution to reducing the prevalence of degraded land and ecosystem services. These assumptions and their potential effect on the realization of future impact are assessed in Table 19.

Table 19. Challenge 2 Assumptions Assessment

Assumption	Assessment
FTA holds a credible position in academic and research-for-development realms, and can exert influence over the research agenda and trajectory on the role of forests, trees, and agroforestry systems in restoring land and ecosystem services.	**Sustained**; across multiple geographies, FTA is known as a credible source of information on topics related to the dynamics of land and ecosystem service degradation. FTA researchers' positions as experts allowed for greater access to relevant fora to build relationships with stakeholders (e.g., policymakers, partner organizations, NGO advocates, local research institutions, etc.) and share findings, which supported uptake and use of outputs.
FTA's engagement and training efforts are sufficient to benefit all participants with new knowledge, skills and relationships that stimulate adoption and scaling of new practices.	**Partially sustained (context dependent)**. Adoption rates are extremely variable and context specific. When tested, they were variable, in one instance as low as 14%.A key impact pathway within FTA's work on land restoration is the capacity-building of key stakeholders (including smallholders, SMEs, researchers, policy-makers/decision-makers, private sector, etc.). By providing new knowledge and training on the dynamics of land degradation, practices to restore land, data collection and tracking systems, monitoring and decision-support tools, and providing technical assistance to ensure effective use and application of such knowledge, FTA equipped multiple levels of stakeholders to restore land and ecosystem services. Many of these stakeholders continue to rely on FTA researchers and partners for ongoing support for implementation.
Science-based policies and strategies to which FTA has contributed create the enabling environment for resilient and sustainable restoration of land and ecosystem services, and are effectively implemented.	**Insufficient evidence.** Policy impact assessments for all policies to which FTA influenced were not feasible under the scope of this study. In addition, time lags for outcomes to trigger impacts are particularly long, when it comes to trees and forests. Time lags are longer than FTA's program cycle of 10 years.
Partnerships create conditions for collective action toward goals of restoring degraded land and ecosystem services.	**Sustained.** FTA has developed strategic partnerships with government agencies through positioning research and researchers as sources of technical policy advice (particularly in Vietnam on the topic of RES). Partnerships with NGOs and extensionists have been helpful to continue promotion of sustainable restoration, and ensure continuity post project. Research partnerships with universities have been helpful to build local research capacity. In some cases, short term project cycles have hindered the ability for long-term mutually beneficial partnerships that lay the foundation for transformational change.
All land that benefits from FTA restoration innovations (e.g. FMNR, intercropping, species selection tools) experiences a net increase in ecosystem goods and services.	**Partially sustained (context dependent).** There were some cases where tried, tested and true were applied over large areas to restore degraded lands, and other cases where adoption was low due to a lack of extension, market linkage, or loss/damage due to extreme climatic events or pests.
Information is accessible enough, policies are effective enough, and partnerships are strong enough to create the political pressure and incentives necessary to prompt investment response from the private sector.	**Partially sustained (context dependent).** There were some strong examples of co-investment models and schemes being adopted once introduced, and further scaled by implementing partners. In part this is facilitated by the reality of the context. Global restoration is high on the agenda and promoted as a viable solution to address multiple challenges (e.g. biodiversity loss, climate change).
Data sources containing impact estimates (i.e., targets, achieved impacts, potential impacts) consulted in the review are valid, accurate, credibly-derived, and reliable	**Partially sustained.** We continuously interrogated the impact estimates found in our review to test this assumption. It was necessary to query the corresponding sources of data supporting the estimates to classify each impact estimate as either an impact target, impact that has been achieved to date, or impact that has potential to be achieved in the future. This enabled the evaluators to determine the likelihood that FTA contributed to the realization of the impact in question, and produce more realistic lower and upper limit estimates. However, we acknowledge that the impact ranges still reflect considerable margins of error as projects' reporting on impacts was often vague, not transparent, not quantifiable, and not always scientifically-derived. In some cases, these factors led the evaluators to doubt the accuracy of reported impacts and whether numbers reflected double-counting.

FTA made notable contributions to awareness-raising, capacity-building, practice change, and policy change as well as research over the past ten years to reduce harmful forestry and agricultural practices that drive land and ecosystem service degradation, and promote more sustainable practices. FTA's contributions to outcomes have in some cases resulted in realized impacts, and are likely to catalyze further impacts in the future. However, the realization of impacts rely on several conditions, and sometimes rather optimistic assumptions, including the effective enforcement of revised policies, the full adoption and implementation of new practices, the scaling up of initiatives, and continuity of collective action post-project and post-FTA. While FTA holds a credible position as an independent supplier of scientific knowledge that is useful to inform actions to restore degraded land and ecosystem services, FTA is one contributor among many organizations that have prioritized this complex challenge. The sensitivity of key assumptions that vary based on the research initiative, contextual factors in which the research is taking place (e.g., geography), and specific contributions of the research, including the notion that research outputs are relevant, appropriately translated, adapted to fit the needs of boundary partners, and positioned for use. For example, research projects based in countries in which FTA is well-established, where key scientists have connections to stakeholders (e.g. restoration program implementers, farmers, etc.), and where those stakeholders are interested in and actively looking for evidence and guidance to support their decisions and actions, had a higher likelihood for outcome realization to support impact contributions.

Looking Forward with a Legacy of Partnership

As illustrated in the results, FTA research and engagement activities have involved a broad range of stakeholders, to in some cases facilitate self-sustaining partnerships that continue progress and momentum to restore land and ecosystem services. A successful example is the Transformative Partnership Platform (TPP) on agroecological transitions, which was formally established in 2020 with support from FTA. We expect that the collective action and continued investment implied through the TPP's activities will continue progress on the reversal of land and ecosystem degradation at scale.

Box 3. Highlighting the Transformative Partnership Platform (TPP)

TPP intends to bolster available evidence on the performance of agroecological systems across contexts. The platform aspires to attract other partners to better coordinate work on agroecology and foster transitions to more sustainable agricultural and food systems. TPP addresses key evidence and implementation gaps in priority domains, closely aligned with the global challenges – areas where action is needed to unlock potential for widespread global adoption of agroecological approaches. Within each of these domains, the TPP will seed fund activities designed to generate proposals and investment in the area, as well as one or more funded projects involving TPP partners. Some external projects aligned to the TPP domains will also be supported, where there is added value to both parties in working together. A feature of the TPP is not only operating within each domain but, also, synthesizing evidence and learning across domains to foster transformative change.

The TPP will ***document and evaluate the viability of agroecological practices across Africa***. This work will inevitably benefit from and build on the legacy of FTA's profile on scaling agroforestry practices for context-appropriate land restoration. The evaluative work under TPP aims to understand and document which practices work where and for whom, and what motivates adoption. It is expected that this partnership will continue important research and engagement to facilitate the scaling and adoption of sustainable agroecological practices that restore land and ecosystem services.

The TPP will ***inform sustainable pest, disease, and weed management*** to ensure agricultural productivity and reduce the use of chemicals that adversely impact health, soil and water quality, pollinators, and biodiversity. Agroecological approaches are being tested to overcome threats such as the fall army worm in maize and swollen shoot virus in cocoa. It is expected that such management will restore ecosystem services and function, and thereby increase the resilience of agricultural systems.

The TPP will ***advance inclusive cross-scale metrics for agricultural systems*** to bring agricultural and food system performance metrics into the future. This research will move beyond traditional metrics on monoculture yield, and capture environmental, economic and social externalities (whether production is degrative or regenerative, and the associated effects on biodiversity and climate change) to better reflect the value of agroecological approaches.

The TPP will ***investigate how agroecological approaches can contribute to inclusive and risk-mitigating management of water resources.*** Water scarcity is increasing as the population continues to grow, and use water for irrigation, which is lowering water tables. Climate change and pollution are exacerbating this problem. This domain is expected to make contributions to improve the availability of clean-water, a critical ecosystem service.

The TPP will ***explore the links between soil health and agroecological practices*.** Agroecological approaches rest on the premise that the use of agro-biodiversity and recycling, and the phasing out of chemical inputs will promote the maintenance of soil organic carbon and diverse soil biota to ensure soil health. Recent advances in metagenomics will be mobilized to better understand nutrient cycles at farm and landscape scales.

The TPP will ***develop operational indicators to evidence the relationships between diversity and resilience*.** Biodiversity and economic diversification are assumed to result in resilient agriculture and food systems, but there is a need to understand and quantify the relationship between them.

Conclusions

Key pathways to realize outcomes were through direct support to active planting, and capacity building to take on board new practices. However, in some cases lack of extension services and market linkages prevented widespread adoption and scaling as intended. Not all research initiatives effectively built on one another to advance topics and progress to impacts effectively. Effective research in development requires systematic, purpose driven project design, implementation, and monitoring. Mapping from the start how FTA's strategy aims to address global challenges would have assisted with the positioning of bilateral projects to ensure that all research interventions serve the FTA strategy for effective research in development, and donor interests. Furthermore, such a framework would have laid the foundation for effective monitoring and evaluation of the key contributions that FTA makes to support accountability and learning.

Programmatic approaches add value to strategic interventions. Short-term project cycles are inadequate to stimulate transformative change. FTA has a range of short- and long-term engagements in certain topics and geographies. Trust and mutually beneficial partnerships take a substantial commitment of time and resources to optimize potential for influence. Well defined programmatic approaches enable sustained engagement and long-term relationships necessary for influence and progress on addressing key challenges. FTA has succeeded in bringing partners together on certain focal areas, including REDD+, landscape restoration, options by context, agroforestry policy, and RES policy to address land and ecosystem service degradation. In Vietnam, FTA holds a well-established position within the Ministries of Agriculture and Forestry, serving on technical working groups to actively participate in policy development. This is a result of continued investment in research efforts on rewards for ecosystem services. As many potential impacts rest on the effective implementation of policy, there is a role for research in supporting the implementation of policy (e.g. as done in Peru with Agroforestry Concessions).

Relationships and sustained engagement are key to achieving policy influence. Policy influence is more likely with sustained and long-term engagement in topics to build rapport necessary to serve as technical advisors. Contributing to national (e.g. RES, AFCs) and international policy mechanisms (e.g. COP decisions, REDD+) is a key pathway by which FTA supports a favourable policy environment for restoration of land and ecosystem services to take place. Many of the other impact pathways intersect with and are influenced by policy change on land and ecosystem service restoration.

Effective capacity development is a critical social process contribution where research can be positioned for use. Training, facilitating, and incentivizing farming communities to engage in activities that serve to restore lands is a predominant means by which FTA contributes to impact that restores land and ecosystem services. Participation in the research process and capacity-building through knowledge sharing was an effective means to empower communities and smallholders to sustainably manage their lands and participate in policy/decision-making discussions. Partnerships with communities and smallholders supported the uptake of research outputs and the formalization of recommendations into practice. This was variably illustrated using farm demonstration

plots to showcase positive effects of agroforestry practices, but in some cases adoption rates were low. Establishing partnerships with NGOs working directly with communities and supporting the interests of meeting restoration goals were key to scaling efforts. Demonstrating the benefits of adopting new practices through trials and assessments proved effective in some cases. However, barriers to adoption were in some cases not systematically addressed by the interventions (e.g. market linkages) which reduced FTA's research effectiveness. In some cases, FTA self-monitored and assessed workshops and trainings, but in other cases, this was a lost learning opportunity.

Systematic and continuously embedded monitoring and evaluation is critical for effective and adaptive research design and implementation. The most direct way in which FTA contributes to restoration of land and ecosystem services is through the establishment of demonstration trials where new agroforestry practices and active planting schemes can be observed. More systematic and embedded monitoring and evaluation of these sites poses an opportunity for researchers and monitoring and evaluation staff to collaborate on strategies to promote innovations for their impact, and facilitate adoption. The PATSPO project is one example where monitoring and evaluation has gone hand in hand with the design of the research. This has generated information necessary for adaptive project management that demonstrates high impact potential.

Much of the impact estimates rely on the survival of trees, and the effectiveness of continued sustainable management. In some cases, despite best efforts trees may not survive as a result of exogenous influences (loss to fire, loss to pests, loss to unexpected climatic conditions), however, FTA has pursued research efforts in attempts to mitigate these effects (e.g. through research on fire and haze, fall armyworm).

FTA achieved influence in natural resource research by providing opportunities for the next generation of researchers to build skills, and establishing transdisciplinary partnerships: Few clusters under Challenge 2 utilized a research pathway to contribute to outcomes and impacts. FTA is a research organization; therefore, much of its work focuses on the development of knowledge that can be taken up and used by stakeholders, as well as influence the next generation of researchers, and academic debates in general. FTA works to build the capacity of researchers, local universities, government research agencies, and international research organizations to advocate for science-based decision-making and advance research that aims to restore land and ecosystem services. This has been particularly successful for the D4R tool, which has been successful in peaking researchers' interest and establishing a solid foundation of academic partners to further expand the network for potential global influence. Furthermore, the tool is providing opportunities for multidisciplinary collaboration and serves as a platform for researchers across institutions to make data and research accessible to users and shape restoration programs.

Challenges to Overcome and Recommendations for Enhanced MELIA

The assessment of Challenge 2 provides opportunities for FTA and its research centres to consider optimizing monitoring, evaluation, and learning to more strategically align the program to address complex challenges. These challenges include the following:

1. ***Inconsistencies in monitoring, evaluation, and impact reporting and data management.*** Varying levels of project documentation and data presented a challenge for the evaluation team to categorize projects to one or more of the five challenges, as well as identify projects with promising indications of outcomes and impacts. This made the categorization, selection, and assessment processes highly time consuming. Project selection was in part driven by the availability of project documentation, so it is possible that key FTA research efforts have been overlooked or omitted. These inconsistencies are further confounded by the differences between institution systems and databases. For example, some institutions have systematic and robust databases while others are less advanced and developed. In addition, the ways in which project reports and/or evaluations document evidence of outcomes and impacts are inconsistent. This is further reflected into MARLO (the database built for CRPs and where projects are referenced for FTA), which acts a repository but does not impose a specific format for reporting outcomes. Therefore, the investigation teams needed to dig into the project reporting documentation. This was particularly apparent in reporting for multi-country projects and programs, where reported evidence is often not disaggregated by study

sites, let alone by country. Few evaluation reports and/or project documents quantify or estimate impacts in terms of the five challenges or their targets, and variability in units of reporting is common. Often reporting focuses on documenting project activities and outputs, rather than contributions to outcomes, impacts, or other changes in the wider system (results-based reporting). There are inconsistent conceptualizations and uses of evaluation terminology across projects. For example, the terms 'output', 'outcome', and 'impact' are used inconsistently. These keywords could not simply be searched and pulled from reports, so the desk review involved much closer reading, review, and translation of content into the appropriate concepts.

2. ***Diffusion of topics and geographies of research and engagement signals a lack of coherence in FTA's program strategy to address complex global challenges.*** Building on discussions from the 2020 FTA Science Conference, many of FTA's research projects in fact are Type I projects that aim to address Type III 'wicked' problems (i.e., the five challenges). While FTA, partners, and researchers consider they are doing transdisciplinary research and make such claims in proposals and final reporting, this may not be the case in practice. Siloes often remain or attempts at transdisciplinary approaches fall short – both can be driven by internal or external factors. Moreover, research efforts are diffuse across geographies and topics. These are clearly missed opportunities, as many of the topics and geographies in which FTA operates are closely aligned and often rely on the same local actors and external processes that FTA engages. New projects could leverage pre-existing personal and institutional relationships established by researchers within their own institution. Overlooking these networks also overlooks the valuable institutional memory of the relationships and engaging in those contexts, which can be a source of valuable learning and efficiency for new research initiatives as well as serve to reinforce and strengthen existing relationships. Moreover, research efforts inconsistently build on one another, affecting FTA's capacities to address complex problems meaningfully and strategically in each country and/or region. In part, this is a result of inconsistent and intermittent use of ToC across institutions and projects, and an artefact of the diffusion and lack of coherence inherent to responding to bilateral donor demands. Effective, centrally coordinated information management systems are critical to facilitate integration and coherence. Often the strengths that the ToC tool can provide for more strategic interventions (e.g., building shared understanding, negotiation, communication, consensus-building, adaptive project management, etc.) are not leveraged, and in many cases some impact pathways are likely to hold up and demonstrate greater potential than others. Effective integration mechanisms are required to ensure that research programs aiming to address complex type III problems reach their full potential for influence within the scope of short-term project cycles. Therefore, research-for-development programs need to clearly and explicitly link strategies and goals at both project and program scales.

3. ***Target setting is useful when targets set are feasible, well aligned, and continuously monitored.*** Many of FTA's projects did not set or document impact targets (e.g., proposal stage, end-of-project reporting stage), nor did they continuously reflect on them to adaptively manage projects. One reason that might explain this is that projects' MELIA activities were often designed to fulfill proposal or final reporting requests from the respective project donor. Donor requirements are variable, some donors require projects to set targets and report against them, while others do not. The absence of baseline data diminished the rigour of impact estimates, and the ability to provide more certainty in the ranges of potential impacts claimed. It can be daunting for researchers to lay claim their potential impact at the proposal stage (particularly when funding and other resources remain unclear), only to be held accountable to original (possibly overly ambitious) targets at project-end. More explicit documentation of impact targets, and baseline measurements, particularly as part of the ToC, requires researchers to be more accountable to targets they set and more intentional in how they design and implement projects to reach those targets. Challenge 2 encompasses a broad range of potential proxy indicators. While underreporting is likely, the lower limit impact estimate (approximately 2.1 million ha) for land under restoration resulting from FTA research contributions is much lower than the anticipated target of 30 million ha. Furthermore, FTA's targets do not match the broad concept of ecosystem services, despite interest in reporting (i.e. biodiversity

increases, soil quality). This data is collected in some cases during research projects, but is not always systematically reported for monitoring and evaluation purposes. Optimizing data sharing and collaboration between research managers and MELIA could better facilitate communication and impact measurement to facilitate research uptake and use.

Based on the identified challenges described above, the evaluation team concludes with the following recommendations to enhance MELIA, which can strengthen the design, monitoring, learning for adaptive program managemetn.

1. ***Aim for systematic and consistent documentation of projects and influence across institutions.*** To the extent possible, targeted intended outcomes and impacts (i.e., beyond activity and output level) for the specific challenges that FTA aims to address should be quantified and reported on project level (both in project design and final reporting), and program-level targets should be derived from these documents. Specific outputs of interventions should clearly link to intended outcomes and impacts. Evaluating outcome realization should precede impact estimation in order to adequately qualify the impact potential of research interventions. More systematic and continuous monitoring and evaluation remains an untapped potential for researchers and evaluators to work more constructively and collaboratively. The ability to document and link ToC components to observed changes is powerful for reporting, valuable to determine influence, and key to learning how change does or does not happen in different contexts (e.g., drawing connections between project activities or specific outputs to the realization of intended outcomes and impacts). Beyond such learning, effective and continuous monitoring and evaluation can help demonstrate potential impacts of research innovations, and policy options to better facilitate adoption and uptake. For example, the PATSPO project has a core underlying assumption that adoption requires appreciation for the value of improved genetics and applying quality planting material in restoration, and has employed ex ante modeling to demonstrate the benefits. A transparent monitoring and evaluation process is recommended from start to finish of research programs using systematic data collection and storage tools, and engaging researchers and key stakeholders from inception in the M&E process. Theory-based evaluation offers the opportunity for both summative and formative assessment, and can facilitate both continuous learning and accountability to intended outcomes. Considering the increasing need to establish well-functioning, results-based monitoring and reporting systems for documenting and presenting achieved results to donors in a credible way, this evaluation method and its concepts are recommended for future research to support consistent MELIA data management across research institutions. .Baseline data that characterizes the context of the intervention should be collected over targeted project areas, to lay the foundation of evidence for estimating impacts and evaluating outcomes. Acknowledging the administrative resource requirements for research teams to document progress not only on activity and output level, but also towards intermediate and higher-level outcomes, research institutions are recommended to both provide supporting MELIA teams and continuously consider and invest in further possibilities to support research teams. An identified bottleneck and common theme in this assessment exercise was the need for the development of a consistent program-wide MELIA database system , the establishment of associated workflow systems, and a common digital platform which support research teams to easily feed results on outcomes and impacts into these systems. It is also recommended to collect disaggregated MELIA data on gender and youth promotion in projects where appropriate, in order to satisfy donors' information interest in the centers' performance in these fields (in some projects, this data was not collected, though the evaluator team assumes this would have been possible and promising).
2. ***Strive for consistency in the application of monitoring and evaluation concepts.*** We suggest the following definitions for terminology be adopted, and recommend enhanced capacity-building for FTA researchers on these definitions and the use and implementation of these concepts:
    a. "Outputs: The products, goods, and services of the research and the research process (i.e., knowledge, fora, and processes generated by the activities).

   b. Outcomes: Changes in knowledge, attitudes, skills, and relationships manifested as changes in behaviour.
   c. Impacts: Changes in flow (e.g., greenhouse gas emissions) or state (e.g., level of atmospheric carbon), resulting wholly or in part from a chain of events to which the research has contributed." (Belcher, Davel, & Claus, 2020, p.9)

3. ***Use nested ToCs to support challenge-centric program and strategy design.*** Researchers and program managers should fully utilize ToC as a core element of strategic project planning and adaptive management. How FTA aims to contribute to complex social problems should dynamically guide program strategy, design, and implementation. A robust and dynamic ToC for the challenges to which FTA aims to address would be a useful tool to guide strategic program management, and align efforts in overlapping geographies and research topics to maximize intended contributions to outcomes, impacts, and targets. Collaboratively developing ToCs for research projects would also provide the opportunity to collect outcome and impact data throughout the research process as part of adaptive management and monitoring to support the setting and reaching targets. Target-setting encourages researchers to aspire for big impact through their research projects, but also guides them to reflect on what is possible and set reasonable and feasible impact targets. More explicit target-setting and documentation makes it easier for researchers, project coordinators and managers, and MELIA to attract funding and coherently report progress back to donors. Project-level impact targets should also align with program-level targets for impact and be reported on consistently in projects' midterm and final reports. Future research-for-development programs should be guided by the value offer of purpose-driven central coordination for impact, which can be informed by explicit and well-developed ToC. This holds great potential for sustaining funding and upholding commitments to a culture of learning. Furthermore, such impact assessment of research innovations that ultimately aim to support restoration of land and ecosystem services can help build a strong case for uptake and scaling, as the benefits of adoption are robustly measured, and therefore can be clearly articulated to target audiences throughout the research process.

References

Belcher, B. M., Davel, R., & Claus, R. (2020). A refined method for theory-based evaluation of the societal impacts of research. *MethodsX*, *7*: 100788.

Bozzano, M., Jalonen, R., Thomas, E., Boshier, D., Gallo, L., Cavers, S., ... & Loo, J. (2014). *Genetic considerations in ecosystem restoration using native tree species. State of the World's Forest Genetic Resources–Thematic Study*. Food and Agriculture Organization of the United Nations.

Earl, S., Carden, F., & Smutylo, T. (2001). *Outcome mapping: Building learning and reflection into development programs*. Ottawa, Canada: International Development Research Centre.

ELD (2015). The Value of Land: Quick Guide to the Report. Retrieved from: https://www.eld-initiative.org/fileadmin/pdf/ELD_Report_Quick_Guide.pdf

FAO (2021). Soil degradation: Definitions. Retrieved from: https://www.fao.org/soils-portal/soil-degradation-restoration/en/

Finlayson, R. (December, 2017). Peru's integrated approach to nationally determined contributions can boost agroforestry's role in fighting climate change. Retrieved from: http://blog.worldagroforestry.org/index.php/2017/12/14/perus-integrated-approach-to-nationally-determined-contributions-can-boost-agroforestrys-role-in-fighting-climate-change/

FTA. (2016). FTA Revised Phase II Full Proposal (2017-2022). Retrieved from: https://tinyurl.com/48k8eu44

Gitz, V., Place, F., Koziell, E., Pingault, N., van Noordwijk, M., Meybeck, A., & Minang, P. (2020). *A joint stocktaking of CGIAR work on forest and landscape restoration* (Vol. 4). CIFOR.

INBAR (2015). Annual Report (2015): South-South Cooperation. Retrieved from: https://www.inbar.int/wp-content/uploads/2020/05/1493092660.pdf

Kaija, E. (2021). Forest restoration could ringfence $6.3 trillion in ecosystem services. Retrieved from: https://forestsnews.cifor.org/71573/forest-restoration-could-ringfence-6-3-trillion-in-ecosystem-services?fnl=en Pedercini et al. forthcoming. Priority landscapes for tree-based restoration in Ethiopia. PATSPO. Working Paper. World Agroforestry, Nairobi, Kenya (in press December 2021). Not for quotation as final.

Pedercini et al. forthcoming. Priority landscapes for tree-based restoration in Ethiopia. PATSPO. Working Paper. World Agroforestry, Nairobi, Kenya (in press December 2021). Not for quotation as final.

Sutton, P. C., Anderson, S. J., Costanza, R., & Kubiszewski, I. (2016). The ecological economics of land degradation: Impacts on ecosystem service values. Ecological Economics, 129, 182-192.

Vogel, C., Moser, S. C., Kasperson, R. E., & Dalbelko, G. D. (2007). Linking vulnerability, adaptation, and resilience science to practice: Pathways, players, and partnerships. *Global Environmental Change, 17*: 349-364.

van Schoubroeck et al, forthcoming. Modelling the impact of improving tree genetic resources in Ethiopia. PATSPO. Working Paper. World Agroforestry, Nairobi, Kenya (in press December 2021 or January 2022). Not for quotation as final.

Young, J., & Bird, N., (2015). Informing REDD+ policy: An assessment of CIFOR's Global Comparative Study. Overseas Development Institute, London.

Appendix 1. Cluster-level ToCs and Explanations: Challenge 2 (High Prevalence of Degraded Land and Ecosystem Services)

Cluster: Climate Resilient Cacao (Global) (Figure 3)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Integrated Approach to Improving Yield Efficiency and Resilience to Climate Change through Better Use of Cacao Genetic resources	Bioversity	2018-2019	€220,580.13	Brazil, Colombia, Cote D'Ivoire
Follow on project: Research on heat and drought tolerant cocoa planting material for: An integrated approach to improving yield efficiency and resilience to climate change through better use of cacao genetic resources	Bioversity	2013-2015	USD 100,000	Colombia, Costa Rica, Brazil

Purpose: To enhance climate-change resilience of cacao (provision ecosystem services)

Cacao provides livelihoods to more than 6 million people globally, and its productivity and quality is predicted to be increasingly constrained by climate change. Cocoa has a narrow genetic base, but over a thousand varieties of cacao are held in genebanks and in farmers' fields across the world. The physiological characteristics pertaining to drought tolerance and resilience of the full diversity of cacao varieties remain under-assessed.

Bioversity has undertaken a global effort across Latin America and Africa to conduct research activities to promote better use of climate resilient cacao genetic resources, to improve yields and promote resilience to climate change. Through assessing the physiological characteristics of cacao varieties, developing criteria for resilience, developing protocols, and establishing data and knowledge sharing platforms to sustain investment on a global scale, it is expected that cacao breeding programmes will adopt more resilient cacao varieties and farmers will then gain access to more resilient varieties, to have better yields in spite of drought and other extreme weather events resulting from climate change. As a result, cacao plantations will remain intact and resilient to provide sustainable livelihoods to farmers (enhanced provision ecosystem services), and will not become degraded.

Expected impact from the cluster: Not available.

FTA Outcome Assessment and Impact Estimation: Challenge 2 (High Prevalence of Land and Ecosystem Service Degradation)

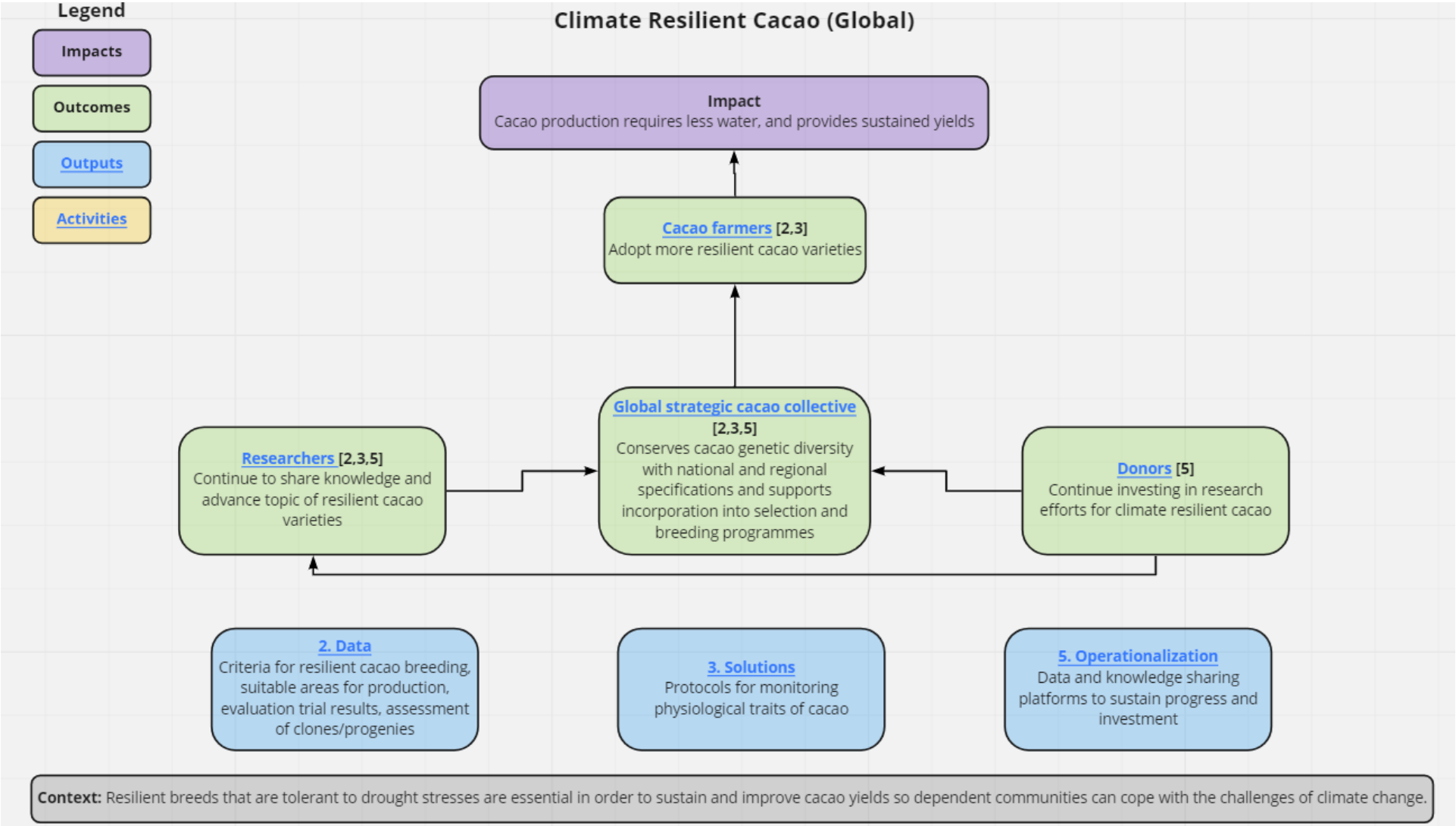


Figure 3. Cluster-level sub-ToC for FTA research on Climate Resilient Cacao

Cluster: Scaling Context-Appropriate Agroforestry Systems for Restoration (Figure 4)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Regreening Africa: reversing land degradation by scaling up evergreen agriculture	ICRAF	2017-2022	21,400,547	Ethiopia, Rwanda, Somalia, Mali, Niger, Ghana & Senegal
SAIRLA: Bringing evidence to bear on negotiating ecosystem service and livelihood tradeoffs in sustainable agricultural intensification	ICRAF	2016-2020	885,294	Burkina Faso, Ethiopia, Ghana, Malawi, Tanzania, Zambia
Nutrition sensitive forest restoration to enhance capacity of rural communities in Burkina Faso	Bioversity	2016-2019	563,850	Burkina Faso
PATSPO: Provision of adequate tree seed portfolios	ICRAF	2018-2021	8,000,000	Ethiopia
Drydev: A regional programme in the Sahel and Horn of Africa, enhancing Food and Water Security for Rural Economic Development	ICRAF	2013-2019	50,000,000	Burkina Faso, Ethiopia, Kenya, Mali, Niger
Community Forestry Tree Seed Banks (CATS Banks) Building Agroforestry Scaling up Platform for Diversifying Livelihood Opportunities in Malawi & Mozambique	ICRAF	2010-2013	€319,709.77	Mozambique, Malawi
Agroforestry Food Security Program I & II	ICRAF	Phase I: 2012-2016 Phase II: 2016-2018	€400,000 (phase I) €1,000,000 (phase II)	Malawi
AFLI II: Developing and promoting market-based agroforestry and rehabilitation options for Northwest Vietnam	ICRAF	2017-2021	USD 2,043,442	Vietnam
Indonesian Rural Economic Development	ICRAF	2016-2018		Indonesia

Purpose: Restoration of degraded lands through adoption of agroforesty practices and options by context

Land degradation threatens the livelihoods and the food and nutrition security of the poorest, most vulnerable farmers and pastoralists. Tackling this challenge demands an ambitious but proven and effective approach: incorporating trees into cropland, communal land and pastoral areas will speed up the reclamation of degraded landscapes. Mixed crop, tree and livestock systems on farms and within farming landscapes demonstrate high potential to reverse land degradation and improve productivity to address other challenges, particularly food and nutritional security, and rural poverty and vulnerability. Agroforestry has already been successfully deployed to reverse land degradation in specific places. The challenge now is to scale-up relevant practices across the globe.

FTA has spearheaded several research initiatives aiming to co-develop and support the implementation of context-appropriate options for restoration. The research is specifically targeting scaling the adoption of agroforestry practices, or sustainable agricultural intensification to restore degraded land to be productive again thereby enhancing ecosystem services. FTA has (1) framed restoration as a matter of context, (2) provided data and methods for assessing suitability, monitoring and analyzing degradation dynamics, and identifying priority species based on individual community needs; (3) developed decision support tools to support context-appropriate restoration, manage trade-offs, develop needs-based restoration schemes, and provided recommendations to breeding plans for priority species; (4) trained farmers and co-developed knowledge on successful land restoration; and (5) supported up and out-scaling of agroforestry through pilot nursery establishment and demonstration plots to encourage uptake. It is expected that knowledge and processes (i.e. establishing communities of practice) facilitated by FTA research would support governments to improve the policy and institutional environment to support the uptake of contextually appropriate restoration options, and that NGOs and international organizations would be equipped to develop restoration schemes that meet local needs and consider socio-economic factors. Seed suppliers are expected to develop closer ties to farmers and supply quality seeds and seedlings that meet local needs. As a result, farmers would be enabled to adopt more resilient

seed portfolios and varieties, and context appropriate agroforestry practices in soil and water conservation to support effective restoration in their communities, thereby restoring degraded land for effective and sustainable tree, crop, and livestock production.

Expected impact from the cluster: >9 million ha of land under agroforestry-based restoration; >1 million farmers with improved trees, breeds, varieties and/or management practices

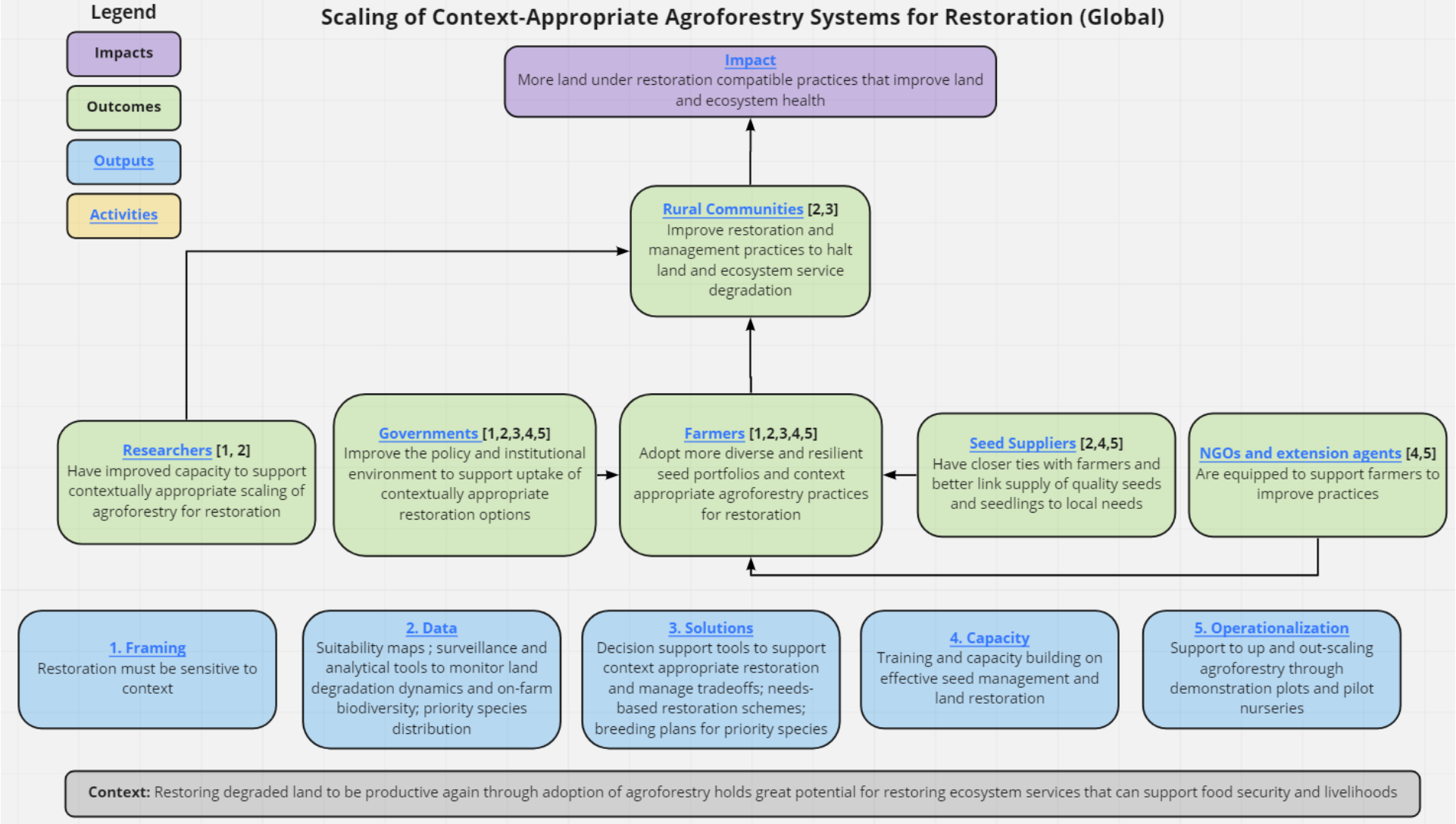


Figure 4. Cluster-level sub-ToC for FTA research on Scaling Context-Appropriate Agroforestry Systems for Restoration

Cluster: Forest Landscape Restoration (Global) (Figure 5)

Project	*Centre*	*Duration*	*Budget*	*Countries*
DFID KNOWFOR 2: FLR SLANT	CIFOR	2015-2017	714,599	China, Ethiopia, Peru, Mexico, Brazil, Colombia
Sloping Lands in Transition: Land use change and smallholder adaptive capacity	CIFOR	2016-2019	540,000	Bhutan
Opportunities for tropical forest and landscape restoration: A Public Forum by Sarawak State Government: Developing policy to ensure restoration of strategy and policy to successfully restore productive forest	Bioversity	2017	17,352	Malaysia
Alliance for forestry innovation	Bioversity	2014-2017	276,373	Peru

Purpose: Improve restoration and land management policy frameworks

Unsustainable extraction of forest resources degrades land. Global processes (Bonn Challenge among others) that have promoted Forest Landscape Restoration (FLR) commitments are driving an increased interested at the national level in how to plan, implement and report on the progress of FLR. At the same time, many countries who have committed to ambitious reforestation targets have significant capacity and knowledge gaps in relation to undertaking landscape scale reforestation. There is also concern that the interaction between environmental, social and economic implications and trade-offs of forest landscape restoration are poorly understood and theorised. There is currently a need to engage at the sub-national, national and international levels to capitalise on the reforestation momentum and support improved FLR practice and inform global understandings and approaches to FLR to enhance ecosystem services.

FTA has invested in supporting national restoration plans across the world by providing critical data on gaps, needs and barriers to restoration, tools and methods for assessing ecosystem service contributions of different management options (forest and on-farm), building capacity in researchers and partners, convening multistakeholder for a to share knowledge on forest landscape restoration, and supporting implementation by co-creating workplans. It is expected that these collective contributions will equip policymakers to scale up existing forest landscape restoration efforts in the context of national commitments to biodiversity conservation/provision and climate change, and develop more effective restoration strategies. Partners are expected to support smallholder participation in forest management planning, and governments are expected to gain awareness and capacities to harmonize government and community goals for land use so that restoration strategies are aligned with community priorities. The private sector is expected to capitalize on new opportunities arising from commitments to sustainable forestry and attract investment. As a result, farmers will play a greater role in forest governance and the restoration of their landscapes yielding positive development outcomes for upstream and downstream users of forest ecosystem goods and services.

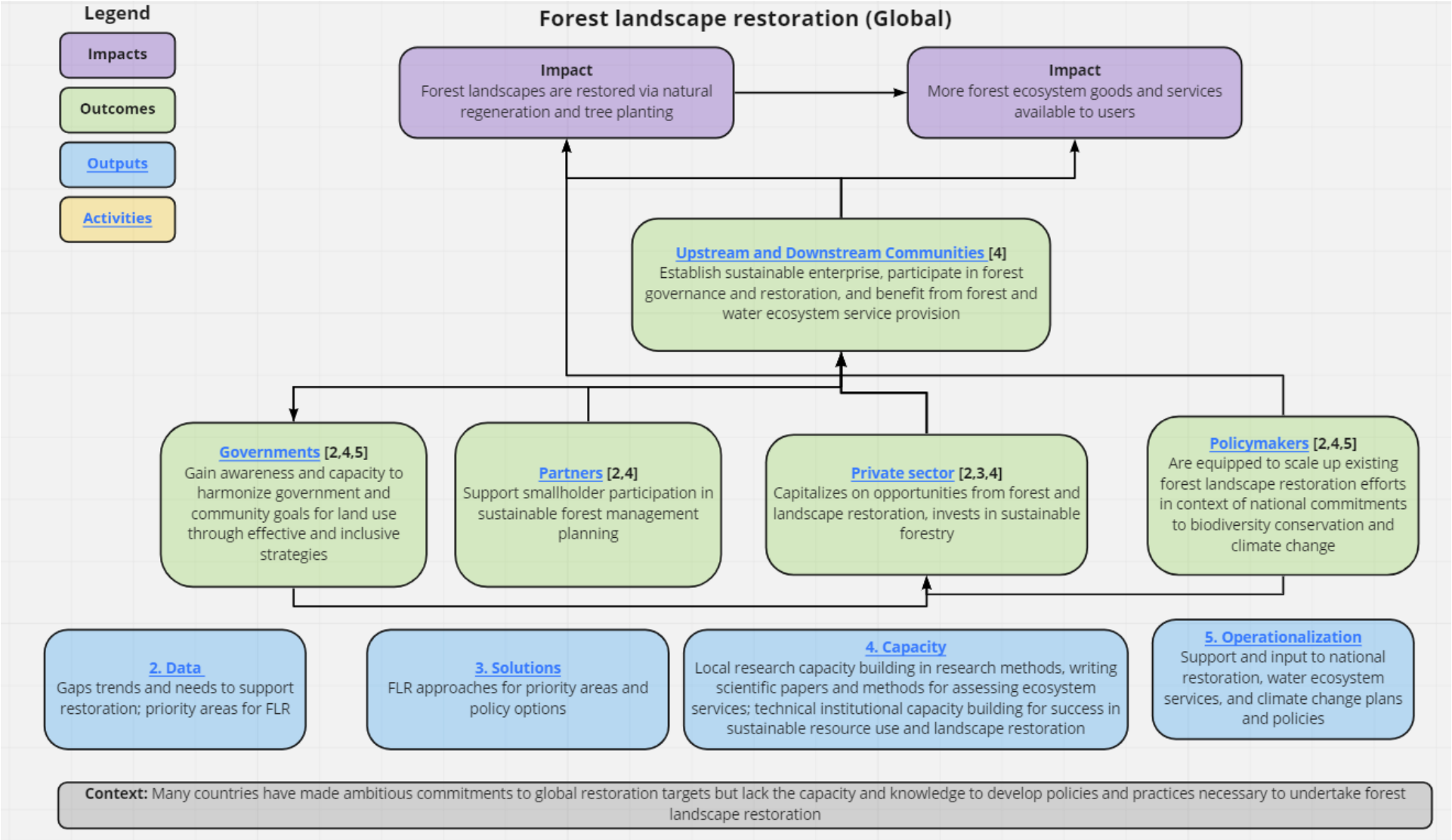


Figure 5. Cluster-level sub-ToC for FTA research on Forest Landscape Restoration

Cluster: Bioeconomy Development to Restore Degraded Land (Asia & Africa) (Figure 6)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Bamboo as sustainable biomass energy	INBAR	2009-2013		Ethiopia and Ghana
South-South Knowledge transfer strategies	INBAR	2014-2018		Tanzania, Ethiopia, Madagascar
Dutch-Sino East Africa Bamboo Development Programme	INBAR	2016-2019 (Phase 1) 2020-2023 (Phase 2)		China, Ethiopia, Kenya, Uganda
Inter-Africa Livelihood Development Programme	INBAR	2018-2021		Cameroon, Ghana, Ethiopia, Madagascar
Socio economic and environmental benefits of bioenergy production on degraded land in Indonesia	CIFOR	2015-2020		Indonesia

Purpose: To restore degraded lands with bamboo to provide alternative energy sources for rural communities and reduce greenhouse gas emissions

In rural and peri-urban areas of Africa and Asia, many households rely on wood as the primary energy source, especially for cooking. Wood extraction for charcoal production is a significant driver of forest degradation and deforestation. Simultaneously, large natural reserves of indigenous and planted bamboo within these regions remain untapped as an energy source. Two factors obstruct bamboo energy development: 1) limited community knowledge and skills to adopt bamboo-planting and energy products in their practices; and 2) national policy-makers' awareness gaps on the benefits of bamboo energy provision. Bamboo is resilient, and can be planted on degraded land to restore its productivity.

FTA has responded by investing in research and training activities to promote the upscaling of bamboo to restore degraded land and equip communities to develop a sustainable bamboo (bio)-economy. By collecting and analyzing comparative data on the calorific value and carbon footprint, the projects framed bamboo as a viable alternative fuel source. Models for sustainable business and value chains, and training on bamboo planting, propagation, harvest, and procurement was expected to facilitate community support and uptake. Furthermore, direct support to bamboo development strategies was undertaken in Ghana to contribute to a favourable policy environment. The projects piloted on farm planting, and established nurseries for bamboo, as well as assessed the potential for nyamplung to restore peatland. By demonstrating the potential of the bamboo economy to support livelihood needs, and for restoration of degraded land through research and engagement activities, it was expected that policymakers would facilitate rather than obstruct bamboo market development, and communities would be equipped to adopt sustainable practices, and participate in the bamboo market, attracting private sector investment and growing the economy. As a result of planting activities necessary to sustain a thriving bamboo market, degraded lands would be restored, and communities would receive benefits from increased access to provision ecosystem services. Greenhouse gases would be reduced by increasing natural stock, and by reducing pressure on natural forest for fuelwood.

Expected impact from the cluster: Not available

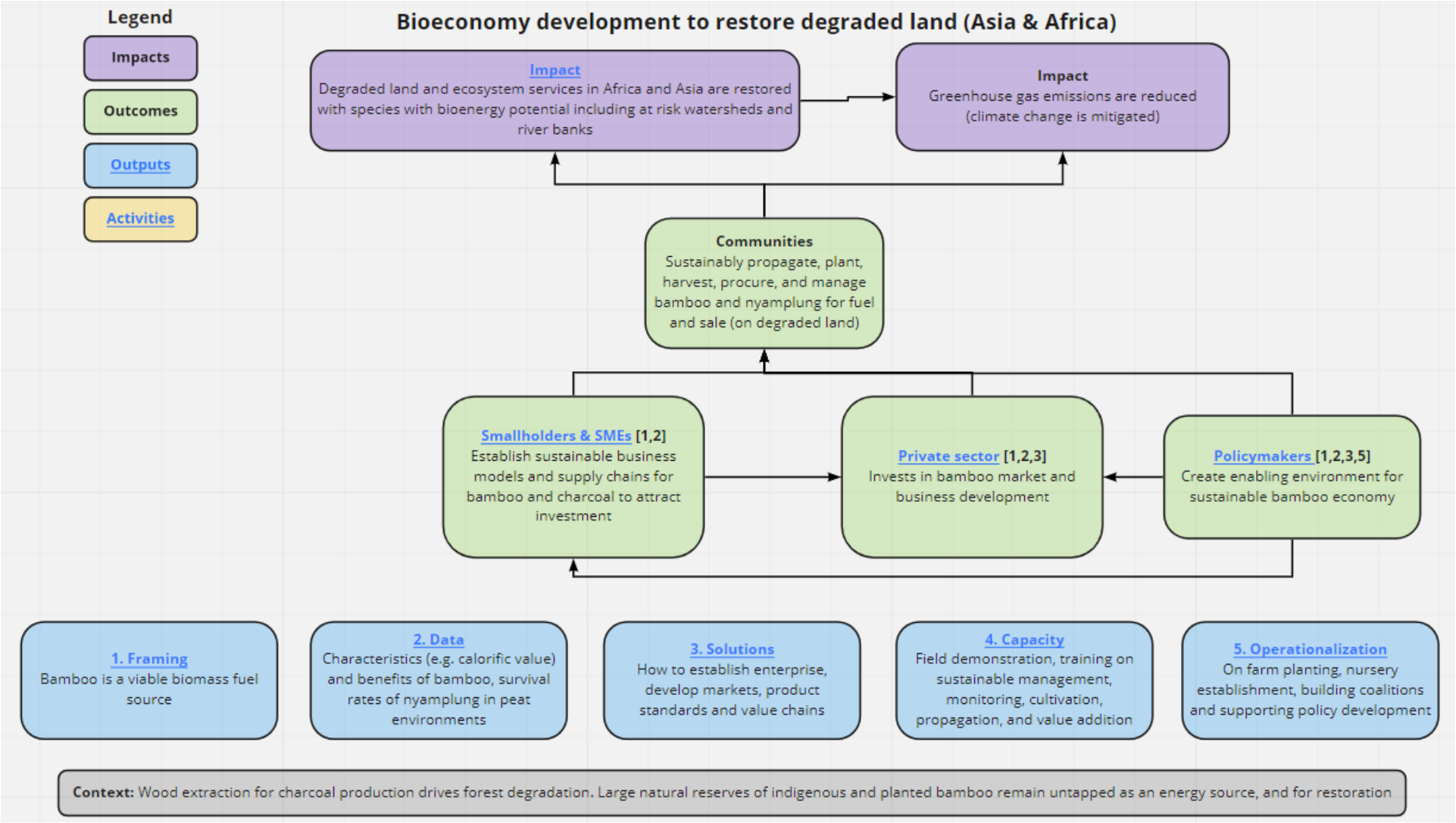


Figure 6. Cluster-level sub-ToC for FTA research on Bioenergy Development to Restore Degraded Land

Cluster: REDD+ Policy Mechanism (Figure 7)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Learning from REDD: A Global Comparative Analysis (Phase 1 of GCS REDD+ Program)	CIFOR	2010 - 2013	USD 10,194,000	Indonesia, Vietnam, Nepal, Brazil, Peru, Bolivia, DRC, Tanzania, Cameroon
Learning from REDD+: An enhanced global comparative analysis (Phase 2 of GCS REDD+ program)	CIFOR	2013 - 2015	USD 10,238,910	Cameroon, Tanzania, Indonesia, Vietnam, Brazil and Peru. A subset of project activities will take place in Burkina Faso, DRC, Mozambique, Papua New Guinea, Nepal, Bolivia and Guyana
Opportunities and Challenges to Developing REDD+ Benefit Sharing Mechanisms in Developing Countries (accompanying phase 2 of GCS REDD+ program)	CIFOR	2012 - 2016	USD 6,556,500	Brazil, Cameroon, Indonesia, Peru, Tanzania, Vietnam
REDD : Research to Support Design and Implementation (accompanying phase 2 of GCS REDD+ program)	CIFOR	2012 - 2015	USD 9,899,000	Indonesia, Vietnam, Papua New Guinea, Nepal, Tanzania, Burkina Faso, Mozambique, Cameroon, Peru, Brazil, Bolivia
A Global Comparative Study for achieving effective, efficient and equitable REDD+ results (Phase 3 of GCS REDD+ program)	CIFOR	2016 - 2020	USD 10,752,688	Brazil, Indonesia, Peru, Ethiopia, Guyana, Myanmar, DRC, Vietnam
From Climate Research to Action under Multilevel Governance: Building Knowledge and Capacity at Landscape Scale (internal acronym: MLG) (TT: overlapping phases; this project started in the middle of GCS REDD+ phase 2 and ended in the middle of phase3)	CIFOR	2014 - 2018	USD 4,979,230. 15	Indonesia, Mexico, Peru, Vietnam
SECURED Landscapes: Sustaining Ecosystem and Carbon benefits by Unlocking Reversal of Emissions Drivers in Landscapes	ICRAF	2013-2015	NOK 10,000,000	Cameroon, DRC, Indonesia, Peru, Viet Nam

Purpose: Support development and implementation of REDD+ to reduce emissions from forest degradation

To support the effective implementation of global policy mechanisms (REDD+), reliable data are needed to address the negative effects of deforestation-driven climate change. FTA has undertaken a broad range of research projects on REDD+. FTA played a role in facilitating learning platforms for REDD to achieve the 3Es (Effective, Efficient, Equitable), tested stepwise approaches to estimate reference emission levels, quantified emissions, developed tools to support low carbon development strategies and emission reduction plans, and conducted multiple policy impact studies at the country level, assessing corporate initiatives, exploring incentives and trade-offs for benefit sharing mechanisms, and developing improved monitoring, measurement, reporting, and verification (MMRV) systems. FTA research framed REDD+ policy opportunities and gaps, particularly for MMRV to raise the profile of REDD+ governance and carbon management, and generated data quantifying carbon emissions, modeling land use scenarios, and providing decision support tools. In addition, the research proposed recommendations for global and national REDD+ policies, measures, and greenhouse gas reduction commitments, developed training and supports for the REDD+ learning community, as well as provided guidance for the implementation and monitoring of REDD+ policies. As a result of these contributions, multi-level governments were expected to develop and implement more effective and informed emission reduction policies and action plans, partners and allies would support policy implementation at various levels and play an active role in the monitoring of government and private sector REDD+ commitments to hold these actors accountable to their commitments. As a result, the private sector was expected to adhere to REDD+ policies, and change their practices to reduce deforestation-related emissions. Researchers were also expected to build capacities and advance research on REDD+, which would continue to feed into REDD+ policy development and implementation. Ultimately, it was expected that REDD+ will better fill its mandate to reduce deforestation and land degradation-related emissions through enhanced forest management at the national and international level, thereby enhancing ecosystem services in forest landscapes.

Expected impact from the cluster: To be determined.

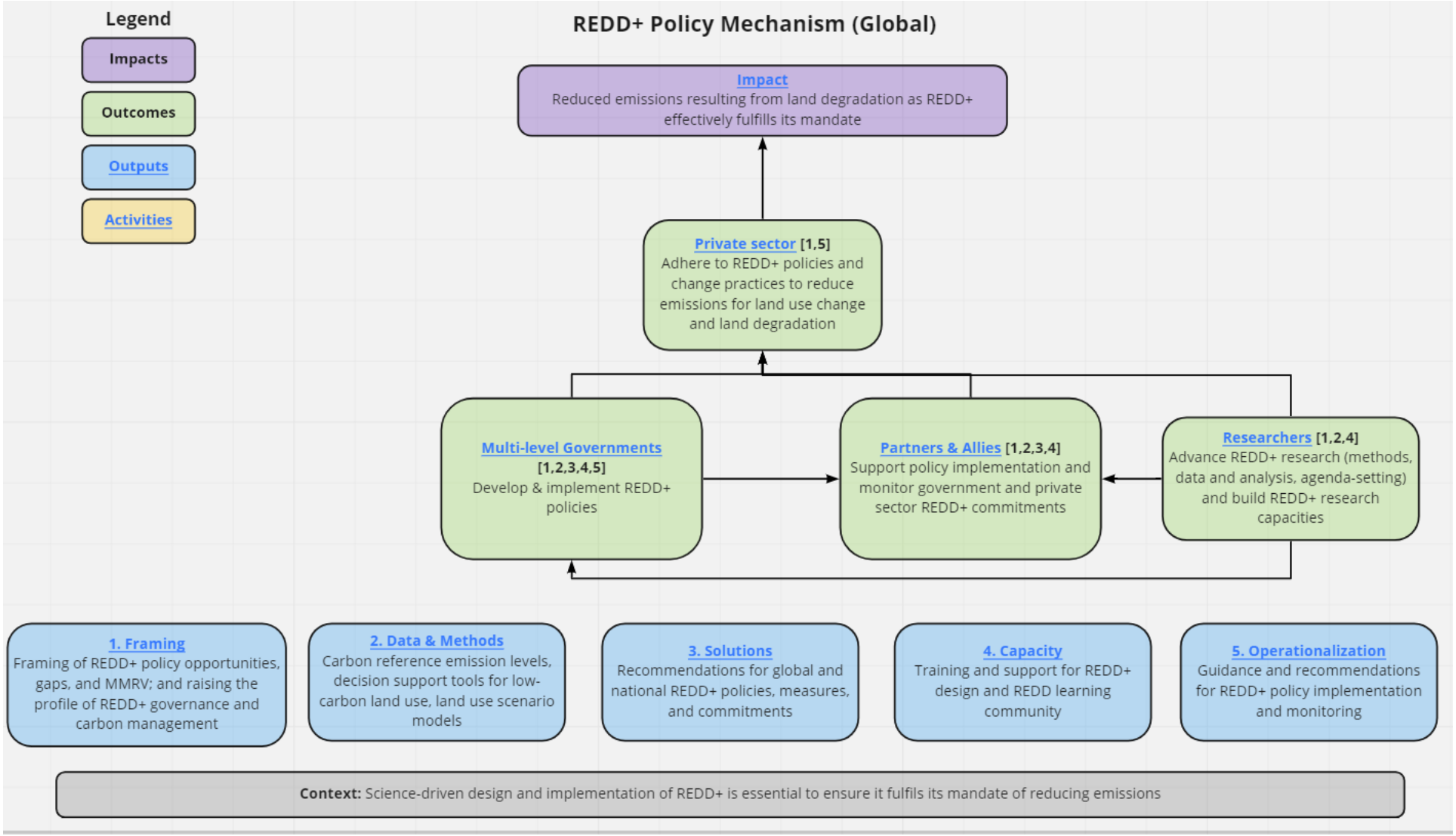


Figure 7. Cluster-level sub-ToC for FTA research on REDD+

Cluster: Innovation for resilient landscape restoration (Latin America) (Figure 8)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Laying the foundations for climate- smart restoration: A toolkit for Peru's tropical dry forest	Bioversity	2018-2020	12,016.36	Peru
Asociar recursos, capacidades y competencias tecnicas y cientificas para el diseno de protocols de restaruacion ecologica del boseue seco tropical	Bioversity	2015-2017	123,272.73	Colombia
Seed systems in restoration under 20x20 initiatives	Bioversity	2016-2017	137,000	Colombia; Peru; Mexico, Guatemala; Costa Rica' Colombia; Perú; Chile; Argentina

Purpose: Restoration of dry tropical forest in Peru

Tropical dry forests are some of the most threatened ecosystems in the Neotropics. Many restoration projects in these regions fail because they do not consider genetic and functional aspects of species. Degraded land needs contextually suitable species for restoration to optimize improvements to ecosystem functioning and provision services to mitigate and adapt to climate change.

Bioversity has undertaken several projects across Latin America to provide innovation that supports contextually appropriate restoration to meet ecological and social needs for ecosystem services. The research has contributed to framing the importance of local context in restoration by supplying governments, restoration program implementers, and NGOs with spatially referenced species data, and decision-support tools to inform which species are best planted where to support effective restoration efforts for both communities and the ecosystems on which they rely. As a result is expected that donors allocate resources to effective restoration initiatives that account for genetic diversity and function of species in context, and restoration program implementers select the appropriate species combinations to effectively restore degraded areas (considering natural regeneration as an option). By conducting analyses of seed supply chains and proposing functional seed supply systems, national governments are expected to be equipped top effectively distribute and supply seeds to promote restoration. By conducting community needs assessments and building technical capacities for planning, implementing and monitoring restoration, in addition to providing analyses for functional seed production and supply systems it is expected that smallholders would be better supported by governments and gain high quality, site appropriate planting material that meets their provision needs, and enhances local ecosystem function. As a result of more effective restoration initiatives across Latin America, it is expected that degraded land will be restored and thereby increase the ecosystem services that can be derived.

Expected impact from the cluster: 400,000 ha of tropical dry forest in Peru is restored

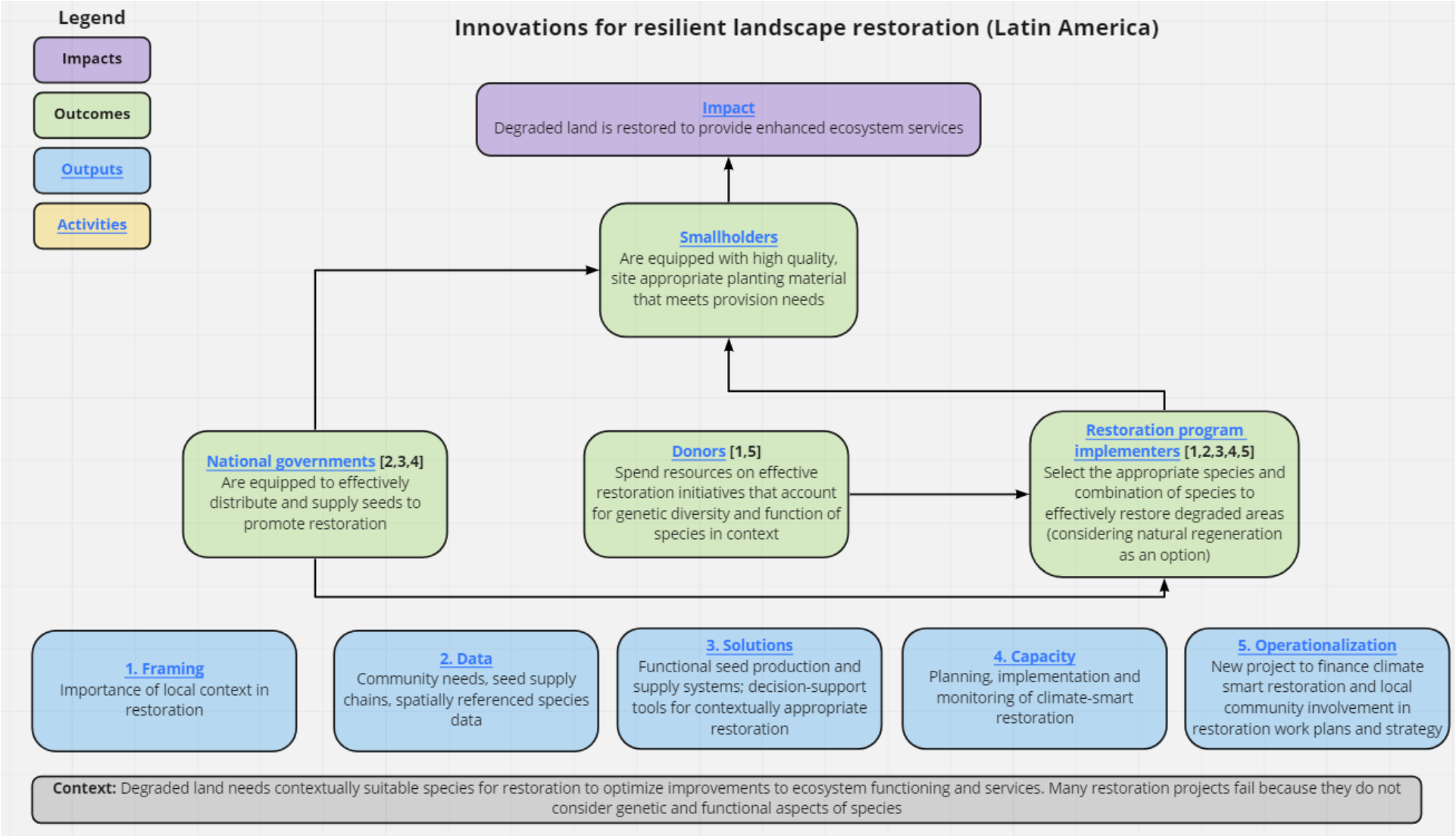


Figure 8. Cluster-level sub-ToC for FTA research on Innovations for Resilient Landscape Restoration

Cluster: Agroforestry Concessions in Peru (Figure 9)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Support to the Development of Agroforestry Concessions in Peru (SUCCESS)	ICRAF	2016-2017	€125,000	Peru
PARA: Piloting approaches to rural advisory services in support of scaling of the Agroforestry Concessions scheme in Peru	ICRAF	2019-2022	1,343,930.56	Peru
Peru's Agroforestry Concessions Scheme: Collaborative Action to secure Multi-level Readiness for Implementation of an Innovative, Transformative Policy Project	ICRAF	2020-2023	3,260,000	Peru

Purpose: Successful implementation of Agroforestry Concessions in Peru to facilitate sustainable practices (soil and water conservation), emission reductions and enhance the availability of ecosystem services through productive and well managed land

Informal farming communities' expansion of the agricultural frontier is a driver of deforestation and land degradation in the Peruvian Amazon. FTA research aimed to support the implementation of agroforestry concessions for eligible smallholders in Peru such that they could comply with requisite sustainable practices, including tree cover, water, and soil conservation. FTA worked with and engaged governments, NGOs, and local communities to frame challenges and opportunities for the agroforestry concession mechanism (e.g., compliance barriers for eligible smallholders), as well as expanded definitions of smallholders and concepts of smallholder heterogeneity. FTA's research also quantified the potential GHG reduction impact of successful implementation of the mechanism and mapped eligible zones and areas, and proposed a new approach for zoning. Along with capacity and training for researchers and communities, FTA research co-produced guidance to implement and operationalize the agroforestry mechanism and its technical guidelines. As a result of these interventions, it is expected that the government at the national and sub-national levels would revise existing policy and effectively implement the mechanism, and NGOs support these processes to ensure smallholders can benefit from and comply with the mechanism's requirements. Eligible smallholders would be incentivized to apply for and be awarded a concession, develop and maintain their capacities to comply with the provisions of the concession, and adopt more sustainable practices. It is expected that the culmination of these outcomes would allow the mechanism to realize its potential for sustainable rural development, by reducing the amount of forest cut down to expand agricultural areas for maize, cocoa and coffee, and supporting restoration of degraded land the Peruvian Amazon.

Expected impact from the cluster: 1.5 million hectares of forest land in Peru; 0.36 GT Co2 emissions avoided.

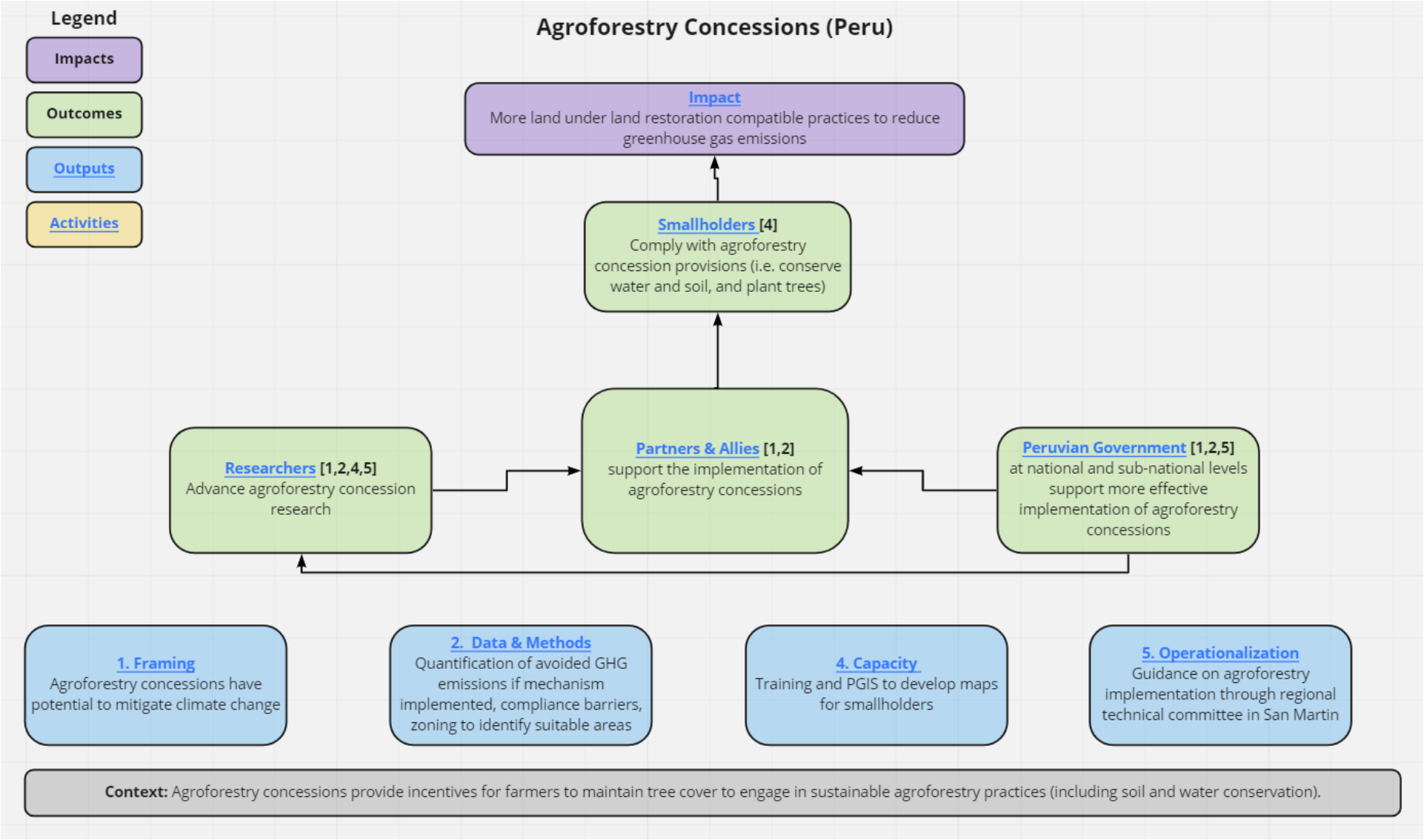


Figure 9. Cluster-level sub-ToC for FTA research on Agroforestry Concessions in Peru

Cluster: Research Capacity Building for Sustainable Forest and Agricultural Land Management and Restoration (Figure 10)

Project	*Centre*	*Duration*	*Budget*	*Countries*
REFORCO (Appui a la politique Nationale de conservation et gestion des forets et de la biodiversite en republique democratique du Congo)	CIFOR	2009-2016	USD 7 817 199	Democratic Republic of the Congo (DRC)
FCCC (Forests and Climate Change in Congo)	CIFOR (CIRAD, INBAR, ICRAF listed as partners)	2013-2016	USD 7 800 094	DRC
FORETS (Formation, Recherche, Environment dans la Tshopo)	CIFOR (CIRAD, INBAR, ICRAF listed as partners)	2016-2021	USD 28 971 000	DRC

Purpose: Build local research capacity for better management of agricultural and forest lands in the DRC

Forests and agriculture are key drivers of economic growth in the Democratic Republic of the Congo (DRC). What was formerly lush tropical forests, DRC forest landscapes are experiencing large scale fragmentation due to overexploitation, economic instability, population growth, and low research capacity to effectively manage landscapes.

FTA has undertaken collaborative research and capacity building initiatives in the DRC to address the issue of low research capacity in agriculture and forestry, in partnership with the University of Kingsangani (UNKIS). By providing direct support to the renovation, and supplying required equipment for appropriate learning spaces, and informing curriculum development, that UNKIS would have a better environment for prospective students. As a result more Congolese students would be better trained in sustainable development and transfer their learning to practice. PhD, Master and Bachelor's students would produce rigorous research results for the benefit of development practitioners and policymakers in the area to access the information they need. It is expected that providing solutions to agroforestry management with research, supporting communities to access markets, and providing ad hoc training, that development practitioners, policymakers and government staff with forest and agricultural management mandates (e.g. at the Ministry of Environment) would have access to robust research findings upon which to base their policies and strategies for landscape management, restoration, and climate change adaptation, and mitigation. As a result of direct support to planting and restoration initiatives, as well as awareness raising of the benefits of sustainable management, communities are expected to participate in sustainable management, and restoration of landscapes in the DRC to provide more biodiversity, ecosystem services, and reduce carbon emissions.

Expected impact from the cluster: Target landscape of 400 000 ha (FORETS)

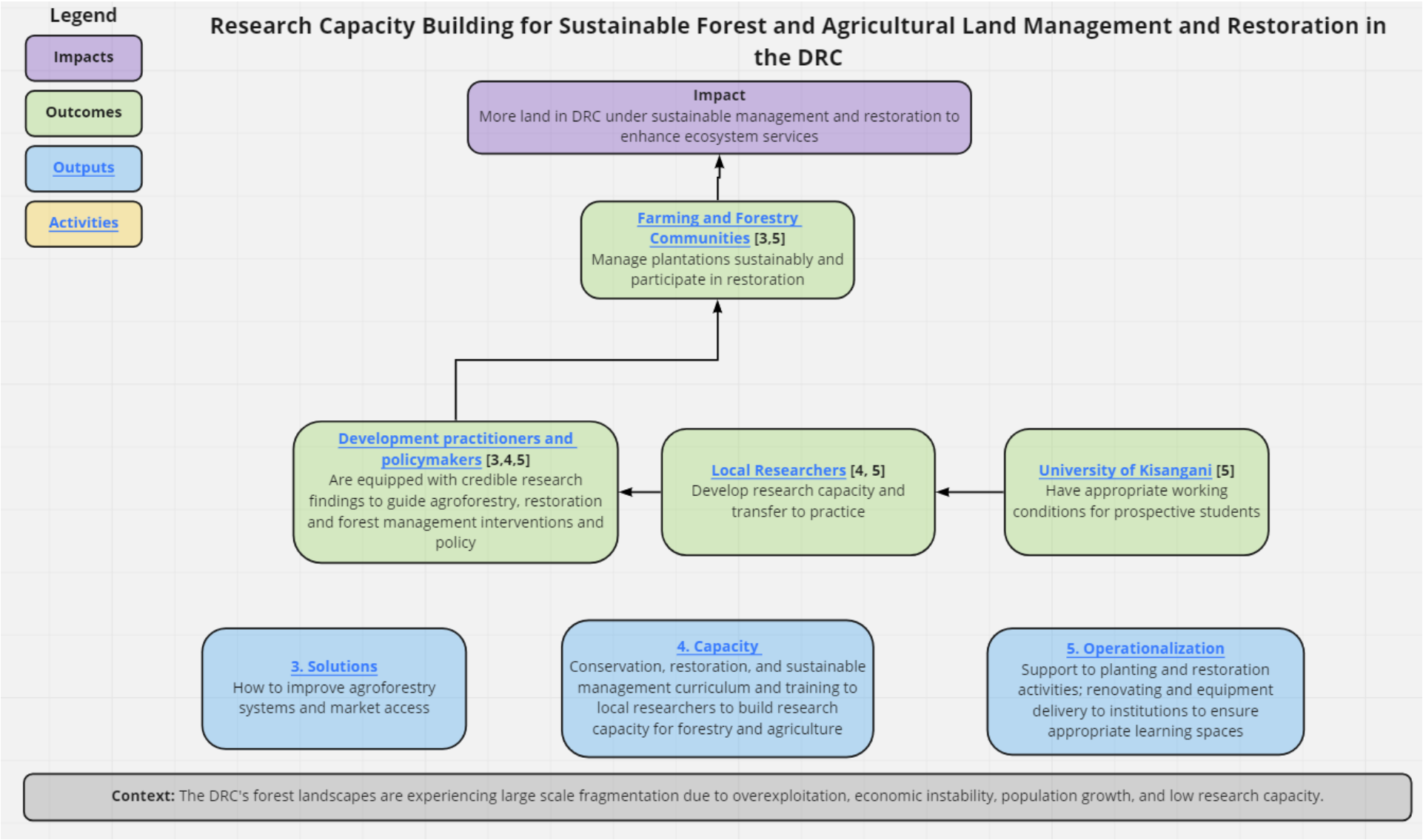


Figure 10. Cluster-level sub-ToC for FTA research and capacity building for Sustainable Forest and Agricultural Land Management and Restoration in the DRC

Cluster: Conservation and sustainable use of genetic resources (Africa) (Figure 11)

Project	*Centre*	*Duration*	*Budget*	*Countries*
FAO Planning and organization of a SAFORGEN regional workshop on the conservation and use of forest genetic resources in SSA	Bioversity	2018-2019	60 000	Sub-Saharan Africa
Threats to priority food tree species in Burkina Faso: Drivers of resource losses and mitigation measures	Bioversity, CIFOR, ICRAF	2012-2016	657 650.00	Burkina Faso
Aide à l'application des normes FSC sur la régénération et la diversité génétique des essences du bassin du Congo	Bioversity	2015-2017	24’640.25	Cameroon

Purpose: To improve the sustainable use and conservation of genetic resources to meet both conservation and development needs.

Land use change and overexploitation of resources in forest ecosystems are eroding tree genetic resources. Tree genetic resources harbour significant economic, environmental, scientific and social value. Conservation and sustainable use of tree genetic resources are important for maintaining species diversity and commercial viability, so that forest trees can survive, adapt and evolve under changing environmental conditions. In response, there have been global efforts to develop action plans for the conservation, sustainable use and development of forest genetic resources (e.g. Forest Stewardship Council Standards, Global Plan of Action on Forest Genetic Resources) to serve conservation and development objectives.

FTA has joined forces with FAO and national forest research institutes to align with global efforts and initiatives to curb unsustainable land and resource use, and management to sustain natural stocks and biodiversity. FTA produced: (1) data on land uses, habitat suitability, priority species lists, and the regenerative potentials of species; (2) solutions for ensuring regeneration and maintenance of forest genetic stocks, (3) developed capacity of researchers and natural resource managers, and (4) co-developed work plans and strategies. It was expected that through increased research capacity, and collaboration with national forest research institutes would help advance the agenda on conservation and sustainable use of forest genetic resources, and that governments would adopt recommendations to globalize sustainable management and align with national plans for biodiversity. For example, the FSC standards would adopt recommendations to ensure sustainable regeneration of exploited species. National stakeholders were expected initiate more projects and place greater priority on conservation and sustainable use of resources to meet development objectives. As a result, the private sector would have a sustainable resource stock over the long term, and communities would have sustainable access to genetic resources, and manage them effectively to meet development and conservation objectives. Together it is expected that more trees and forest genetic resources would be sustained to provide ecosystem services.

Expected impact from the cluster: Not available

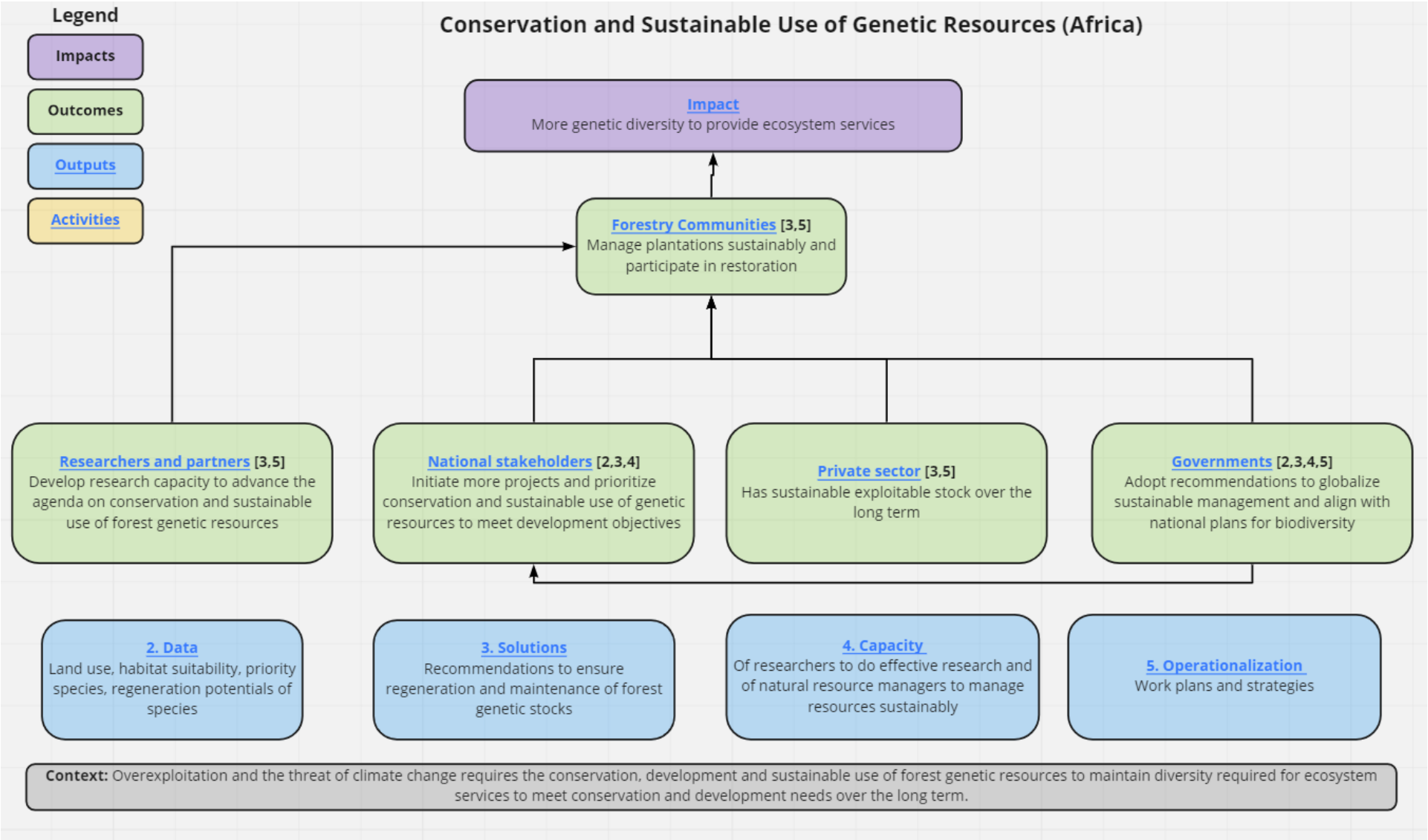


Figure 11. Cluster-level sub-ToC for FTA research on Conservation and Sustainable Use of Genetic Resources in Africa

Cluster: Fire and Haze (Indonesia) (Figure 12)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Political Economy Study of Fire and Haze in Indonesia	CIFOR	2015 - 2015	USD 281,722	Indonesia
DFID Know-for 2: Political economy of fire and haze	CIFOR	2015 - 2017	USD 413,249	Indonesia
Disaster Preparedness Specific Discipline Integrated Programme in Riau, Indonesia	CIFOR	2018 - 2020	USD 307,685	Indonesia

Purpose: Drylands become sustainably managed

Anthropogenic fires in Indonesia threaten forests and peatlands, which have high carbon storage, provide habitat for scarce species, retain water, and hold archaeological records for cultural preservation. Peatland degradation as a result of drainage for agricultural use poses an enhanced risk for natural fires to occur, and releases large amounts of carbon emissions into the atmosphere contributing to climate change.

FTA research investigated the social, ecological, and economic dimensions of fires in Indonesia with the intent to inform policy and practice. FTA's research contributed by framing fire issues (there are political and economic incentives to burn), concepts to address issues (fire prevention), and raising the profile of fire-related issues. FTA generated data on the causes and locations of fires, as well as overlapping land claims. The research proposed solutions including recommendations for fire prevention policy and practice that consider context, as well as guidance and input to fire prevention policy development processes at the national and regional levels. FTA also established multi-stakeholder fora for fire prevention in Riau. As a result of these contributions, it was expected that the public would gain awareness of the importance of forest and land fire prevention and demand action. Furthermore, direct support to communities in Riau to co-develop community based models for peatland restoration is expected to contribute to the restoration of peatlands to reduce the risk of fires occurring on degraded peatlands. Public demand, in combination with FTA's contributions to policy, would help inform governments' development and implementation of regulations on fire prevention. NGO allies would advocate for fire prevention as a result of accurate and reliable data, and researchers would advance research on fire and haze. The resulting pressure from policy and the public would influence the private sector to commit to the fire prevention agenda and ultimately lead to farmers no longer using fire in agricultural practices, reducing instances of fire in Indonesia and corresponding forest and peatland loss. Furthermore, direct support from FTA research to communities in Riau to co-develop community based models for peatland restoration is expected to contribute to the restoration of peatlands to reduce the risk of natural fires occurring on degraded peatlands thus increasing carbon sinks, and ecosystem services.

Expected impact from the cluster: Not available

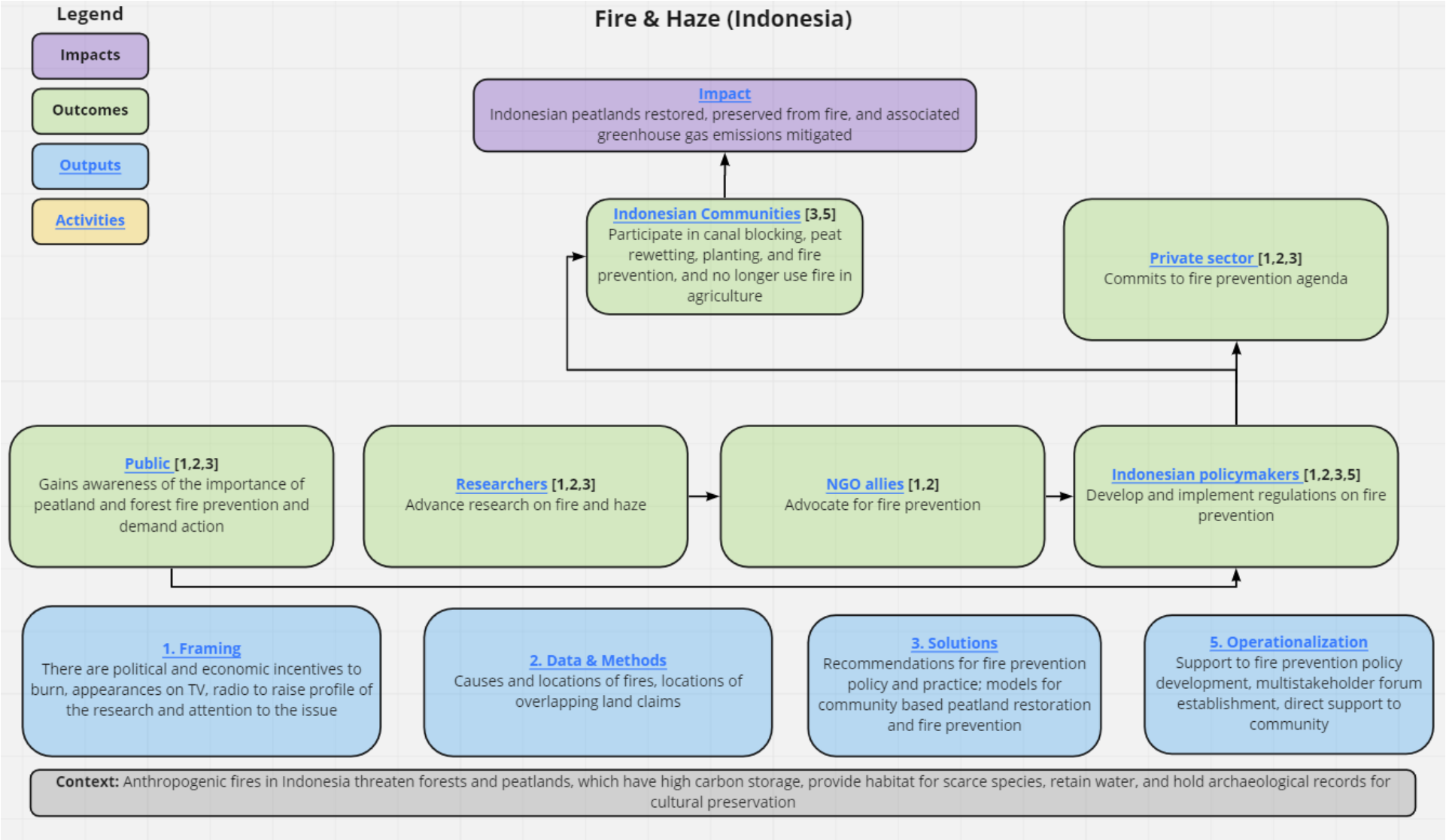


Figure 12. Cluster-level sub-ToC for FTA research on Fire and Haze (Indonesia)

Cluster: Conservation and Sustainable Use of Genetic Resources (Asia) (Figure 13)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Developing cryopreservation protocols for subtropical crops and establishing cryogenebank at RDA	Bioversity	2015-2018	338 162.00	Korea
Conservation for diversified and sustainable use of fruit tree genetic resources in C Asia	Bioversity	2012-2017	1 398 208.00	Kyrgyzstan, Tajikistan, Uzbekistan
Conservation and sustainable use of cultivated and wild tropical fruit diversity: promoting sustainable livelihoods, food security and ecosystem services	Bioversity	2009-2015	3 661 674.00	Indonesia, India, Malaysia, Thailand
Upgrading and broadening the new South Pacific International Coconut Genebank	Bioversity	2016-2019	494 532. 14	Fiji, Papua New Guinea, Samoa

Purpose: Conservation and sustainable use of fruit tree genetic resources

Valuable genetic resources of fruit tree crops are under pressure in Asia due to overexploitation and degradation of natural ecosystems, overgrazing, climate change, and increased disease and insect attacks. Asia is home to important agricultural and tree biodiversity, as the origin of many crops that support rural livelihoods and ecosystem function. Research interventions to support informed germplasm conservation are critical to achieve the sustainable use and management of key fruit tree genetic resources on which communities and ecosystems depend for their sustained function.

FTA has undertaken various research initiatives aiming to conserve genetic diversity to meet sustainable ecosystem and livelihood benefits across the Asia Pacific (Fiji, Papua New Guinea, Samoa, Korea), Central Asia (Kyrgyzstan, Tajikistan, Uzbekistan), and Southeast Asia (Indonesia, India, Malaysia, Thailand). In Central and Southeast Asia, initiatives have focused on fruit tree species diversity, to develop knowledge and capacity to adopt better practices that would support farming communities to sustain and enhance biodiversity on farm. In the Asia Pacific, the research has focused on informing genebank and cryopreservation (e.g. tissue-culture) protocols and patents to preserve coconut and other key crop germplasm. As a result of FTA research contributing improved maps, spatial data, species population data, and sustainable use and record keeping practices, and support to policy development, policymakers were expected to develop germplasm management plans that would facilitate community engagement in sustainable resource use and ensure maintenance of genetic diversity. As a result of capacity building activities, genebank staff, educational institutions, and researchers trained through research programs would gain technical expertise to advance the agenda on genetic diversity and facilitate new breeding outputs. More stakeholders would be equipped with participatory assessment, conservation, valuation, and sustainable use practices of tree resources. With more protocols, and policies guiding conservation, more germplasm will be conserved to support sustainable rural development. With more communities engaged in sustainable resource use and maintaining species crop diversity on farms, it is expected that there will be improved genetic diversity, breeding, and production of climate-resilient crops that support both ecosystem function and rural livelihoods.

Expected impact from the cluster: >10 000 000 people with improved access to improved varieties, trees, breeds (coconut, fruit, nut)

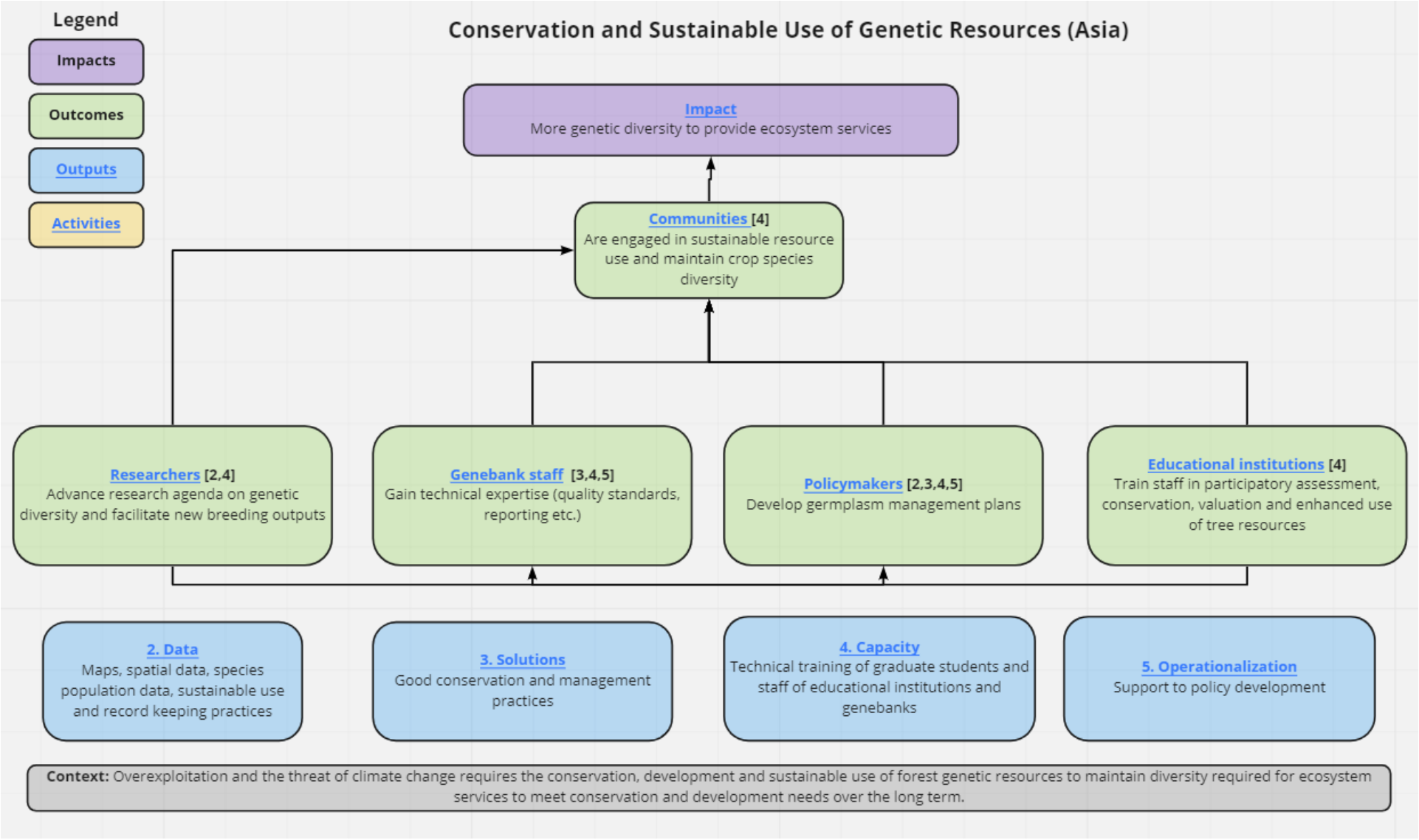


Figure 13. Cluster-level sub-ToC for FTA research on Conservation and Sustainable Use of Genetic Resources (Asia)

Cluster: Green Growth (Asia) (Figure 14)

Project	*Centre*	*Duration*	*Budget*	*Countries*
Green Growth Action Plan	ICRAF	2018-2019	46,400	Vietnam
Green Rubber	ICRAF	2014-2017	1,394,623	China, Laos, Myanmar & Thailand

Purpose: Support policy and practice change for green growth of cash crop commodities

Loss of natural forest due to the expansion of cash crop (e.g. rubber) plantations had led to the degradation of local ecosystem services such as biodiversity, soil retention, watershed services and climate regulation. Moreover, reliance on cash crop production leaves communities susceptible to price volatility. Intercropping has been proposed as a viable solution to increase ecological and social value.

FTA has undertaken research to investigate the potential for green rubber alternatives in the Mekong region (China, Myanmar, Laos, Thailand), and supported the development of a Green Growth Plan in Vietnam. The projects aimed to restore local ecosystem services, such as biodiversity, soil retention, watershed services, and climate regulation in the monoculture landscapes (e.g rubber) through promoting intercropping, and other alternative agroforestry practices. The projects applied a participatory approach, set agroforestry trials and provided capacity building and training to smallholders with the aim that they would adopt green alternatives to rubber monocultures (e.g. by intercropping valuable timber species). It was expected through the participatory trials, rubber farmers would see the value of green alternatives to rubber, and apply promoted management practices by the project. Furthermore, stakeholder engagement with NGOs was expected to stimulate interest in the potential to improve sustainable rubber production and develop procedures to monitor biodiversity and ecosystem services. Furthermore, through training and building capacity of PhD students, it was expected that research would advance sustainable rubber issues and attract investment. As a result of the spatial analyses of land use change, and interviews with smallholders and government agencies, it was recommended that international guidelines for management of sustainable rubber, and provincial green growth (in Lam Dong) be developed. It is expected that recommendations would be taken up and reflected in new guidelines for sustainable production of cash crops, and smallholder adoption of new agroforestry practices (e.g. intercropping) will result in cash crop plantations that provide more ecosystem services rather than diminish them.

Expected impact from the cluster: Not available.

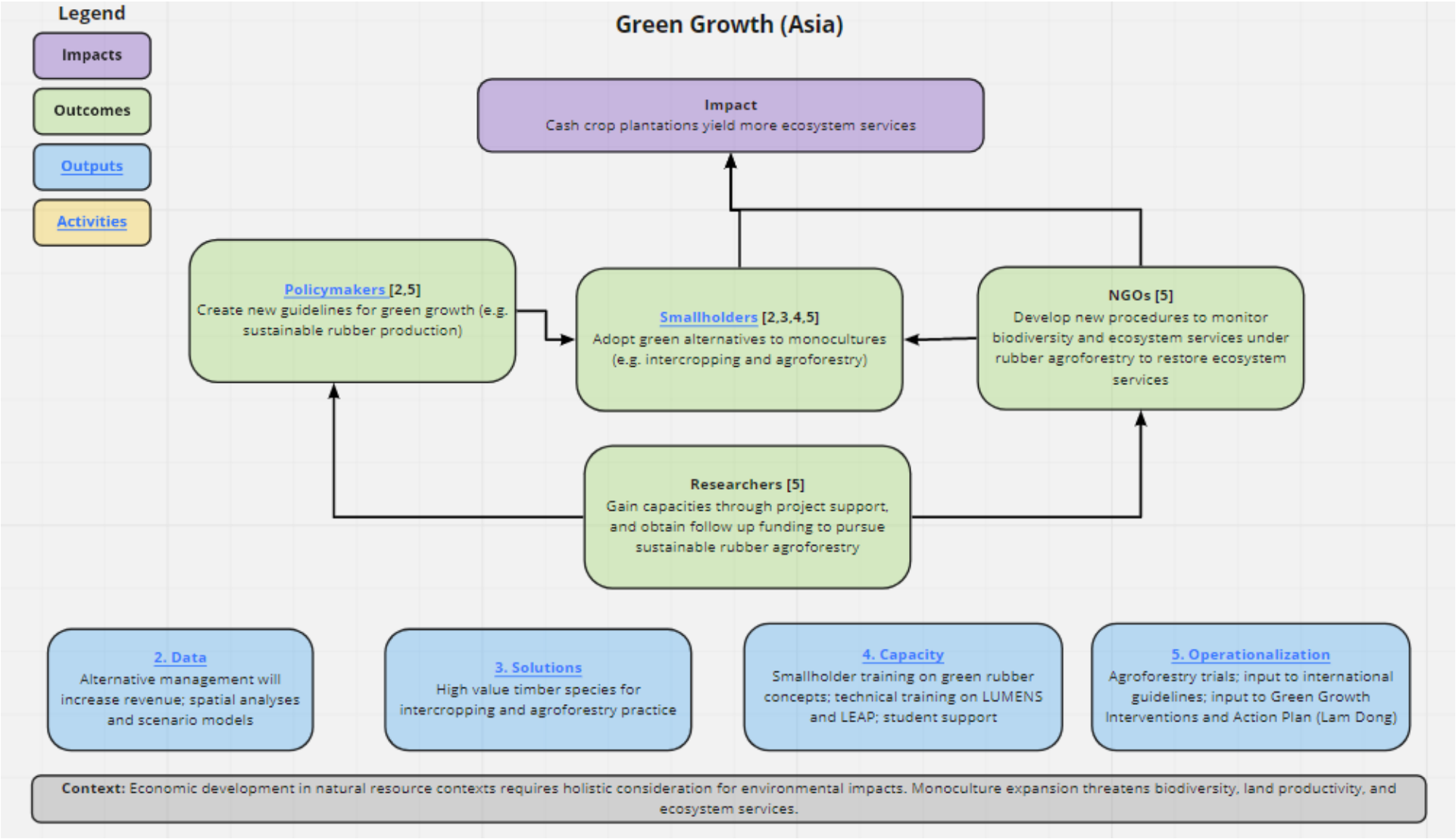


Figure 14. Cluster-level sub-ToC for FTA research on Green Growth in Asia

Cluster: Incentives for Sustainable Agricultural Practices (Asia) (Figure 15)

Project	*Centre*	*Duration*	*Budget*	*Countries*
RUPES 2 - Rewards for, use of and shared investment in pro-poor environmental services, phase 2	ICRAF	2008-2012	USD 1,500, 000	China, India, Indonesia, Nepal, Philippines, Viet Nam
INREMP: Integrated Natural Resource and Environmental Management Program	ICRAF	2018-2020	USD 2,078, 641	Phillipines
Vietnam Forests and Deltas project to support implementation of Payments for Forest Environmental Services (PFES)	CIFOR	2016-2018	USD 26, 323	Vietnam
Sustainable, Low Carbon Emission Agriculture and Water Resource Co-Investment of Rejoso Watershed (Gerakan Rejoso Kita) (2019-2022), 1st phase (2016-2018)	ICRAF	2016-2018 (phase 1) 2019-2022 (phase 2)	EUR 449,433	Indonesia
Climate smart, tree based co-investment	ICRAF	2014-2017	USD 978,253	Indonesia, Philippines, Vietnam
Integrated watershed management for enhancing local livelihoods and biodiversity conservation in Indonesia	CIFOR	2015-2018	300 000	Indonesia

Purpose: Informing the creation and supporting the implementation of incentives that effectively curb unsustainable agricultural practices (particularly water management) to provide more ecosystem services

Incentive mechanisms are required to halt poor natural resource management and agricultural practices that increase land degradation and threaten ecosystem services. Rewards or payment for ecosystem services have been proposed as viable mechanisms to support natural resource restoration and protection of ecosystem services, but require institutional and community support for successful implementation.

FTA has undertaken research across Asia to support the development of national policy frameworks to promote incentive schemes for restoration and preservation of ecosystem services, primarily in the form of rewards or payments for ecosystem services. FTA undertook spatial analyses of land cover and land use change and created rapid assessment tools for biodiversity and hydrology. Through participatory training activities and workshops, communities would learn the value of ecosystem services, and become aware of reward programs. It was expected that the resulting technical knowledge (e.g. land cover maps, carbon storage potential, hydrological analyses) would contribute to policies on environmental management and protection (Indonesia), climate change (Philippines, Vietnam), and rewards for ecosystem services (India, China, Nepal). Participatory approaches were also expected to contribute to strengthening institutions and delivery of incentive schemes to encourage communities to participate in land restoration and protection (e.g. monitoring water use in Rejoso Watershed in Indonesia). Program implementers would be equipped with improved capacity and data to implement incentive programs for ecosystem service enhancement. It is expected that widespread adoption of reward for ecosystem services, co-investment schemes, and sustainable land management practices would become widespread across Asia. As a result, ecosystem services are expected to be improved through enhanced incentives and rewards for the restoration and protection of land.

Expected impact from the cluster:

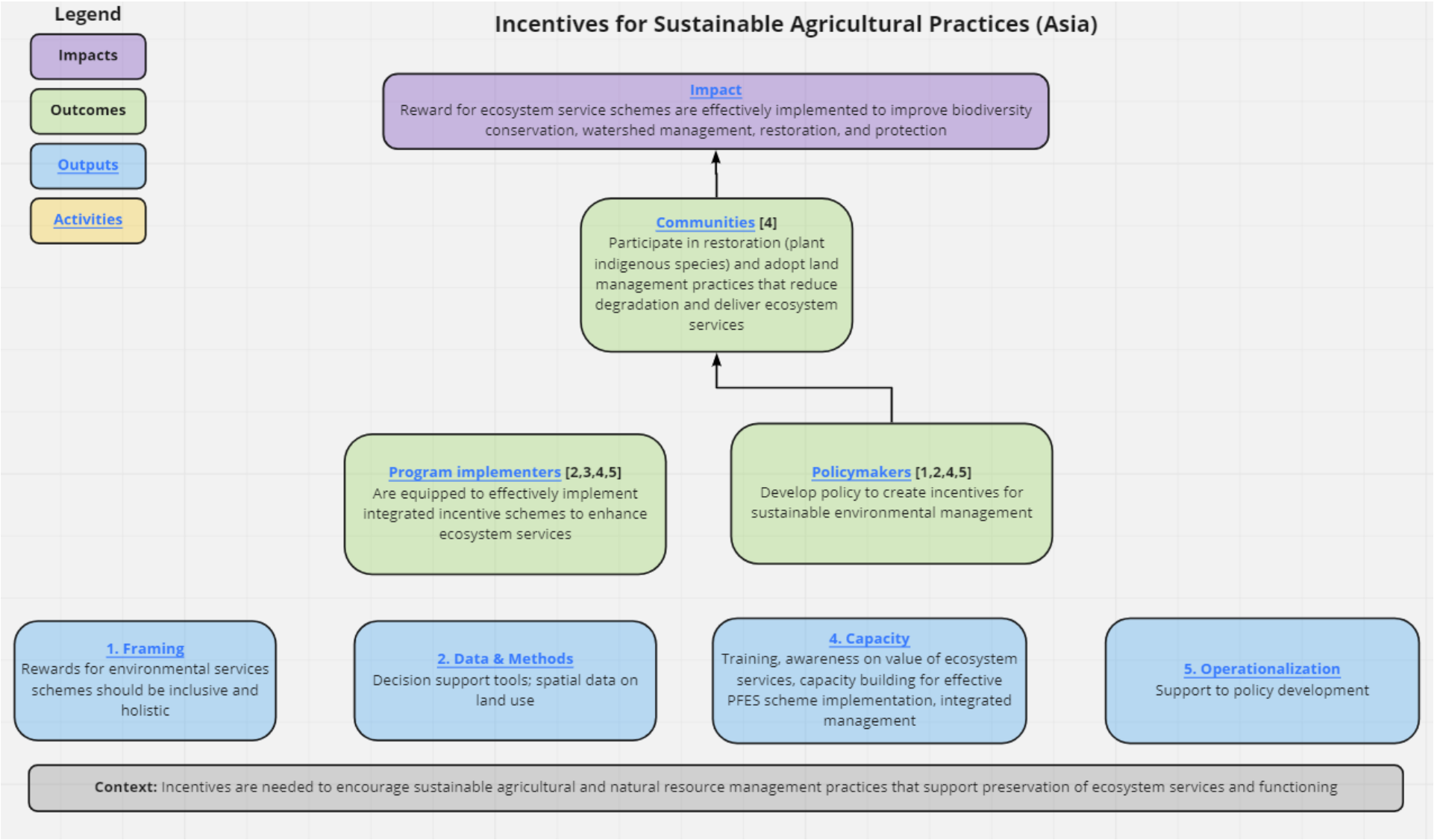


Figure 15. Cluster-level sub-ToC for FTA research on Incentives for Sustainable Agricultural Practices (Asia)

Appendix 2. Disaggregated Cluster Appraisal of Already Existing Evaluation Evidence (by Project) for Challenge 2 (High Prevalence of Degraded Land and Ecosystem Services)

Climate Resilient Cacao (Global) cluster

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Integrated Approach to Improving Yield Efficiency and Resilience to Climate Change through Better Use of Cacao Genetic resources (*Bioversity*) Brazil Colombia Costa Rica Cote D'Ivoire	• 1 Outcome story (2012) • 1 Bioversity Annual report (2012) • 1 Final review report (2017) • 1 Final report (2019)	*low reliability and confidence; all based on limited internal reporting • Researcher outcomes (L): not externally validated • Global strategic cacao collective outcomes (L): not externally validated • Donor outcomes: (M): sustained investment and interest indicated but not externally validated. • Cacao farmer outcomes (L): no primary data	Y (low reliability – not externally validated) [potential]: 500 ha in Colombia	• All outcomes need more detail on capacities built, use of project outputs to support outcome assessments, this is not the focus of available reporting. Available reporting focuses on outputs generated from the project. Impact estimations: Could be derived from a policy review/ adoption study • *Additional document review (policy documents, protocols, trip reports, external media)* • *Interviews/surveys with scientists, members of global strategic cacao collective & farmers in study areas*	*Outcome level:* Possibly. *Impact level:* Possible to collect and quantify (as potential).
Follow on project: Research on heat and drought tolerant cocoa planting material for: An integrated approach to improving yield efficiency and resilience to climate change through better use of cacao genetic resources (*Bioversity)* • Colombia • Costa Rica • Brazil	• 1 Final report (2020) • 1 technical report (2019)	*low reliability and confidence; all based on limited internal reporting • Researcher outcomes (L): not externally validated • Global strategic cacao collective outcomes (L): not externally validated • Donor outcomes: (M): sustained investment and interest indicated but not externally validated. • Cacao farmer outcomes (L): no primary data	N (not available)	• All outcomes need more detail on capacities built, use of project outputs to support outcome assessments, this is not the focus of current reporting. Available reporting focuses on outputs generated from the project. Impact estimations: Could be derived from a policy review/adoption study • *Additional document review (policy documents, protocols, trip reports, external media)* • *Interviews/surveys with scientists, members of global strategic cacao collective & farmers in study areas*	*Outcome level:* Possibly. *Impact level:* Possible to collect and quantify (as potential).

Scaling of Context-Appropriate Agroforestry Systems for Restoration (Global) Cluster

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Regreening Africa: reversing land degradation by scaling up evergreen agriculture (*ICRAF*) • Ethiopia • Rwanda • Somalia • Mali • Niger • Ghana • Sengal	• 1 baseline survey report (2020) • 2 annual reports (2019, 2020) • 1 FTA annual report (2019) • 1 project log (2018-2019) • 2 internal blogs (2019, 2020) • 1 ICRAF annual report (2018)	*moderate-high reliability: multiple internal sources corroborate targets, achievements and strategies employed, but limited critical assessment on extent and how outcomes are realized. *moderate-high confidence: triangulation of information from multiple internal data sources, however, no primary data collection or externally commissioned reports • Farmer outcomes (M): strategy detailed, models indicate uptake, but effects not reported • Seed supplier outcomes: N/A • NGO and extension agent outcomes (L): no details of effects beyond involvement in the project • Government outcomes (M): details of policy engagements, but project contributions not clear • Rural community outcomes (L): strategy to reach community	Y (high reliability, adoption data being collected on an ongoing basis) [target] Evergreen agricultural practices are adopted over an area of at least 1 million ha [achieved] 442,179.1 ha under restoration across the 8 countries	• All outcomes require more precise critical analysis of achievement, outcomes are not currently reported in an actor-specific way. • Government outcomes require more detail on capacities built, and policies influenced Impact estimations: Require validation/updating. • *Interviews/surveys with scientists, partners, participating (lead) farmers.*	*Outcome level:* Yes – annual reporting reports against intended outcomes, so data availability/ the ability to serve multiple needs appears promising. *Impact level:* Yes – preliminary figures are available that require external validation/updating

		specified, but no effects • Researcher outcomes (L): no details beyond convening experts in Kenya in effort to influence and coordinate the land restoration agenda			
SAIRLA: Bringing evidence to bear on negotiating ecosystem service and livelihood tradeoffs in sustainable agricultural intensification (*ICRAF*) • Burkina Faso • Ethiopia • Ghana • Malawi • Tanzania • Zambia	• 1 final report (2020) • 1 FTA final report (2019)	*low reliability: limited self-reported evidence base *low confidence: limited self-reported evidence base • Farmer outcomes (L): not disaggregated • Seed supplier outcomes: N/A • NGO and extension agent outcomes (M): endline survey indicates use of information SAI to design projects and programs / provide direct extension and train farmers • Government outcomes (L): not disaggregated • Rural community outcomes (M): indications that community stakeholders are using knowledge on Sustainable Agricultural Intensification (SAI) • Researcher outcomes: N/A	N (not available in current dataset)	• All outcomes require more precise critical analysis of achievement, outcomes are not reported in an actor-specific way. • Indications that stakeholder disaggregated dataset exists to specify who accessed which knowledge for what use, and how relationships changed. Impact estimations: Require further evidence collection • *Collection of mid-line and end-line surveys used to report stakeholder use of research* • *Interviews/surveys with scientists, partners, participating (lead) farmers.*	*Outcome level:* Possible that more evidence is available. *Impact level:* Yes – possible to obtain hectarage from trial results from application of Tradeoff Analysis Model for Multi-Dimensional Impact Assessment.
Nutrition sensitive forest restoration to enhance capacity of rural communities in	• 1 final report (2019) • 1 internal blog (2016)	*moderate reliability: some external corroboration from farmer testimonial	Y (moderate reliability) [achieved]	• Much of the existing reporting focuses on outputs, more details on actor specific outcome achievements required.	*Outcome level:* Yes – indication that evaluative work is being pursued

Burkina Faso (*Bioversity*) • Burkina Faso	• 1 internal blog (2019) • 1 FTA final report (2019)	*low-moderate confidence: limited internal evidence base, corroboration on only one outcome. • Farmer outcomes (M): farmer testimonial corroborates indications of useful training provided on how the project assisted him to restore degraded land • Seed supplier outcomes (M): indications that the National Tree Seed Centre will have better tools to select appropriate tree species for restoration • NGO and extension agent outcomes (L): self-reported that inventory of innovations helps tiipaalga and NGOs changed their implementation approach in light of findings to increase access to restoration for widows and women • Government outcomes: N/A • Rural community outcomes (L): indicated as potential influence on communities, no assessment • Researcher outcomes (M): students trained, not externally validated	3 ha restored through fencing to protect natural generation of trees, selective tilling, sowing or selectively planting trees [target] 5 million ha (via contribution to Burkina Faso's commitment to AFR100)	• Farmer outcomes require more detail on specific changes resulting from the training they received. • Seed supplier outcomes require evidence of use of the tool to support restoration programs • NGO and extension agent outcomes need validation and specificity of what the project contributed to their work. • Researcher outcomes require more detail on project experience from students trained Impact estimation: Available, but possible to derive more representative/refined figure. • *Interviews/surveys with scientists, partners (tiipaalga), participating farmers, national tree seed centre, user assessment of the tool and its utility/application.*	*Impact level:* Yes - indication that evaluative work is being pursued

PATSPO: Provision of adequate tree seed portfolios (*ICRAF*) • Ethiopia	• 1 ex ante impact assessment (2019) • 1 project brief (2021) • 1 midterm review • 3 FTA Annual reports (2017, 2018, 2019) • 1 ICRAF annual report (2018) • 3 videos (2021, 2021, 2021) • 3 newsletters (2020, 2021, 2021)	* high reliability: rigorous ex ante assessment *moderate-high confidence: multiple internal sources corroborate targets, achievements and strategies employed, but limited critical assessment on extent and how outcomes are realized. • Farmer outcomes (M): training and capacity building initiatives delivered on collection and procurement • Seed supplier outcomes (M): self-reported that seed processing and testing protocols being followed, requires external validation. • NGO and extension agent outcomes (L): require details of use of project outputs, indications that extension training has been provided • Government outcomes (M): requires more detail and external validation; policy influence self-reported via support to the preparation of a tree seed policy; government partner interview • Rural community outcomes (L): support to participatory forest	Y (moderate-high reliability) [potential] 313,000 ha shrubland, grassland, woodland, forest, cropland under restoration [potential] 80, 000 tonnes soil conserved / year via the effect of quality seeds applied over targeted area [target] 8,542,650 ha shrubland, grassland, woodland, forest, cropland under restoration	• All outcomes require external validation • Farmer outcomes require more detail of the benefits realized through training on collection and procurement of tree seeds • Seed supplier outcomes require external validation. • NGO and extension agent outcomes require more detail on their use of project outputs. • Government outcomes require more detail on their use of project outputs, and how the project influenced the development of the tree-seed proclamation • Researcher outcomes require more detail on effects of publications (via bibliometrics) Impact estimation: Requires validation/updating • *Interviews/surveys with scientists, partner (governmental and non-governmental)s, seed suppliers (BSOs), participating farmers* • *Bibliometrics*	*Outcome level:* Yes *Impact level:* Yes

		management agreements indicated • Researcher outcomes (L): over 80 publications produced and disseminated, academic partnership to strengthen delivery system			
Drydev: A regional programme in the Sahel and Horn of Africa, enhancing Food and Water Security for Rural Economic Development (*ICRAF*) • Burkina Faso • Ethiopia • Kenya • Mali • Niger	• 1 external evaluation (2018) • 1 final report (2020) • 1 internal webpage (n.d.) • 1 external webpage (2021) • 3 ICRAF annual reports (2015, 2017, 2018) • 3 FTA annual reports (2017, 2018, 2019)	*moderate-high reliability: external validation through evaluation, but variable specificity in reporting *moderate-high confidence: multiple sources corroborate claims • Farmer outcomes (H): adoption studies and satisfaction surveys completed • Seed supplier outcomes (H): direct provision of seeds through project; facilitated partnerships with farmer organizations to strengthen links • NGO and extension agent outcomes (M): cooperation indicated to be intensive and beneficial • Government outcomes (M): co-development of community action plans indicated, but policy specific integration of outputs unclear, indications that DryDev trainers engaged by country governments to	Y (high reliability, externally validated and tested) [achieved] 265,902 ha degraded land rehabilitated, managed under improved practices (e.g. climate smart, farmer managed rehabilitation)	• NGO and extension agent outcomes require specifics and external validation of learning, uptake of findings, scaling • Government outcomes require evidence of learning, uptake of findings, and specifics of policy influence Impact estimation: Requires validation/updating • *Interviews/surveys with scientists, NGO and extension agents, government representatives*	*Outcome level:* Yes – high degree of overlap between challenges *Impact level:* Not needed

		provide extension services • Rural community outcomes (H): some communities (e.g. in Ethiopia) report benefits in terms of increased provision services (e.g. no longer reliant on government programs), co-ownership of plans, community spirit, application of new training and direct support to restoration of pastures and cattle corridors in communes supported communal land rehabilitation. • Researcher outcomes: N/A			
Community Forestry Tree Seed Banks (CATS Banks) Building Agroforestry Scaling up Platform for Diversifying Livelihood Opportunities in Malawi & Mozambique (*ICRAF*) • Malawi • Mozambique	• 1 internal evaluation (2014) • 1 final report (2012)	*moderate-high reliability: external validation through evaluation, but variable specificity in reporting *moderate-high confidence: multiple sources corroborate claims, representative sample taken • Farmer outcomes (H): externally validated by participating farmers • Seed supplier outcomes (M): direct support by project, establishment of banks and orchards • NGO and extension agent outcomes (M): indications of involvement and improved access	N	• NGO and extension agent outcomes require specificity of changes influenced by the project Impact estimation: Requires work to bring units in line/ further querying • *Additional document review (e.g. trip reports, training materials)* • *Interviews/surveys with scientists, project partners, NGO and extension agents representatives*	*Outcome level:* Possibly – low input to fill gaps *Impact level:* Yes – possible to apply conversions to bring units to ha

		among participants, but influence unclear • Government outcomes: N/A • Rural community outcomes (M): adoption noted to be high to benefit communities through capacity building for diversified livelihoods • Researcher outcomes: N/A			
Agroforestry Food Security Program I & II (*ICRAF*) • Malawi	• 1 internal evaluation (2019) • 1 project webpage (n.d.) • 1 FTA Annual report (2018)	*moderate-high reliability: external validation through evaluation, but variable specificity in reporting *moderate-high confidence: multiple sources corroborate claims • Farmer outcomes (H): external validation from evaluation • Seed supplier outcomes (L): not assessed • NGO and extension agent outcomes (M): assessed to be a gap • Government outcomes (M): more details required • Rural communities (H): effects measured and externally validated through survey • Researcher outcomes: N/A	Y (high reliability, based on adoption studies and surveys) [achieved] 2,117 ha benefitted from restoration measures	• Government outcomes require more detail on lobbying for inclusion of Agroforestry Seed in draft seed Act and whether this was achieved; similar analysis required for district level by-laws. • Seed supplier outcomes require more detail on influence of voluntary germplasm certification, engagement and effects on seed supply and delivery systems. • NGO and extension agent outcomes require assessment and qualification of how the project aimed to and failed to influence these groups through their working arrangement. Impact estimation: available • *Interviews with scientists, nursery operators, partnering NGOs and District Councils*	*Outcome level:* Possibly – low input to fill gaps *Impact level:* Not needed
AFLI I: Agroforestry for livelihoods of	• 1 OICR (2021)	*moderate reliability *moderate confidence	Y [achieved]	• Government outcomes require more detail on contributions to various policies and specifics of project influence.	*Outcome level:*

smallholder farmers in Northwest Vietnam AFLI II: Developing and promoting market-based agroforestry and rehabilitation options for Northwest Vietnam • Vietnam	• 2 Final reports (2019) • 4 peer reviewed papers • 1 technical report – no.24 (n.d.)	• Farmer outcomes (H) • Seed supplier outcomes (M) • NGO and extension agent outcomes (M) • Government outcomes (H) • Rural communities (M) • Researcher outcomes (M)	6,200 ha of degraded land were planted with son tra in Yen Bai province [achieved] 3,820 ha of existing son tra plantations were rehabilitated through better germplasm and management practices **[Total achieved: 10,254 ha]** [potential] 1.4 million ha could be under son tra agroforestry	• NGO and extension agent outcomes require more detail of project contributions to their practices and benefits received from training (e.g. farmer field day training) • Seed supplier outcomes require details of nursery establishment and project contributions • Community outcomes require details of benefits to adopting agroforestry, and how many people are benefiting from new government programs (incentive schemes). Impact estimation: available, may be useful to investigate carbon sequestration, soil, biodiversity, and water effects. • *Interviews with scientists, government representatives/policymakers, NGOs, extension agents, farmers* • *Provincial policy review (Yen Bai provincial Decision 2412/QD-UBND; Yen Bai provincial Resolution15/2015/NQ-HDND; Yen Bai provincial Decision 27/2015/QD-UBND)* • *National policy review (National Action Plan Framework for Adaptation and Mitigation of Climate Change of the Agriculture and Rural Development Sector (2008-2020); National Decision no. 1055/QD-TTg (by Prime Minister) Decision on the promulgation of the national plan to adapt to climate-change period 2021 - 2030, with a vision to 2050; MARD Decision no. 156/QD-BNN-KHCN)*	Pursued as Challenge 4 deep dive *Impact level:* Pursued as Challenge 4 deep dive
Indonesian Rural Economic Development (*ICRAF*) • Indonesia	• 3 project reports (plan, midterm, annual)	*moderate reliability *moderate confidence • Farmer outcomes (H) • Seed supplier outcomes: n/a • NGO and extension agent outcomes (M) • Government outcomes (L): no evidence • Rural communities (M)	Y (moderate reliability) [achieved] 120 ha of farmer demonstration plots rehabilitated through planting 24,671 quality seedlings	• Farmer outcomes require external validation of project contributions to new practices and adoption • Government outcomes require more detail on contributions to the expected contribution to the water management committee regulations to increase availability of water to farms • Extension agent outcomes require external validation of farmer demonstration trials and benefits • Community outcomes require details of benefits to adopting agroforestry	*Outcome level:* Possibly, low input to fill gaps *Impact level:* Low potential quantification, but worth checking for soil, water, biodiversity quantification.

		• Researcher outcomes: n/a	21 farmer managed natural rehabilitation plots were established to demonstrating intercropping over 20-25 ha each = 420 ha. **[Total achieved: 540 ha]** [target potential] 5000 ha of land is rehabilitated	Impact estimation: available but would benefit from ground truthing/update may be useful to investigate carbon sequestration, soil, biodiversity, and water effects as these are qualified but not quantified. Indications that data is available for soil effects for intercropping practices. • *Interviews/surveys with scientists, government representatives/policymakers (e.g. members of water management committee), participating extension agents, farmers*	

Forest Landscape Restoration (Global)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
DFID KNOWFOR 2: FLR SLANT (*CIFOR*) • China • Ethiopia • Brazil • Mexico • Peru • Colombia	• 1 CIFOR annual report (2017) • 1 news release (2017) • 1 project annual report (2017)	*low reliability *low confidence • Government outcomes n/a • Partner outcomes: n/a • Private sector outcomes n/a • Policymaker outcomes (L) • Community outcomes: n/a	Y (low reliability – needs external validation) [potential/target] 2 million ha of planted forest in Peru	• Policymaker outcomes require evidence of learning and policy changes to which the project contributed. Impact estimates require assessment of policies noted to have been influenced • *Additional document review (project documents, policy documents, trip reports, external media)* • *Interviews/surveys with national policymakers, partners, research team, community* • *Quantification for impact estimation:* policy analyses and impact assessments to which the project contributed	*Outcome level:* No, Significant gaps. *Impact level:* May be possible to ground truthing validate Peru figure externally
Sloping Lands in Transition: Land use change and smallholder adaptive capacity (*CIFOR*) • Bhutan	• 1 project brief (2019) • 1 midterm report (2019) • 1 final report (2019)	*reliability: low (self-reported sources) *confidence: low • Government outcomes (L): no evidence • Partner outcomes (L): limited evidence • Private sector outcomes: n/a • Policymaker outcomes (L) • Community outcomes (M)	N	• Government outcomes: need evidence of government learning and attitudinal change; need evidence of inclusive and evidence-based policy development; need evidence of uptake of project outputs • Partner outcomes: need evidence of uptake of project outputs; need evidence of support for sustainable forest management planning • Policymaker outcomes require details of policy development and contributions on restoration, water ecosystem services, and climate change • Community outcomes: need more detail of oak forest replanting initiative and PFES negotiations/opportunities Impact estimations: Is it possible to determine the hectarage of study sites? • *Additional document review (project documents, policy documents, trip reports, external media)* • *Interviews/surveys with governments, partners, research team, community*	*Outcome level:* No, substantial evidence gaps require intensive data collection *Impact level:* Possible

				• *Quantification for impact estimation: calculate area of study sites/ oak forest replanting initiative on barren land*	
Opportunities for tropical forest and landscape restoration: A Public Forum by Sarawak State Government: Developing policy to ensure restoration of strategy and policy to successfully restore productive forest (*Bioversity*) • Malaysia	• 1 outcome story • 1 workshop report (2017) • 1 government website (2021)	*reliability: moderate (external & self-reported sources) *confidence: high • Government outcomes (H) • Partner outcomes: n/a • Private sector outcomes (L): limited evidence • Policymaker outcomes: (H) • Community outcomes (L): limited evidence	Y (higher reliability, impact reported on external government website) [potential/target] 200,000 ha were identified as priority areas for restoration (include degraded forests on state land, degraded Totally Protected Areas, buffer zones) [achieved] 9,732 ha restored to date	• Government outcomes: need more detail of technical capacities built, learning and output uptake; need evidence of policy implementation • Private sector outcomes: need more detail of licensing; need evidence of restoration investments • Community outcomes: need more detail of community involvement in multi-stakeholder processes; need evidence of restoration activities undertaken Impact estimations: Requires ground truthing / external validation. • *Additional document review (policy documents (DF Circular No. 2/2019; DF Circular No. 10/2018) project documents, trip reports, external media)* • *Interviews/surveys with governments (Ministry of Urban Development and Natural Resources, Forest Department), private sector actors (Sarawak Timber Industry Development Corporation, Sarawak Timber Association, Sarawak Forestry Corporation, Harwood Timber), community members, any other stakeholders (e.g. University Putra Malaysia) who attended the public forum*	*Outcome level:* Preliminary evidence of policy influence is promising, but key gaps remain *Impact level:* Possible
Alliance for Forestry Innovation in India – Innovation in Ecosystem Management and Conservation (*Bioversity*) • India	• 1 midterm progress report (2017) • 1 external website (2017)	*reliability: moderate (external & self-reported sources) *confidence: high • Government outcomes (L): limited evidence • Partner outcomes (L): no evidence • Private sector outcomes: n/a • Community outcomes (H)	N	• Government outcomes: need more detail of Forest Department learning and attitudinal change; need evidence of governmental support to supply saplings and changes to which the project may have contributed • Partner outcomes: need evidence of NGO learning; need evidence of NGO support to communities post-project • Community outcomes: need more detail on uptake of biodiversity management tools, Narmada River Rehabilitation Program in Mandla and nursery establishment contributions of the project, and perceived effects Impact estimations: Is it possible to determine the area under restoration/NTFP planting?	*Outcome level:* No - significant evidence gaps remain *Impact level:* No – likely not feasible to collect

				• *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with governments, partners, research team, community* • *Quantification for impact estimation: quantification of area under restoration by NTFP planting / where biodiversity management tools are applied?*	

Bioeconomy development to restore degraded land (Asia & Africa)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Bamboo as sustainable biomass energy (*INBAR*) • Ethiopia • Ghana	• 1 OICR (2020) • 1 powerpoint presentation • 2 INBAR annual reports (2012, 2013) • 1 project website (n.d.)	*moderate reliability: no external validation/primary data *moderate confidence: no external validation/primary data • Smallholder and SME outcomes (M): training figures provided with limited details of project contribution • Private sector outcomes N/A • Policymaker outcomes (M) limited evidence for connection between project outputs and policy outcomes • Bamboo community outcomes (L)	Y (moderate reliability, internally reported) [achieved] Bamboo planted on 1200 ha in pilot sites in Ethiopia; 80 ha in Ghana; 240 ha in Madagascar; 80 ha in Tanzania	• SME and smallholder outcomes require specific details of how INBAR facilitated the establishment of 216 enterprises, and facilitated the use of stoves • Policymaker outcomes require details of project influence on learning, attitudes, relationships and connect with subsequent changes in policy (e.g.. in Ghana adopting bamboo into national biomass energy policy, and strategic plan development) • Bamboo community outcomes require assessment of uptake and validation of effects of project contributions Impact estimates need more detail on effects in terms of water cycling, soil fertility, and carbon sequestration effects. • *Interviews with project participants* • *Additional document review: policy documents, external media* • *Consultation with biophysical scientist to advise on quantifying effects on other ecosystem services (beyond provision)*	*Outcome level:* Possibly with case study in Ethiopia to collect stakeholder perspectives for external validation *Impact level:* Not needed
South-South Knowledge Transfer Strategies (*INBAR*) • Tanzania	• 1 OICR (2021) • 1 video (2017)	*moderate reliability: no external validation/primary data	Y (moderate reliability, internally reported, but triangulated	• SME and smallholder outcomes require external validation for trainings provided • Policymaker outcomes require details of project influence on learning, attitudes, relationships and	*Outcome level:* Possibly with case study in Ethiopia to collect stakeholder

• Ethiopia • Madagascar	• 1 project brochure (2019) • 1 INBAR annual report (2018) • 1 project website (n.d.)	*moderate confidence: no external validation/primary data • Smallholder and SME outcomes N/A • Private sector outcomes N/A • Policymaker outcomes (M) limited evidence for connection between project outputs and policy outcomes • Bamboo community outcomes (M): outcomes and benefits from training requires external validation	across internal sources) [achieved] Bamboo planted on 357.86 ha of degraded land	connect with subsequent changes in policy (e.g.. national development strategies) • Bamboo community outcomes require assessment of uptake and require external validation for trainings provided Impact estimates need more quantification on effects in terms of water cycling, soil fertility, and carbon sequestration. Indications that bamboo has a positive effect. • *Interviews with project participants* • *Additional document review: policy documents, external media* • *Quantification of effects observed on pilot plots in terms of soil water holding capacity, reducing soil erosion, controlling silt and sequestering carbon.*	perspectives for external validation *Impact level:* Not needed
Dutch-Sino East Africa Bamboo Development Programme (*INBAR*) • China • Ethiopia • Kenya • Uganda	• 1 OICR (2019) • 1 FTA news article (2020) • 4 INBAR annual report (2017, 2018, 2019, 2020) • 1 project website (n.d.) • 1 external evaluation	*moderate reliability: no external validation/primary data *moderate confidence: triangulation of internal sources • Smallholder and SME outcomes (M): training details provided, led to behaviour change (i.e. planting bamboo), no external validation • Private sector outcomes (M): requires external validation • Policymaker outcomes (M): requires external validation • Bamboo community outcomes (M): requires external validation	Y (moderate reliability, internally reported, but triangulated across sources) [achieved] Bamboo planted on 1465.9 ha of degraded land [potential] Bamboo could cover 17,000 ha of degraded land in Kenya, Uganda, and Ethiopia	• SME and smallholder outcomes require external validation for trainings provided and subsequent learning • Private sector outcomes require detail of the NGO-Community-Private Sector-Partnership (NCPP) model, and stakeholder perceptions of project's contribution to this. • Policymaker outcomes require details of project influence on learning, attitudes, relationships and connect with subsequent changes in policy (e.g.. development of bamboo strategies and action plans) • Bamboo community outcomes require assessment of uptake and require external validation for trainings provided, and benefits from the bamboo sector and the NCPP model Impact estimates need more quantification on effects in terms of water cycling, soil fertility, and carbon sequestration. Indications that bamboo has a positive effect. • *Interviews with project participants* • *Additional document review: policy documents, external media*	*Outcome level:* Possibly with case study in Ethiopia to collect stakeholder perspectives for external validation *Impact level:* Not needed

				• *Consultation with biophysical scientist to advise on quantifying effects on other ecosystem services (beyond provision)*	
Inter-Africa Livelihood Development Programme (*INBAR*) • Ethiopia • Cameroon • Ghana • Madagascar	• 1 OICR (2021) • 1 FTA news article (2019) • 1 INBAR annual report (2019) • 1 project website (n.d.)	*low reliability: project in early stages of development *low confidence: project in early stages of development • Smallholder and SME outcomes (M): training reported • Private sector outcomes N/A • Policymaker outcomes (M) • Bamboo community outcomes (M)	N (not available in current dataset)	• SME and smallholder outcomes require external validation for trainings provided and subsequent learning in terms of climate change adaptive capacities, and assessment of uptake • Policymaker outcomes require details of project influence on learning, attitudes, relationships and assessment of intended changes in policy (e.g.. National Bamboo Strategic Plan for Ghana, integration in national sustainable development plans, and programs particularly for climate change) • Bamboo community outcomes require assessment of uptake and require external validation for trainings provided in terms of climate change adaptive capacities Impact estimates need more quantification on effects in terms of water cycling, soil fertility, and carbon sequestration. Indications that bamboo has a positive effect. • *Interviews with project participants* • *Additional document review: policy documents, external media* • *Consultation with biophysical scientist to advise on quantifying effects on other ecosystem services (beyond provision)*	*Outcome level:* Possibly with case study in Ethiopia to collect stakeholder perspectives for external validation *Impact level:* Possibly
Socio economic and environmental benefits of bioenergy production on degraded land in Indonesia (*CIFOR*)	• 3 technical reports (2019,2020)	Low-moderate reliability • Smallholder and SME outcomes (M): training reported • Private sector outcomes N/A • Policymaker outcomes: N/A • Community outcomes (M)	[achieved] 17 ha of nyamplung demonstration trials established to assess suitability for restoring peatland	• All outcomes require external validation Impact estimates need more quantification on effects in terms of water cycling, soil fertility, and carbon sequestration. Indications that nyamplung has a positive effect, but is not quantified. • *Interviews with project participants* • *Consultation with biophysical scientist to advise on quantifying effects on other ecosystem services (beyond provision)*	*Outcome level:* Possibly with key participants in trials *Impact level:* already have, but would benefit from ground truthing

REDD+ Policy Mechanism (Global)

FTA Outcome Assessment and Impact Estimation: Challenge 2 (High Prevalence of Land and Ecosystem Service Degradation)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Learning from REDD: A Global Comparative Analysis (Phase 1 of GCS REDD+ Program) (*CIFOR*) • Indonesia • Vietnam • Nepal • Brazil • Peru • Bolivia • DRC • Tanzania • Cameroon	• 1 evaluation report (2015)	*external evaluation – higher reliability *confidence: high • Government outcomes (H) • Partner outcomes (H) • Research outcomes (H): evidence of method uptake and use • Private sector outcomes (L): no evidence	Y (noted in an Indonesian policy [forest moratorium?] – sensitive to assumptions) [potential/target] 26% reductions in GHG emissions by 2020	• Government outcomes: need more detail on capacities built, gov'tal use of project outputs (what is being used and how) • Private sector outcomes: need evidence of private sector learning via project influence, evidence of uptake and use, evidence of practice changes (via policy or research) Impact estimations: Could be derived from a policy review (e.g., Indonesia's forest moratorium, others?) • *Additional document review (policy documents, project documents, trip reports, external media)* • *Interviews/surveys with governments, private sector* • *Quantification for impact estimation: borrow target estimates from gov't policy?* • [potential] Indonesia's forest moratorium (reduce GHG emissions by 26% by 2020)	*Outcome level:* Pursued for Challenge 1 Deep Dive *Impact level:* Pursued for Challenge 1 Deep Dive.
Learning from REDD+: An enhanced global comparative analysis (Phase 2 of GCS REDD+ program) (*CIFOR*) • Cameroon • Tanzania • Indonesia • Vietnam • Brazil • Peru • (a subset of activities done in Burkina Faso, DRC, Mozambique,	*same as above	*same as above	*same as above	*same as above	*same as above

Papua New Guinea, Nepal, Bolivia, Guyana)					
Opportunities and Challenges to Developing REDD+ Benefit Sharing Mechanisms in Developing Countries (accompanying phase 2 of GCS REDD+ program) (*CIFOR*) • Brazil • Cameroon • Indonesia • Peru • Tanzania • Vietnam	• 1 evaluation report (2018) • 1 outcome story (2016)	*external evaluation – higher reliability *confidence: high • Government outcomes (M): needs more detail on type of learning • Partner outcomes (M): needs more detail on practice change among actors/networks supporting cross-sector approaches for low emissions dev't • Research outcomes (M): indications of uptake/use • Private sector outcomes (M): indications of MRV adherence/uptake?	Y (higher reliability impact estimations noted in evaluation report and outcome story) [achieved] 1,015,760 ha PFES forest area where FTA supported monitoring and evaluation system development and implementation and is experiencing improvements in ecological conditions [potential] Vietnam's PFES monitoring and evaluation system targets 6.5 million ha of forest area	• Government outcomes: need more detail on learning, gov't uptake/use of project outputs, changes in policy • Partner outcomes: need evidence of partner learning, evidence of support/advocacy for practice change • Research outcomes: uptake and use of project outputs • Private sector outcomes: evidence of learning, evidence of practice changes (e.g. adherence to MRV) <u>Impact estimations:</u> Could be derived from a policy review policy review (e.g., Peru REDD+ Benefit Sharing Strategy, Vietnam PFES, etc.)? • *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with gov't, partners, research team, private sector* • *Bibliometric analyses* • *Quantification for impact estimation: Policy review*	*Outcome level:* Pursued for Challenge 1 Deep Dive *Impact level:* Pursued for Challenge 1 Deep Dive
REDD: Research to Support Design and Implementation (accompanying phase 2 of GCS REDD+ program) (*CIFOR*) • Indonesia • Vietnam • Papua New Guinea • Nepal	• 1 final report (2015) • 1 outcome story (2017) • 1 evaluation report (2015)	*external evaluation, self-reported – varying reliability *confidence: high • Government (H): evidence for Brazil, Vietnam, Peru • Partners (L/M): COP and UNFCC participation but unclear whether evidence used to help inform decisions • Research (L): lacks specificity, need details	Y (impact estimations noted in outcome stories) – self-reported [potential] Vietnam (PFES budget supports forest protection) [potential] Peru (national strategy for climate change, national	• Government outcomes: need more detail on learning, gov't uptake/use of project outputs, changes in policy • Partner outcomes: need evidence of partner learning, evidence of support/advocacy for practice change • Research outcomes: uptake and use of project outputs • Private sector outcomes: evidence of learning (e.g., via pilots), evidence of practice changes <u>Impact estimations:</u> Could be derived from a policy review policy review (Vietnam, Peru)?	*Outcome level:* Pursued for Challenge 1 Deep Dive *Impact level:* Pursued for Challenge 1 Deep Dive

• Tanzania • Burkina Faso • Mozambique • Cameroon • Peru • Brazil • Bolivia		of country-level partnerships with young academics • Private sector (L): minimal evidence in Vietnam about pilot implementation	commitment to climate change)	• *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with gov't, partners, research team, private sector* • *Bibliometric analyses* • *Quantification for impact estimation: Policy review?*	
A Global Comparative Study for achieving effective, efficient and equitable REDD+ results (Phase 3 of GCS REDD+ program) (*CIFOR*) • Brazil • Indonesia • Peru • Ethiopia • Guyana • Myanmar • DRC • Vietnam	• 1 midterm review/evaluation report (2019) • 1 external evaluation report (2021)	*external evaluation – higher reliability *confidence: high • Government outcomes (M): needs more detail on type of learning • Partner outcomes (M): needs more detail on practice change among actors/networks supporting cross-sector approaches for low emissions dev't • Research outcomes (M): indications of uptake/use • Private sector outcomes (M): indications of MRV adherence/uptake?	Y (not quantified – qualified in terms of improving target countries to achieve and assess carbon and non-carbon benefits)	• Government outcomes: need more detail on learning, gov't uptake/use of project outputs, changes in policy • Partner outcomes: need evidence of partner learning, evidence of support/advocacy for practice change • Research outcomes: uptake and use of project outputs • Private sector outcomes: evidence of learning, evidence of practice changes <u>Impact estimations:</u> Possible to derive from policy mechanisms? • *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with gov't, partners, research team, private sector* • *Bibliometric analyses* • *Quantification for impact estimation: policy analyses for targets*	*Outcome level:* Pursued for Challenge 1 Deep Dive *Impact level:* Possible to collect and quantify?
From Climate Research to Action under Multilevel Governance: Building Knowledge and Capacity at Landscape Scale (MLG) (*CIFOR*) • Indonesia • Mexico • Peru	• 1 final report (2019)	*self-reported – lower reliability *confidence: moderate • Government outcomes (M): indication of project inputs to and uptake in countries' national REDD+ and climate change strategies and MRV system • Partner outcomes (L) • Research outcomes (L)	N	• Government outcomes: need evidence of gov't learning, evidence on capacity-building, need more detail on gov't uptake/use of project outputs, evidence of changes in policy and implementation of policy • Partner outcomes: need evidence of partner learning and capacity-building, evidence of support/advocacy for policy and practice change • Research outcomes: uptake and use of project outputs (e.g., methods, data) by researchers • Private sector outcomes: evidence of learning, evidence of practice changes	*Outcome level:* Pursued for Challenge 1 Deep Dive *Impact level:* Pursued for Challenge 1 Deep Dive

• Vietnam		• Private sector outcomes (L): indication of learning via GLF, indication of PS commitment to addressing climate change		Impact estimations: is it possible to use policy targets for the specific countries' National REDD+ and Climate Change Strategies where project influence can be traced? • *Additional document review (policy review, project documents, trip reports, external media)* • *Interviews/surveys with gov't, partners, research team, private sector* • *Bibliometric analyses* • *Quantification for impact estimation: policy analysis*	
SECURED Landscapes: Sustaining Ecosystem and Carbon benefits by Unlocking Reversal of Emissions Drivers in Landscapes (*ICRAF*) • Cameroon • DRC • Indonesia • Vietnam • Peru	• 1 final report (2016) • 1 external website (2018) • 1 evaluation (2014)	*reliability: moderate-high *confidence: moderate • Government outcomes (H): indications of learning/training, indication of Indonesian province-level and use of tools, evidence of NDC contributions, indications of gov't interest in LUWES tool (Peru, Cameroon, Vietnam) • Partner outcomes (L): indication of TMP continued involvement • Private sector outcomes (M): 24 Peruvian companies involved in carbon market (measure, management, offsetting emissions); Indonesian company (WKS) did calculations and defined a mitigation plan • Research outcomes (L)	Y (projected) – questionable reliability [target] total of 1,210,682 ha of landscapes covered by forests and total 660,234 ha of landscapes covered by sustainable land use plans (e.g. low emissions development strategies) in Cameroon, Peru, Indonesia, and DRC [potential] estimated potential emissions reductions over 1 year (6,081,361 tonnes CO^2) [achieved] 714 ha of sustainable land use plans developed in	• Government outcomes: need more detail on learning, more detail on capacities built, need evidence of gov'tal use of project outputs (what is being used and how) (e.g., LUWES tool, recommendations) • Partner outcomes: need evidence of partner learning, partner support/advocacy for REDD policy dev't/implementation • Private sector outcomes: need evidence of private sector learning via project influence, evidence of research uptake and use, more detail and evidence of practice changes (via policy or research) • Research outcomes: uptake and use of project outputs Impact estimations: Already have. • *Additional document review (policy analysis, project documents, trip reports, external media)* • *Interviews/surveys with governments, private sector* • *Bibliometric analyses* • *Quantification for impact estimations: policy analysis, ground-truthing/remote sensing?*	*Outcome level:* TBD. Existing evidence has some promising indications that require evidence. *Impact level:* Requires ground truthing

			Tanjabar, Indonesia [potential] 68,000 ha covered by low emissions development strategies in Ba Be, Vietnam [achieved] 212 ha piloted under a community forestry management scheme in Bac Kan, Vietnam [achieved] 6,000 ha covered by a sustainable land use management plan in Padre Abad, Peru [achieved] 3,000 ha of farms adopted cocoa management models [achieved] 10,000 ha of pilots implemented in DRC		

Innovation for Resilient Landscape Restoration (Latin America)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Laying the foundations for climate-smart restoration: a toolkit for Peru's tropical	• 1 blog (2020) • 1 internal evaluation report (n.d.) • 1 final report	* moderate reliability: workshop surveys, primary data collection with some key target audiences *moderate confidence: corroboration of internal	Y (low-moderate reliability) [achieved] 10 ha community protection of degraded dry forest	• National government outcomes require details of use of the Diversity for Restoration tool • Restoration program implementer outcomes require assessment of extent of use of the Diversity for Restoration tool (e.g. in which	*Outcome level:* Possibly. *Impact level:* Requires ground-truthing

dry forest (*Bioversity, CIAT*) • Peru	• 2 external project identification forms (2020, 2020) • 1 external project review form (2020)	sources, validated with primary data collection • National government outcomes (L) • Donors outcomes: n/a • Restoration program implementers (M): indications that the tool is useful to diverse audiences, and shows evidence of learning and intentions to use (NGO, researcher, government) • Smallholder outcomes (L)	for natural rehabilitation [potential] 400,000 ha is restored using the tool (PIP Verde project); 2,278 ha is restored using the tool (GEF project in Peru); 6,000 ha restored using the tool (GEF project in Madagascar) [target] 3.2 million ha degraded land is restored if tool is scaled	projects, where, and over which area it has been applied in Burkina Faso, Peru, Colombia) • Smallholder outcomes require details of effects observed in landscapes where the tool has been applied to restore land, how the project supported the community to in protection of dry forest, nursery establishment and implementation of seed harvest and propagation projects. Impact estimations: Could be further ground truthed with assessment of PIP Verde implementation • *Additional document review (restoration program documents, project documents, trip reports, external media)* • *Interviews/surveys with project researchers, those involved in PIP Verde, GEF 7, and familiar with the tool* • *Use metrics of the diversity4restoration tool* • *Quantification for impact estimation: check for PIP Verde evaluation and indicated Bioversity evaluation*	
Associar recursos, capacidades y competencias tecnicas y cientificas para el diseno de protocols de restaruacion ecologia del bosce seco tropical (*Bioversity*) • Colombia	• 1 outcome story	*low-moderate reliability: self-reported (outcome story) *low confidence: no triangulation • National government outcomes (L): only aspirations through partnership • Donors outcomes: n/a • Restoration program implementers (M): indications of uptake to support restoration program in Medellin • Smallholder outcomes (L)	Y (moderate reliability) [achieved] 13,000 ha of forest lost due to hydroelectric dam construction now under restoration informed by the tool	• National government outcomes require details of uptake of tools and learning from project through partnership with national research institute • Restoration program implementer outcomes require details of application of the species selection tool to restoration programs at national and local scales. • Smallholder outcomes require details of effects observed in landscapes where the tool has been applied to restore land , how the project supported the community to in protection of dry forest, nursery establishment and implementation of seed harvest and propagation projects. Impact estimations: Could be further ground truthed by checking the source and validating with restoration program staff in Medellin. • *Additional document review (restoration program documents, project documents, trip reports, external media)*	*Outcome level:* Possibly. *Impact level* Requires ground-truthing

				• *Interviews/surveys with project researchers, Colombian government officials, and restoration program staff in Medellin* • *Use metrics of the map-based tool* • *Quantification for impact estimation: verify the source of the number provided in the outcome story / with staff at the department in Medellin responsible for the restoration initiative.*	
Seed Systems in restoration under 20x20 initiatives (*Bioversity*) • Colombia • Peru • Mexico • Guatemala • Costa Rica • Chile • Argentina	• 1 report (2018)	*low reliability *low confidence • No evidence of outcomes	N (not available in current dataset)	• All outcomes require details and evidence (national government, restoration program implementers, donor, and smallholder learning and behaviour change) Impact estimations: Requires assessment of effects of a fit for purpose seed system to supply sufficient quality and quantity of seeds for restoration. • *Additional document review (restoration program documents, project documents, trip reports, external media)* • *Interviews/surveys with target groups of interest*	*Outcome level:* No, insufficient existing evidence base, not feasible given time and resources. *Impact level:* No.
Tool-based innovations (i.e. not project specific)					
Tool	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this tool be prioritized for additional evidence?
Land Degradation Surveillance Framework (LDSF) • 30 countries	• 1 poster (2020) • 1 blog (2015) • 1 working paper (Gitz et al. 2020)	*moderate reliability *moderate confidence • National government outcomes: no evidence • Restoration program implementers (L): indications of relevance and utility, but no external validation • Smallholder outcomes: no evidence	Y 2.5 m ha under enhanced surveillance for land/ecosystem health	• All outcomes require details and evidence (national government, restoration program implementers, and smallholder learning and behaviour change) Impact estimations: Requires checking LDSF data points for FTA project areas. • *Additional document review (restoration program documents, project documents, trip reports, external media, partner project documentation)* • *Interviews/surveys with site managers, researchers and users of the LDSF.*	*Outcome level:* Possibly *Impact level:* Possibly
Agroforestry Species Switchboard • Global	• 1 OICR (2021)	*moderate reliability *moderate confidence • National government outcomes: no evidence • Restoration program implementers (M):	N	• All outcomes require details and evidence (national government, restoration program implementers, and smallholder learning and behaviour change) Impact estimations: Requires checking with restoration program implementers who have accessed the switchboard	*Outcome level:* No, ultimately contingent on utility of linked databases

		download metrics indicate high use/utility, requires external validation • Smallholder outcomes: no evidence		• *Additional document review (restoration program documents, project documents, trip reports, external media, partner project documentation)* • *Interviews/surveys with site managers, researchers and users of the Switchboard*	*Impact level:* No
Vegetationmap4africa • Nepal • Burundi • Ethiopia • Kenya • Malawi • Rwanda • Tanzania • Uganda • Zambia	• 1 FP outcome story (2016)	*moderate reliability *moderate confidence • National government outcomes: no evidence • Restoration program implementers (L): indications of promising activities with partners but no report of outcomes • Smallholder outcomes: N/A	N	• All outcomes require details and evidence (national government, restoration program implementers, and smallholder learning and behaviour change) Impact estimations: Requires checking with restoration program implementers who have accessed the switchboard • *Additional document review (restoration program documents, project documents, trip reports, external media, partner project documentation)* • *Interviews/surveys with site managers, researchers and users of the map and the application*	*Outcome level:* No *Impact level:* No

Agroforestry Concessions in Peru

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Support to the Development of Agroforestry Concessions in Peru (SUCCESS) (*ICRAF*) • Peru	• 1 outcome evaluation report (2019) • 2 press releases (2018, 2018) • 1 peer reviewed article (2015) • 1 ICRAF final report (2018) • 1 FTA final report (2019)	*external evaluation – higher reliability *confidence: high Government outcomes (H): policy changes too nascent Partner outcomes (H) Research outcomes (M/H): low evidence of external researcher uptake Smallholder outcomes (L): low primary evidence from smallholders/ farmers associations	Y moderate reliability (based on expert consultations and external documents) [lower level achievement] Farmers must conserve forest remnants, ≥ 20% of concession area needs to be under sustainably managed	• Government outcomes: update on gov'tal support for AFCs, update on AFC policy implementation, update on San Martín pilot • Partner outcomes: update on partner involvement in AFC issues • Research outcomes: update on external uptake of SUCCESS outputs • Smallholder outcomes: need more detail on smallholder learning and changed practices, update on San Martín pilot Impact estimations: Already have for ha under restoration and Co2, could check for effects in terms of water, biodiversity, and soil quality. • *Interviews/surveys with governments, partners, research team, smallholders (e.g., those involved in San Martín pilot)*	Pursued for Challenge 3 deep dive

			agroforestry, including implementation of soil and water conservation measures 193 ha covered under the 33 contracts issued = **36.8 ha** *80tC/ha* 3.7Co2 conversion = **7155.5 tonnes Co2 sequestered** [upper limit achievement] 120.87 ha under restoration (assumes all AFC land is under restorative practice) = **193 ha***80tC/ha* 3.7 Co2 conversion =**57,128 tonnes Co2 sequestered** [lower limit potential] 1 million ha of land and 452 000 ha of forest eligible for AFCs = total of 1.452 million ha (applying 20% stipulation as per mechanism) = **290,400 ha** under restoration *80tC/ha* 3.7 Co2 conversion = **85, 958, 400**	• *Bibliometric analyses* • *Quantification for impact estimation: borrow potential estimates quantified by project*	
Peru's Agroforestry Concessions Scheme: Collaborative Action to secure Multi-level Readiness for Implementation of an Innovative, Transformative Policy Project *(ICRAF)* • Peru	• 4 press releases (2020, 2021, 2021, 2021)	*reliability: high (external sources) *confidence: high Government outcomes (L) • Partner outcomes (L)		• Government outcomes: need evidence on governmental attitudes/support for AFCs, evidence of governmental capacity-building, evidence of changes in relationships • Partner outcomes: need evidence on partner support for AFCs (e.g., GGGI, SPDA) and changes in relationships • Research outcomes: need evidence on researcher capacity-building and changes in relationships • Smallholder outcomes: need evidence on smallholder learning and capacity-building from pilots, evidence of changes in smallholder practices Impact estimations: Already have for ha under restoration and Co2, could check for effects in terms of water, biodiversity, and soil quality. • *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with gov't, partners, research team, smallholders (e.g., pilot participants)*	
PARA: Piloting approaches to rural advisory services in support of scaling of the Agroforestry Concessions scheme in Peru *(ICRAF)* • Peru	• No evidence	No evidence		• Government outcomes: need evidence on governmental attitudes/support for AFCs and pilots, evidence of governmental capacity-building, evidence of changes in relationships • Partner outcomes: need evidence on partner involvement in AFC issues and changes in relationships • Research outcomes: need evidence on researcher capacity-building and changes in relationships • Smallholder outcomes: need evidence on smallholder learning and capacity-building from pilots, evidence of changes in smallholder practices Impact estimations: Already have for ha under restoration and Co2, could check for effects in terms of water, biodiversity, and soil quality. • *Additional document review (project documents, trip reports, external media)*	

			tonnes Co2 sequestered [upper limit potential] **1.452 million ha** * *80tC/ha* 3.7 Co2 conversion = **429 792 000 tonnes Co2 sequestered**	• *Interviews/surveys with gov't, partners, research team, smallholders (e.g., pilot participants)* • *Quantification for impact estimation: borrow potential estimates quantified by project* [beware of double-counting]	

Research Capacity Building for Sustainable Forest and Agricultural Land Management and Restoration in the DRC

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
REFORCO (Appui a la politique Nationale de conservation et gestion des forets et de la biodiversite en republique democratique du Congo) (*CIFOR*) • DRC	• 1 final report (2016) • 1 CIFOR annual report (2018)	* moderate reliability (external evaluation surveys conducted on Master and Doctoral programmes) *moderate confidence • University of Kisangani outcomes (H) • Local researcher outcomes (H) • Development practitioners and policymaker outcomes (L) • Farming and forestry community outcomes: n/a	N	• Development practitioner and policymaker outcomes require details of capacities built and applied as a result of project contributions Impact estimations not likely to be quantifiable, unless clear changes in practices to restoration are identified in outcome evaluation. • *Bibliometrics* • *Interviews/surveys with Ministry and institutions responsible for nature conservation and forest management, participants in trainings to assess in detail capacities obtained and applied in practice* • *Review of external evaluation surveys conducted for reporting.* • *Additional document review (trip reports)*	*Outcome level:* Possibly, as the projects build off each other *Impact level:* Not possible
Forest and Climate Change in the Congo (FCCC) (*CIFOR in partnership with INBAR, CIRAD, ICRAF*) • DRC	• 1 final report (2016) • 1 CIFOR annual report (2015) • 1 FTA annual report (2017)	*moderate reliability *moderate confidence • University of Kisangani outcomes (M) • Local researcher outcomes (M)	Y (moderate reliability) [achieved] Support to the facilitation of tree planting activities	• Development practitioners and policymaker outcomes require details of how capacities to respond to climate change have been improved • Farming and forestry community outcomes require follow up to assess whether landowners planted suggested species.	*Outcome level:* Possibly *Impact level:* Already have, requires ground truthing

		• Development practitioners and policymaker outcomes (L) • Farming and forestry community outcomes (L)	undertaken by Virunga foundation (afforestation for energy, agroforestry plantations) in 4600 ha of Virunga National Park [achieved] 3153.4 trees planted by WWF in agroforestry area [achieved] Carbon fixation to the order of 1.4 million tonnes of CO2 (Virunga foundation planting) [achieved] Carbon stocking 900 000 tonnes Co2 WWF agroforestry planting	Impact estimations could attempt to quantify biodiversity, soil and water cycling effects of tree planting activities undertaken. • *Bibliometrics* • *Interviews/surveys with MECNT, ICCN, and other governmental organizations who participated in short-term trainings* • *Interviews/surveys with Master students to assess how they are applying skills acquired* • *Interviews/surveys with UNKIS, WWF, Virunga National Park, Virunga Foundation and local associations to assess project effects on practice.* • *Interviews/surveys with landowners and partners engaging in tree planting/restoration to assess tree species planted and success* • *Additional document review (trip reports)*	
FORETS (Formation, Recherche, Environment dans la Tshopo) (*CIFOR in partnership with INBAR, CIRAD, ICRAF*) • DRC	• 3 midterm reports (2017, 2018, 2019) • 3 CIFOR annual reports (2016, 2018, 2019) • 1 webpage (n.d.)	*moderate-high reliability *moderate-high confidence • University of Kisangani outcomes (H) • Local researcher outcomes (H) • Development practitioners and policymaker outcomes (H)	Y (moderate reliability) [achieved] 300 ha of land have been restored from planting [potential] 1.5 million trees will have been	• Farming and forestry community outcomes require more detail of benefits received from training and from demonstration plots, and effects of the project. Impact estimations could attempt to quantify biodiversity, soil and water cycling effects of tree planting activities undertaken. • *Bibliometrics, use of maps* • *Interviews/surveys with stakeholders involved in local and regional development planning process, partners (INERA, Belgian Royal Museum for*	*Outcome level:* Possibly *Impact level:* Already have, requires ground truthing

		• Farming and forestry community outcomes	planted by 2021 on 600 ha [target] 400,000 ha expected to have planted indigenous and non-indigenous species	*Central Africa, and Resources and Synergies Development, JRC-Ispra), and nursery staff* • *Additional document review (trip reports)*	

Conservation and Sustainable Use of Genetic Resources (Africa)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
FAO planning and organization of a SAFORGEN regional workshop on the conservation and use of forest genetic resources in Africa South of the Sahara (*Bioversity*) • Africa (South of the Sahara)	• 1 workshop report	* low reliability *low confidence: no triangulation • Researchers and partners outcomes (M) • National stakeholders outcomes (L) • Private sector outcomes n/a • Government outcomes n/a • Forestry communities outcomes n/a	N	• All outcomes and impacts require details and evidence (national stakeholders, researchers and partners learning and behaviour change to which the project contributed and perceived implications) • *Interviews with workshop participants*	*Outcome level:* No, insufficient existing evidence base, not feasible given time and resources. *Impact level:* No
Threats to priority food tree species in Burkina Faso: drivers of resource loss and mitigation measures (*Bioversity*) • Burkina Faso	• 2 internal news stories summarizing the findings (2017, 2017) • 1 FTA Annual report (2018)	*low reliability *low confidence • No evidence of outcomes	N	• All outcomes and impacts require further details and evidence (national stakeholders, researchers and partners learning, national stakeholders private sector, governments, and forest communities and behaviour change to which the project contributed and perceived implications) • *Interviews/surveys with researchers and partners, national stakeholders, private sector, governments, forestry communities targeted by the project.*	*Outcome level:* No, insufficient existing evidence base, not feasible given time and resources. *Impact level* No
Aide à l'application des normes FSC sur	• No evidence	*low reliability *low confidence	N	• All outcomes require details and evidence (national stakeholders, researchers and partners, private	*Outcome level:* No, insufficient

la régénération et la diversité génétique des essences du bassin du Congo (*Bioversity*) • Cameroon		• No evidence of outcomes		sector, governments, forestry communities learning and behaviour change to which the project contributed)	existing evidence base, not feasible given time and resources. *Impact level:* No.

Fire and Haze in Indonesia

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Improving the way knowledge on forests and climate is used and understood internationally (Political Economy Study of Fire and Haze in Indonesia) • Indonesia	1 outcome story (n.d.) 2 midterm reports (2016, 2017) 1 article (external theory-based outcome evaluation) (2019) 3 CIFOR annual reports (2015, 2016, 2017) 1 FTA annual report (2015)	* high reliability *high confidence Government outcomes (H) NGO / ally outcomes (H) Research outcomes (M): requires update of bibliometrics Private sector outcomes (M): evidence points to influence being low and outcomes partially achieved, but did lead to follow up MoU with palm oil pulp and paper company Public outcomes (M) Indonesian community outcomes: n/a	Y [achieved] 7 hectares of peatland in Dompas village was rewetted and planted with sago	• Research outcomes: need update on uptake and use of project outputs • Private sector outcomes: update on outcome realization (those previously assessed to be partially achieved) • Smallholder/farmer outcomes: need evidence learning, evidence of practice changes Impact estimations: Derive from policy targets. • *Additional document review (project documents, trip reports, external media, policy review)* • *Interviews/surveys with gov't, research team, private sector* • *Bibliometric analyses, Scopus review* • *Quantification for impact estimation: Policy analysis*	*Outcome level:* No *Impact level:* No, limited relevance to restoration and sensitive to assumptions, but could assess biodiversity, Co2, soil implications of reduced instances of fire
DFID Know-for 2: Political economy of fire and haze • Indonesia	*same as above	*same as above	*same as above	*same as above	*same as above
Disaster Preparedness Specific Discipline Integrated Programme • Indonesia (Riau)	1 final report (2020)	* moderate reliability: self-reported, but indications of survey conducted *moderate confidence Government outcomes (M): preliminary evidence of gov't support and policy change	Y [achieved] Project piloted community-based fire prevention and peatland	• Government outcomes: need update on gov't support, need evidence of gov't learning, evidence of policy change and onward effects • NGO outcomes: need more detail on NGO support, need evidence of NGO learning • Research outcomes: need update on uptake and use of project outputs	*Outcome level:* No *Impact level:* No

		NGO outcomes (L): need to verify NGO/ally support, needs more detail Research outcomes (M) Private sector outcomes (L): engaged, but unclear what resulted Public outcomes (M): media uptake indicates influence on public awareness Indonesian community outcomes (M)	restoration models over 11.1 ha	• Private sector outcomes: update on outcome realization (those previously assessed to be partially achieved) • Smallholder/farmer outcomes: need evidence of learning, evidence of practice changes Impact estimations: Derive from models? (possibly negligible?) • *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with gov't, NGOs, research team, private sector* • *Bibliometric analyses* • *Quantification for impact estimation: Update*	

Conservation and Sustainable Use of Genetic Resources (Asia)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Developing cryopreservation protocols for subtropical crops and establishing cryogenebank at Rural Development Administration of Korea (RDA) (*Bioversity*) • Korea	• 1 e-mail • 1 technology offering (2021) • 1 website (n.d.) • 1 conference paper (2019)	* low reliability *low confidence • Researchers outcomes (M) • Gene bank outcomes (M) • Policymaker outcomes (L) • Educational institution outcomes: n/a • Community outcomes (L): no evidence	N	• Researcher outcomes require details about LOAs, how the project has influenced their research trajectory • Gene bank outcomes require details of changes in practice (i.e. extent of protocol uptake) • Policymaker outcomes require details of RDA learning from the project and implementation of the protocols • *Additional document review (Letters of Agreement between Bioversity, Sunchon National University, University of Leuven, and Philippine coconut authority, protocols)* • *Interviews or surveys with RDA, Sunchon National University, University of Leuven,and Philippine coconut authority* • *Bibliometrics*	*Outcome level:* Possibly, innovation shows promise *Impact level:* No – too early in maturity, might be possible to obtain a potential figure
Conservation for diversified and sustainable use of fruit tree genetic	• 1 peer reviewed publication (2016)	*TBD reliability *TBD confidence • Researchers outcomes: n/a	N	• Educational institutions require more details of project contributions • Community outcomes require details of training applied and learning from the project, as well as observed effects	*Outcome level:* Possibly *Impact level* Possibly, via collection of study

resources in C Asia (*Bioversity*) • Kyrgyzstan • Tajikistan • Uzbekistan	• 1 Bioversity Annual report (2013)	• Gene bank outcomes: n/a • Policymaker outcomes: n/a • Educational institution outcomes (L): no evidence • Community outcomes (M)		• *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with researchers, educational institutions, and community participants*	sites/ assessments of training delivery
Upgrading and broadening the new South Pacific International Coconut Gene Bank (*Bioversity, CIRAD partner)* • Fiji • Papua New Guinea • Samoa	• 1 final report (2019)	• Researchers outcomes (M) • Gene bank outcomes (L): only sparse information from Papua New Guinea • Policymaker outcomes (L) • Educational institution outcomes: n/a • Community outcomes n/a	Y (moderate reliability) [target] 10 million coconut farmers have better access to genetic diversity	Researcher outcomes require more detail of COGENT establishment and influence Gene bank outcomes require more detail of exact project contributions to effective rehabilitation practices employed in PNG, and contributions to gene bank operations in Samoa & Fiji. Policymaker outcomes require more detail of learning, and subsequent changes in knowledge, relationships, and policy. *Interviews/surveys with COGENT members and representatives, gene bank staff in PNG, Samoa & Fiji*	*Outcome level:* Possibly, innovation shows promise *Impact level:* Contingent on assessment of outcomes

Green Growth (Asia)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
Green Growth Action Plan (*ICRAF*) • Vietnam	1 internal blog (2021) 1 external website 1 final report (2019) 1 technical report (2019) 1 policy decision (2021)	* moderate-high reliability *high confidence • Policymaker outcomes (M) • Smallholder outcomes (L)	Y (high reliability) derived from scenario models [potential] • 3.9% reduction in GHG emissions by 2020 • Net reduction of 1,384,909	• Policymaker outcomes require additional evidence and detail of project contributions to the Lam Dong Green Growth Action Plan • Smallholders require more details of how green growth action plan implementation has benefitted/affected them. • *Additional document review (policy review of Lam Dong's Green Growth Action Plan and its implementation)* • *Interviews or surveys with policymakers in Lam Dong and partners involved in plan development* • *Use metrics of the LUMENS & LEAP tools*	*Outcome level:* Possibly, requires triangulation to specify outcomes, status of plan implementation, and project contributions *Impact level:* Already have from scenario modeling

			tonnes Co2/year [future potential] • 15% reduction in GHG emissions by 2030 [potential] 28,300 additional ha of monocultures under coffee agroforestry by 2030 [potential] If 30% of areas of perennial crops converted to agroforestry, water inputs reduced by 36-97 million m^3 per year [potential] DIFA Index measurements project biodiversity in broadleaf forest to increase by 15%; coniferous forest to increase by 3.1%; deciduous forest to increase by 4.8%		
Green Rubber (*ICRAF*)	• 1 internal blog (2016) • 1 final report	*moderate reliability *low-moderate confidence • NGO outcomes (M)	Y (questionable reliability)	• All outcomes require further details of project contributions to changes, and external validation. • Policymaker outcomes require	*Outcome level:* No, substantial gaps

• China • Laos • Myanmar • Thailand		• Researcher outcomes (M) • Policymaker outcomes (L): focused on relevance of outputs rather than outcomes • Smallholder outcomes (M)	Project reported to have impacted up to 2 million smallholder farmers	• *Additional document review (project documents, trip reports, external media, documents on follow up restoration projects)* • *Interviews/surveys with project researchers, policymakers, partners (e.g. RSPB), and rubber smallholders*	*Impact level* No, substantial gaps

Incentives for Sustainable Agricultural Practices (Asia)

Project	Data Sources	Level of Outcome Evidence (L, M, H), Reliability Assessment, & Confidence	Impact Estimations (Y/N) & Reliability Assessment	What additional evidence is required? *Suggestions for additional data collection (for both outcomes and impact).*	Should this project be prioritized for additional evidence?
RUPES 2- Rewards for, use of, and shared investment in pro-poor environmental services phase 2 (*ICRAF*) • China • India • Indonesia • Nepal • Philippines • Vietnam	1 FTA annual report (2012) 1 Donor report (2011) 1 Final project report (2013)	*moderate reliability: assessments based on focus group discussions with participants and non-participants and interviews with partners *moderate confidence • Program implementer outcomes (M) • Policymaker outcomes (M) • Community outcomes (Mp)	Y [achieved] Indonesia: River care contributed to 20% decrease in sedimentation	• Policymaker outcomes require additional evidence and detail of project contributions to each policy • Program implementer outcomes require more detail of partnerships and benefits received from the project • Community outcomes need update of co-investments and changed practices (restoration), evidence of RES benefits Impact estimations: Requires policy review of key policies reported to be influenced by the project, and calculation of study sites where restoration activities are likely. • *Additional document review* • *Policy review of National RES Protocol of Law 32/2009 – Indonesia, Decision No 99/2010 – Vietnam, RES scheme for grasslands – China, National Environmental Policy – India, Climate Change Act 2008 and Sustainable Forest Management Act 2008 – Philippines, and PES – Nepal* • *Interviews or surveys with researchers, policymakers, program implementers and community members*	*Outcome level:* Possibly, requires triangulation to specify outcomes, status of policy implementation *Impact level:* Might not be feasible, requires policy review and calculation of study sites
INREMP: Integrated Natural Resource and Environmental	1 internal webpage (n.d.) 2 internal blogs (2020, 2021)	*moderate-high reliability *high confidence • Program implementer outcomes (M)	Y (subproject figures) [achieved]	• Program implementer outcomes require details of learning, and project contributions and influence on NRM subproject design and implementation (i.e.	*Outcome level:* Possibly, requires triangulation to specify outcomes

Management Program (*ICRAF*) • Philippines	1 evaluation report (2020)	• Policymaker outcomes (L): indicated that policy review undertaken, but no evidence of policy outcomes • Community outcomes (M)	8556 hectares reforested [achieved] 13,927 ha under assisted natural regeneration [achieved] 14,374 ha under agroforestry [achieved] 3,564 ha under commercial tree plantation [achieved] 3,471 under conservation farming [achieved] 80615.5 ha under community based management, monitoring, protection Total achieved: 124,507.5 ha land under restoration	connections between project outputs and outcomes). • Policymaker outcomes require further detail of learning, influence of the project on policy (if any). • Community outcomes require further details of learning and benefits received from the project. • *Additional document review (project documents, trip reports, external media, workshop evaluation reports)* • *Interviews/surveys with program implementers (of natural resource management subprojects), workshop/training participants in target communities, policymakers*	*Impact level:* Already have
Vietnam Forests and Deltas project to support implementation of Payments for Environmental Services *(CIFOR)* • Vietnam	• 1 project brief	*low reliability *low confidence • Program implementer outcomes (L) • Policymaker outcomes (L) • Community outcomes (L)	N	• All outcomes require further details on exact project contribution (i.e. how the project supported implementation of PES and the effects) • *Additional document review (project documents, trip reports, external media, workshop evaluation reports)* • *Interviews/surveys with program implementers, project participants in target communities, policymakers* • *Policy review*	*Outcome level:* Possibly, if overlap with Challenge 1 deep dive case study (Vietnam) *Impact level:* Possibly, if overlaps with Challenge 1 deep dive case study (Vietnam)
Sustainable, Low Carbon Emission Agriculture and Water Resource	• 1 internal webpage (n.d.) • 1 brief (2018)	*low-moderate reliability *low confidence • Program implementer outcomes (L)	Y (low reliability, no evidence of implementation	• All outcomes require further details on exact project contribution	*Outcome level:* No, substantial gaps to fill

Co-Investment of Rejoso Watershed (Gerakan Rejoso Kita) (*ICRAF*) • Indonesia		• Policymaker outcomes (L) • Community outcomes (L)	of co-investment schemes and effects) [potential] 62,773 ha (Rejoso Watershed coverage) could be affected by PES co-investment schemes to improve management and restoration [potential] Tree planting in Rejoso will sequester 677,777 tonnes CO_2 annually	• *Additional document review (project documents, trip reports, external media)* • *Interviews/surveys with researchers partners (TNC, Social Investment Indonesia, Collaborative Knowledge Network, Danone), project participants in target communities, policymakers*	*Impact level:* Already have potential

Climate smart, tree based co-investment in adaptation and mitigation in Asia (aka Smart Tree-Invest) (*ICRAF*)
• Indonesia
• Philippines
• Vietnam
	• 1 final report
	• 1 video (2017)
	• 1 grant results report (2018)
		moderate-high reliability
		*moderate-high confidence
		• Program implementer outcomes (M)
		• Policymaker outcomes (M): indications of policy influence, but unclear how realized
		• Community outcomes (M)
			Y (high reliability) [achieved]
			4 ha restoration land under tree-growth monitoring
				• All outcomes require further details on exact project contribution (e.g. to policies, to communities), and adoption.
				
				Impact estimations require ground truthing.
				
				• *Additional document review (project documents, trip reports, external media)*
				• *Interviews/surveys with researchers, partners, policymakers, community members*
				• *Policy review*
				  ○ *Ha Tinh (Vietnam): Decision No. 71/QD-HDND on the Expansion of the Coverage of the Home-garden Policy in Huong Khe District*
				  ○ *Quang Binh (Vietnam): Decision No. 735/QD-UBND on Funding Support for Pilot Models of Home Gardens in Tuyen Hoa District*
				  ○ *Vietnam (national): Decision No. 819/2016 on Program 135 and the New Rural Development Program, the Local*
					Outcome level:
					Possibly, mostly ground truthing, specifying contributions
					Impact level:
					Possibly, requires input from project researchers

				Agricultural Restructuring Program, and particularly on the CSA implementation as a practical example of climate-change mitigation and adaptation ○ *Vietnam (national): Decision No. 923/MARD/2017 on Green Agricultural Development* ○ *Lantapan Municipal Government (Philippines): Resolution No.. 2017-067, titled "A Resolution Adopting the Co-Investment Scheme as a Sustainable Financing Mechanism for the Management of the Manupali Watershed through the Adoption of Climate-Smart, Tree-Based Farming Practices".*	
Integrating watershed management for enhancing local livelihoods and biodiversity conservation in Indonesia (*CIFOR*) • Indonesia	• 3 midterm reports (2016, 2017, 2018)	*low-moderate reliability: self reported *moderate confidence • Program implementer outcomes (H) • Policymaker outcomes (H) • Community outcomes (L): limited evidence	N	• Program implementer outcomes • Policymaker outcomes require update of policy change and implications of implementation • Community outcomes require: implications of policy implementation (improved water management practices) Impact estimations would require policy review to check for area to be considered under restoration (potential), corresponding soil, water, carbon sequestration, **biodiversity** effects or impact targets. • *Interviews/surveys with researchers, partners (Sawama Center), policymakers (Ministry of Environment and Forestry, Kapas Hulu government), program implementers (Regional Planning Body of Bantaeng District; District Forestry Agency of Bululukumba District), community members* • *Policy review* ○ *Director General of Natural Resources and Ecosystem Conservation, 2018. Letter of Decree No.: SK.380/KSDAE/SET/REN.2/10/2018 on the appointment of the Multi-Stakeholders Task Force on Natural Resource and Ecosystem Conservation, The Ministry of Environment and Forestry.*	*Outcome level:* Possibly, mostly ground truthing, specifying contributions *Impact level:* Possibly, requires input from project researchers

				○ *The Government of Bulukumba District, 2018. Letter of Decree by the Head of Bulukumba District No. 40/ 2018 on Empowering the Community under the Customary Law of Ammatoa Kajang, South Sulawesi.* ○ *The Government of Bulukumba District, 2018. Letter of Decree by the Head of Bulukumba District No. Kpts 375/V/2017 on the formation of task force on empowering the local government's roles in recognizing and protecting the customary rights of Ammatoa Kajang's Community, South Sulawesi.* ○ *The Government of Southeast Sulawesi Province, 2018. Letter of Decree by Southeast Sulawesi Governor's No. 230/2018 on the Formation of the Watershed Forum in Southeast Sulawesi* ○ *The Government of Southeast Sulawesi Province, 2018. Letter of Decree by Southeast Sulawesi Governor's on the Coordination Forum on Watershed Management in Southeast Sulawesi.* ○ *The Government of Sumbawa District, 2018. Letter of Decree by the Head of Sumbawa District on the Management and the Utilization of Environmental Services for Water Resources in Sumbawa District, West Nusa Tenggara.* ○ *The Government of Sumbawa District, 2018. Letter of Decree by the Head of Sumbawa District on Formation of the Team to finalize the Regulatory Framework on Management and the Utilization of Environmental Services for Water Resources in Sumbawa District, West Nusa Tenggara.*	

Appendix 3. Impact Estimates Disaggregated by Cluster and Region

Cluster	Geography			Potential Impacts	Supporting Evidence of FTA's Contribution to Impact	Key Conditions and Caveats Underpinning Impact Realization
	Region	Country(/ies)	Province(s)			
Climate Resilient Cacao (Global)	Latin America	Colombia	Cauca	[high end estimate] 500 ha	Platform developed to boost cocoa productivity, quality and climate resilience via optimizing genetic diversity to develop drought and heat tolerant cocoa varieties. Partner (Agrosavia) plans to trial varieties over 500 ha. .	• Partner organization uses improved varieties recommended and studied by the project • Proposal is funded
Scaling of Context-Appropriate Agroforestry Practices for Restoration	Africa	Ethiopia	Tigray, Amhara, Ormonia, SSNP	**Land under restoration:** [low end estimate] 313,000 ha of shrubland, grassland, forest, woodland, cropland is restored with project supported quality planting material and landscape restoration options [high end estimate] 8,542,650 ha (system target) **Soil effects:** [high end estimate] 130,000 tons of soil conserved per year	PATSPO is working to replace a fraction of BAU genetics seedlings with quality planting material to support landscape restoration. So far, the project identified 13 priority tree species to be implemented across 30 newly established BSOs over 10 sites, trained farmers on seed collection and procurement to improve germination and propagation of trees planted in restoration programs. The estimates are based on seed improvement of Grevillea and Juniperus.	• [low end estimate] 20% of total area is targeted in coming 20 years • Quality genetics trees are 50% more productive than BAU (have higher influx, greater germination, grow faster etc.) • Stakeholders can recognize the value of genetics by understanding potential gains of adopting improved genetics • [high end estimate] Project is successful to reach target
Scaling of Context-Appropriate Agroforestry Practices for Restoration	Africa	Ethiopia, Mali, Niger, Burkina Faso, Kenya	Not specified	[low end estimate] 265,902 ha degraded land restored through options by context	265,902 ha restored through options by context approach across 5 African countries (122,850 ha of degraded communal land rehabilitated, 90,058 ha of farmland managed under improved practices and climate smart practices adopted on 52,994 ha of farmland).	• Project reach and training is successful and leads to adoption and uptake of improved practices and restoration action
Scaling of Context-Appropriate Agroforestry Practices for Restoration	Africa	Kenya, Ethiopia, Somalia, Rwanda, Mali, Niger, Ghana	See annual report (2020) p.8 for detailed breakdown	[low end estimate] 442,179.1 ha under restoration [high end estimate] 1 million ha under restoration	Viable and promising regreening options have been identified and established on targeted scaling sites, including fruit trees, FMNR, nursery establishment, tree plantations and soil	• [low end estimate] Figures reported in latest annual report are correct • [high end estimate] Target is reached

					conservation structures, agroforestry etc.	
Scaling of Context-Appropriate Agroforestry Practices for Restoration	Africa	Burkina Faso	Kourwéogo	[low end estimate] 3 ha [high end estimate] 5 million ha	Mr Kaboré (project participant) is a 38-year-old farmer and father of seven. In his fields in Manefyam, he displays his skills and experience restoring three hectares of degraded lands through fencing to protect the natural regeneration of trees, selectively tilling, and sowing or selectively planting trees. 50 Farmers were trained in: setting up and managing a nursery, propagating local tree species, techniques to recuperate degraded lands, identify forest restoration actions	• [high end estimate] Participatory options and innovations promoted are successfully scaled across the country to support realization of Burkina Faso's AFR100 commitment
Scaling of Context-Appropriate Agroforestry Practices for Restoration	Africa	Malawi	Kasungu	[low end estimate] 2,117 ha benefit from restoration measures	Fertilizer tree systems promoted were found to have low adoption, but those who adopted reported practicing FTS on at least half of their fields. Considering these conditions, 2,117 ha were considered to have benefitted from restoration measures.	• 14% adoption rate among 30,240 farming families targeted • Among those who adopted newly promoted fertilizer tree system practices, they are applying them over half of their fields • Average field size is one ha
Scaling of Context-Appropriate Agroforestry Practices for Restoration	Asia	Vietnam	Yen Bei, Dien Bien, Son La	[low end estimate] 10,254 restored with son tra agroforestry, enrichment planting, establishment of exemplary landscapes to be monitored, or assisted natural regeneration [high end estimate] 1.4 million ha have potential to be under son tra agroforestry (if scaled over application domain)	6200 ha were planted with son tra, 3820 existing plantations were rehabilitated with improved germplasm and management. New exemplary landscapes were established (3 at 50 ha each) and are now under management, monitoring and evaluation. Forest rehabilitation research in Dien Bien and Son La has facilitated enrichment planting in 16ha, planting NTFPs in 8 ha and assisted natural regeneration in 60 ha. While adoption of agroforestry demonstrates promise for provisioning ecosystem services (e.g. income), preliminary principal component analyses demonstrates a risk of poor results for environmental indicators, including soil erosion, at least in the near term.	• [low end estimate] Hectares reported to be under improved practices with restoration potential experience net benefit in ecosystem services. • [high end estimate] The options to restore land are context sensitive, in demand, and are applied over application domain
Scaling of Context-	Asia	Indonesia	East Nusa Tenggara	[low end estimate]	21 farmer managed natural regeneration sites have been	• [low end estimate] Established project study sites are maintained

Appropriate Agroforestry Practices for Restoration				540 ha of farmer managed natural regeneration sites and demonstration plots with high quality seedlings [high end estimate] 5000 ha (target)	established and are applying intercropping, at 20-25 ha each, and 15 demonstration plots planted with high quality seedlings have been established over 120 ha.	post project to continue benefits to the land • [high end estimate] Target is reached.
Forest Landscape Restoration	Latin America	Peru		[high end estimate] 2 million ha	Analysis raised awareness among government actors that tenure conflicts need resolving and adequate incentives need developing to reach the goal of 2 million ha of planted forests	• Awareness leads to changes and solutions to the issues that are sufficient to reach the 2 million ha goal
Forest Landscape Restoration	Asia	Malaysia	Sarawak	[low end estimate] 9732.14 ha restored to date [high end estimate] 200,000 ha identified as priority area for restoration incorporated in Strategy and Action Plan for Forest and Landscape Restoration	As an immediate follow up to the expert workshop, the Sarawak government announced in March 2017 review of policies for managing Licenced Planted Forests in the state. A directive for compulsory replanting in the licensed Planted Forest Areas was issued by the Forestry Department in January 2019 (DF Circular No. 2/2019). Levy for timber from swamp and hill forests was increased from RMB 0.60 to RMB 5.00 through another directive to generate funds for rehabilitation of logged areas (DF Circular No. 10/2018).	• [high end estimate] Financing strategies are successful to restore the entire priority area and policies are effectively implemented • [low end estimate] The strategy helped stimulate restoration action in Sarawak State
Bioeconomy Development to Restore Degraded Land	Asia	Indonesia	Central Java, Central Kalimantan, South Sumatra, East Kalimantan	[low-end estimate] 17 ha of demonstration plots for 13 species to restore degraded lands (including peat)	Research and demonstration plots have been established in five locations representing different types of degraded lands. 11 tree species are planted and monitored over these sites.	• [low end estimate] Monitoring and management over trial sites continues post-project
Bioeconomy Development to Restore Degraded Land	Africa	Ethiopia, Tanzania, Ghana, Madagascar		[low end estimate] Bamboo planted on 1200 ha in pilot sites in Ethiopia; 80 ha in Ghana; 240 ha in Madagascar; 80 ha in Tanzania	Direct support to planting	• Bamboo is well managed to ensure survival
Bioeconomy Development to	Africa	Tanzania, Ethiopia, Madagascar		[low end estimate] 357.86 ha degraded	Same as above	• Bamboo is well managed to ensure survival

Restore Degraded Land				land planted with bamboo		
Bioeconomy Development to Restore Degraded Land	Africa	Kenya, Ethiopia, Uganda		[low end estimate] 700 ha degraded land planted with bamboo [high end estimate] 17,000 ha degraded land identified as suitable for bamboo	Same as above	• [low end estimate] Bamboo is well managed to ensure survival • [high end estimate] Identified suitable land area is restored with bamboo
Bioeconomy Development to Restore Degraded Land	Africa	Ethiopia, Tanzania, Madagascar, Kenya, Uganda		[high end estimate] 17434.43 tons CO_2	Conversion rate applied to total ha of bamboo planed on degraded land reported to date.	• 2.8-3.9 t C stored /ha bamboo planted on degraded land. 1 t C = 3.7 t CO_2
Bioeconomy Development to Restore Degraded Land	Africa	48 member countries		**Land under restoration:** [high end estimate] 5 million ha restored with bamboo **CO_2 sequestration potential:** [high end estimate] 72,150,000 tons CO_2	Member states pledged in 2014 to restore 5 million ha of land with bamboo by 2030.	• [Land under restoration] Commitments are upheld, and strategies are effectively implemented over entire area • [CO_2 sequestration] bamboo is managed effectively (e.g. appropriate harvesting and tending) to increase production and provision and optimize carbon sequestration • [CO_2 sequestration] carbon capture conversion for climate smart management applies to all degraded land where bamboo has been planted
REDD+ Policy Mechanism	Latin America	Peru	Padre Abad, National	[low end estimate] 6,000ha	As part of the SECURED Landscapes project, ICRAF influenced 6,000 ha of forested areas in Irazola district (Padre Abad province) to be managed under a sustainable land use management plan.	• Sustainable land use/management plans are implemented and monitored • Land and forests under various community forestry schemes in Indonesia are managed to enhance ecosystem services (i.e., communities adhere to/comply with requirements, etc.)
REDD+ Policy Mechanism	Asia	Vietnam	Son La, Cat Tien, Dak Lak, Thua Thien Hue, Bac Kan	[low end estimate] 1,015,972 ha [high end estimate] 6,644,508 ha	The PFES forest area in Son La, Cat Tien, Dak Lak, and Thua Thien Hue provinces where CIFOR conducted research and supported implementation of the PFES M&E system is 1,015,760 ha (15% of total PFES potential). From latest PFES annual report (2019), total	• PFES is properly implemented and supported by the M&E system to ensure that payments are accurate • Large amounts of land are not lost to fire/flooding or other natural disasters

					PFES forest area is 6,576,508 ha at national level. In Bac Kan province, 212 ha of forest were put under a CFM regime in the SECURED Landscapes pilots to regenerate forest.	• Other provinces implement the M&E system to ensure PFES payments are more accurate (scaling up) • PFES payments are high enough to change people's behaviour (i.e., an incentivizing factor) • Low emissions development strategy plans are enacted, implemented, and enforced. • Community forestry schemes sufficiently incentivize communities to better manage land and forests • Land and forests under various community forestry schemes in Vietnam are properly/ sustainably managed (i.e., communities with community forestry contracts and/or land use rights certificates adhere to/comply with requirements, etc.)
REDD+ Policy Mechanism	Asia	Indonesia	Jambi	[low end estimate] 714 ha	The SECURED Landscapes project supported a participatory mapping exercise used to develop sustainable land use plans for 714 ha of community forest area in the Tanjabar district (Jambi province).	• Sustainable land use/management plans are implemented and monitored • Community forestry schemes sufficiently incentivize communities to better manage land and forests • Land and forests under various community forestry schemes in Indonesia are properly/ sustainably managed (i.e., communities adhere to/comply with requirements, etc.)
REDD+ Policy Mechanism	Africa	DRC	Bas-Congo, Kinshasa	[low end estimate] 10,000 ha	SECURED Landscapes pilots were implemented in 10,000 ha in Mvululun and Kasangulu villages (Bas-Congo province) and Menkao, Kwango Bridge, and Kingakati villages (Kinshasa province**)**, where sustainable practices and landscape management were implemented.	• Landscape pilots continue to be maintained and managed sustainably to enhance ecosystem services over the area

REDD+ Policy Mechanism	Africa	Cameroon	Mvila	[low end estimate] 3,000ha [high end estimate] 76,234ha	As part of the SECURED Landscapes project, a total of 76,234 ha in Efoulan (Mvila province) were targeted for improved management of cocoa farms (5,771 ha) and forest areas (70,463 ha). 3,000 ha of farms (managed by 600 people) adopted new cocoa management models.	• Project engagement and capacity-building was sufficient to equip communities for better management practices • Communities are sufficiently incentivized to sustainably manage their cocoa farms and surrounding forest areas
REDD+ Policy Mechanism	Asia & Africa	Cameroon, Indonesia, Peru, DRC		**Land under restoration:** [high end estimate] 2,005,925 ha **CO_2 sequestration potential:** [high end estimate] 6,081,361 tons CO_2	Targets for SECURED Landscapes program (extrapolated by areas covered by forest and land use plans with LUWES)	• Forest and land use plans are effectively implemented to restore land and ecosystem services
Innovation for Resilient Landscape Restoration	Latin America	Peru		[low end estimate] 10 ha under community protection [high end estimate] 400,000 ha targeted by PIP Verde restoration project	The project has supported community protection of 10 ha of degraded dry forest. Diversity for Restoration tool supports planning of forest restoration by suggesting species to plan that support both current and projected climate emissions. PIP Verde (public investment project) includes the toolbox to guide restoration planning which targets 400,000 ha.	• [low end estimate] Community protection of land results in restoration • [high end estimate] PIP Verde program reaches its targets
Innovation for Resilient Landscape Restoration	Latin America	Colombia	Medellin	[low estimate] 13,000 ha	Department of Antioquia, Empresas Publicas de Medellin is in charge of the restoration of 13,000 hectares of tropical dry forest, as a compensation for the loss of forest due to the building of the biggest hydroelectric power dam of the country. This restoration was managed using the map-based tool to guide the selection of the subsets of species that best match the conditions of the planting sites and the restoration goals.	• Trees planted survive
Innovation for Resilient Landscape Restoration	Africa	Madagascar, Kenya, Cameroon		[high end estimate] 8,500 ha targeted by restoration programs	GEF funded restoration programs explicitly report in their project descriptions (Madagascar; Kenya &	• Tool is effectively used to reach program targets

				that will apply the D4R tool	Cameroon) intentions to use the D4R tool.	
Agroforestry Concessions in Peru	Latin America	Peru	San Martín, Ucayali	**Land under restoration:** [low end estimate] 38.6 ha [high end estimate] 1,452,000 ha	As part of the SUCCESS project findings, it was estimated that 1 million ha of land and 452,000 ha of forests in the Peruvian Amazon were eligible for AFCs (total potential: 1.452 million ha), that would benefit 120,000 households. The total area of the 33 concessions in San Martín awarded to date is 193 ha. Assuming that these concession holders uphold the 20% stipulation to be under sustainable agroforestry – e.g. tree-planting, soil and water conservation, we consider 38.6 ha are under restoration (realized).	• AFC holders comply with regulations (maintain 20% of land that must be under sustainable agroforestry practices – e.g. tree-planting, soil and water conservation). • Eligible land under the mechanism experiences positive ecosystem service effects, trees survive, and soil and water conservation methods applied are effective • upper limit] All eligible smallholders register for AFCs • [upper limit] Successful/sustainable scaling of AFC in study provinces are supported by NGO and government partners.
				CO_2 sequestration effects: [low end estimate] 11,425.6 tons CO_2 [high end estimate] 42,972,920,000 tons CO_2		• Assumes 80 t C are stocked / ha of coffee or cocoa agroforestry; and 1 ton stocked C = 3.7 ton CO_2 sequestered. Therefore, all eligible AFC concessions apply coffee or cocoa agroforestry
Research Capacity Building for Sustainable Forest and Agricultural Land Management in the DRC	Africa	DRC	Virunga	**Land under restoration:** [low end estimate] 7753.4 ha under restoration	4600 ha trees planted for agroforestry by partner organization - Virunga foundation. 3153.4 ha trees planted by WWF in agroforestry area - ICRAF providing options (e.g. trees with positive impact on soil health, fast growing, multi-use).	• Partner organizations plant trees suggested by FTA scientists over reported areas. • Trees planted survive
				Carbon sequestration effects: [low end estimate] 1.4 million tons CO_2 stocked		• Estimate assumes a volume of aerial woody material of 300 m³. Another approximation is that one m³ of wood contributes to fixing 1 ton of CO_2. The overall estimate is 300 tons of CO2 fixed per ha of plantation, when the trees are mature
Research Capacity Building for Sustainable Forest and Agricultural	Africa	DRC	Yangambi	[low end estimate] 300 ha of land under restoration since 2019 [high end estimate]	FORETS project has supported restoration of 300 ha of land since planting activities undertaken in 2019 by supporting nursery development	• [low end estimate] Trees planted survive and produce benefits and services over the long term.

Land Management in the DRC				400,000 ha targeted to plant 1.5 million trees (indigenous and non-indigenous species)	and pilots. Target project area is 400,000 ha, expected to have planted 1.5 million trees (indigenous and non-indigenous species)	• [high end estimate] Awareness-raising and capacity-building were sufficient to stimulate uptake of sustainable management practices in the Yangambi Biosphere Reserve and other project target areas in Tshopo province
Conservation and Sustainable Use of Genetic Resources (Africa)	No evidence					
Fire and Haze	Asia	Indonesia	Riau	[low end estimate] 85.5 ha of peatland under restoration	In Bengkalis Regency, Riau, community-based fire models have been applied on **11.4 ha** of land. In addition, rewetting practices have been applied to **56 ha** in Dompas village (1 big pond, 42 small ponds, canal blocking applied to 6 areas, 54 monitoring dipwells), along with sago planting on **7 ha**. **11.1 ha** are under community-based monitoring via CO-PROMISE.	• Successful demonstration of fire management practices leads communities to adopt and apply fire management practices in the long-term (e.g., monitoring system, rewetting, etc.)
Conservation and Sustainable Use of Genetic Resources (Asia)	No evidence					
Green Growth (Asia)	Asia	Vietnam	Lam Dong	**Land under restoration:** [high end estimate] 28,300 additional ha of monocultures under coffee agroforestry by 2030 **CO_2 sequestration effects:** [low end estimate] 100,000 tons GHG avoided by 2020 [high end estimate] Net reduction of 1,384,909 tons CO_2 per year **Biodiversity effects:**	FTA scientists supported co-development of Lam Dong's Green Growth action plan, created roadmap, developed land use assessment tools (LUMENS & LEAP), and supported Green Growth Action Plan development. Tools have been taken up by the government.	• Assumed that the benefits of Green Growth scenario as described in the report are sufficiently compelling to be adopted, implemented, and achieved. • Lam Dong's Green Growth Action Plan is effectively implemented and makes a significant contribution greenhouse gas emission reductions, restoration by agroforestry, water cycling, and biodiversity. • ICRAF's contribution is significant enough to have bearing on the outcomes and impacts achieved by the plan.

				[high end estimate] broadleaf forest to increase by 15%; coniferous forest to increase by 3.1%; deciduous forest to increase by 4.8% **Water conservation effects:** [high end estimate] water inputs reduced by 36-97 million m^3 per year		• Models and projections (e.g. DIFA Index) have no margin of error • [water conservation effects] 30% of perennial crops are converted to agroforestry
Incentives for Sustainable Agricultural Practices	Asia	Philippines		[low end estimate] 8,556 ha reforested with direct project support [high end estimate] 124,507 ha covered by facilitated subprojects	Progress for NRM indicates 90% completion of subprojects, areas have been developed or planted and some already in the maintenance and protection activities. The completed subprojects cover a total of 124, 507 hectares out of the target 138,601 hectares. For its natural resources' subprojects, INREMP has also already completed its target areas for reforestation, covering 8556 hectares	• [high end estimate] Subprojects achieve intended results (i.e. targeted areas experience net positive gain in ecosystem services)
Incentives for Sustainable Agricultural Practices	Asia	Indonesia	Rejoso Watershed	**Land under restoration:** [high end estimate] 62,773 ha **CO_2 sequestration effects:** [high end estimate] Tree planting in Rejoso will sequester 677,777 tons Co2 annually	First phase of implementation provides a proof-of-concept that restoring and maintaining watershed functions can be successful through co-invested, performance-based incentive schemes targeting smallholders practicing tree-based intercropping, agroforestry, and water and soil conservation agriculture	• Co-investment incentive schemes are effectively implemented to facilitate restoration of Rejoso watershed • Co-investment incentive schemes are effectively implemented to facilitate tree planting to the extent projected in Rejoso
Incentives for Sustainable Agricultural Practices	Asia	Indonesia	Buol	[low end estimate] 4 ha restoration land under tree-growth monitoring	The local government adopted the co-investment principle in the upcoming district regulations on corporate social responsibility and the Village Fund. The district also replicated several project activities using the district's development budget of about USD 27,000 in 2017. The replications have been carried out in the Mulat-Lantika	• Tree growth monitoring has a positive effect on land and ecosystem service restoration

					Digo watershed, the second-biggest watershed in the district. 4 hectares of restoration land for tree-growth monitoring, and five measurement points in the upstream and midstream watershed area for participatory watershed monitoring.	
TOTAL IMPACT ESTIMATES FOR FTA CONTRIBUTIONS TO LAND AND ECOSYSTEM SERVICE RESTORATION				**<u>Land under restoration:</u>** **Low end estimate:** **2,112,361.6 ha under restoration** **High end estimate:** **34,360,799.9 ha under planned restoration**		
				<u>CO_2 sequestration effects:</u> **Low end estimate:** **1,428,860 tons of CO_2** **High end estimate:** **511,486,047 tons of CO_2**		
				<u>Soil conservation effects:</u> **High end estimate** **130,000 tons of soil conserved per year with use of quality planting material (Ethiopia)**		
				<u>Water conservation effects:</u> **High end estimate:** **Water inputs reduced by 36-97 million m^3 per year under Green Growth Scenario (Vietnam)**		
				<u>Biodiversity effects:</u> **High end estimate:** **Broadleaf forest to increase by 15%; coniferous forest to increase by 3.1%; deciduous forest to increase by 4.8% under Green Growth Scenario (Vietnam)**		

Climate-smart, Tree-based, Co-investment in Adaptation and Mitigation in Asia. Photo by: World Agroforestry

The CGIAR Research Program on Forests, Trees and Agroforestry (FTA) is the world's largest research for development program to enhance the role of forests, trees and agroforestry in sustainable development and food security and to address climate change. CIFOR leads FTA in partnership with ICRAF, the Alliance of Bioversity International and CIAT, CATIE, CIRAD, INBAR and TBI.

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foreststreesagroforestry.org
@FTA_CGIAR
cgiarforestsandtrees@cgiar.org
foreststreesagroforestry