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Assessing the Impact of 10 years of FTA Research

A synthesis of the 5 integrated impact studies

Federica Coccia, Jean-Charles Rouge, Rachel Claus, Rachel Davel, Karl Hughes, Daniela Pinto, Elisabetta Gotor, Stephanie Jones, Tobias Thuerer, Pasha Rachman, George Wakesho, Ravic Nijbroek, Yoshiko Saigenji, Kai Mausch, Tesfaye Woldeyohanes, Joan Kimaiyo, Marta Kozicka, Gabriela Wiederkehr, Brian Belcher, Alexandre Meybeck and Vincent Gitz

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Forests, Trees and Agroforestry

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CGIAR Research Program on Forests, Trees and Agroforestry
CIFOR Headquarters
Jalan CIFOR
Situ Gede, Sindang Barang
Bogor Barat 16115
Indonesia

T +62-251-8622-622
E cgiarforestsandtrees@cgiar.org

foreststreesagroforestry.org

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The 5 detailed integrative impact studies are available here:

Outcome Assessment and Impact Estimation: FTA Research Contributions Addressing Accelerating Rates of Deforestation and Forest Degradation (Challenge 1)

https://www.foreststreesagroforestry.org/publications/research-publication/?title=outcome-assessment-and-impact-estimation-fta-research-contributions-addressing-accelerating-rates-of-deforestation-and-forest-degradation-challenge-1&id=11463_23390

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

https://www.foreststreesagroforestry.org/publications/research-publication/?title=outcome-assessment-and-impact-estimation-ftas-research-contributions-to-address-the-high-prevalence-of-degraded-land-and-ecosystem-services-challenge-2&id=11463_23401

Outcome Assessment and Impact Estimation: FTA's Research Contributions to Address Widespread Unsustainable Land Use Practices (Challenge 3)

https://www.foreststreesagroforestry.org/publications/research-publication/?title=outcome-assessment-and-impact-estimation-ftas-research-contributions-to-address-widespread-unsustainable-land-use-practices-challenge-3&id=11463_23391

Outcome Assessment and Impact Estimation: FTA's Research Contributions to Address Persistent Rural Poverty and Increasing Levels of Vulnerability (Challenge 4)

https://www.foreststreesagroforestry.org/publications/research-publication/?title=outcome-assessment-and-impact-estimation-ftas-research-contributions-to-address-persistent-rural-poverty-and-increasing-levels-of-vulnerability-challenge-4&id=11463_23405

Outcome Evidencing and Impact Estimation: Rising Demand and Need for Nutritious Food for both Current and Future Generations (Challenge 5)

https://www.foreststreesagroforestry.org/publications/research-publication/?title=outcome-evidencing-and-impact-estimation-rising-demand-and-need-for-nutritious-food-for-both-current-and-future-generations-challenge-5&id=11463_23392

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List of Acronyms

ACM	Adaptive Collaborative Management
AFC	Agroforestry concessions
AFR100	African Forest Landscape Restoration Initiative
ASEAN	Association of South East Asian Nations
BRI	Bushmeat Research Initiative
CaSAVA	Capacity Strengthening Approach to Vulnerability Assessment method
CATIE	*Centro Agronómico Tropical de Investigación y Enseñanza* (Tropical Agricultural Research and Higher Education Center)
CBO	Community-based organization
CFE	Community forest enterprise
CFM	Community forest management
CIFOR	Center for International Forestry Research
CIRAD	*Centre de Coopération Internationale en Recherche Agronomique pour le Développement* (French Agricultural Research Centre for International Development)
COFO	FAO Committee on Forestry
CONAP	*Consejo Nacional de Areas Protegidas* (National Council of Protected Areas, Guatemala)
COP	Conference of Parties
CO-PROMISE	Community-based Peatland Restoration Monitoring System
CRP	CGIAR Research Program
DRC	Democratic Republic of Congo
DRYAD	Improving Livelihoods and Land Use in Congo Basin Forests – Financing Sustainable Community Forest Enterprises in Cameroon Project
DryDev	Drylands Development Programme
EL	Exemplar landscapes
ESS	Environment and Social Safeguards monitoring tool
FAO	Food and Agriculture Organization
FDT	Farm demonstration trials
FLEGT	Forest Law Enforcement, Governance and Trade
FP	Flagship program
FREL	Forest reference emission levels
FTA	Forests, Trees and Agroforestry
GHG	Greenhouse gas
GIS	Geographic information system
ha	hectare
ICRAF	World Agroforestry
IDO	Intermediate Development Outcome
INBAR	International Network for Bamboo and Rattan
INSTANT	Information System for Sustainable Land Development framework
IPOP	Indonesian Palm Oil Pledge
ISC	Indonesian Palm Oil Pledge
LORTA	Learning-Oriented Real-Time Impact Assessment initiative

LUMENS	Land Use Planning for Multiple Environmental Services framework
LUWES	Land Use Planning for Low Emission Development Strategy tool
MARLO	Managing Agricultural Research for Learning and Outcomes database
MELIA	Monitoring, Evaluation, Learning and Impact Assessment
MoU	Memorandum of Understanding
MRV/MMRV	Monitoring, Measurement, Reporting, and Verification
M&E	Monitoring and evaluation
NGO	Non-governmental organization
NRM	Natural resource management
NTFP	Non-timber forest product
OxC	Options-by-context
PES/PFES	Payment for Environmental Services
PIPPIB	Forest Concession Moratorium
PPP	Public-private partnership
PoU	Prevalence of undernourishment
QoR4D	Quality of Research for Development framework
REDD+	Reducing Emissions from Deforestation and Forest Degradation
REL	Reference emission levels
RES	Rewards for environmental services
RSPO	Roundtable for Sustainable Palm Oil
SFM	Sustainable forest management
SIS	Safeguards Information System
SLO	System-level outcome
SME	Small and medium enterprises
SRE	Sustainability Research Effectiveness
SRE	UNFCCC Task Force on National Greenhouse Gas Inventories
ToC	Theory of Change
TonF	Trees on farm
UNFCCC	United Nations Framework Convention on Climate Change
UNIKIS	*Université de Kisangani* (University of Kisangani)
USD	United States dollar

Executive Summary

In 2020, following a workshop called by its Independent Steering Committee (ISC), the CGIAR Research Program on Forests, Trees and Agroforestry (FTA) launched a set of studies (FTA 2021a,b,c,d,e) focused on documenting progress of the program's contribution in addressing five key global challenges:

- Challenge 1: Accelerating rates of deforestation and forest degradation;
- Challenge 2: High prevalence of degraded land and ecosystem services;
- Challenge 3: Widespread unsustainable land use practices;
- 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

The global challenges investigated in the studies are complex and interconnected. Unsustainable land use management is a key cause of deforestation, which degrades land and ecosystem services. Forests, trees, and agroforestry are key sources of livelihoods and nutrition for natural resources-dependent communities in the tropics. FTA's strategy addresses the integrative nature of the challenges, as multiple research interventions cut across the challenges.

These studies sought to design a workable approach and method to assess impacts at scale at the level of the FTA program on development challenges, since 2011 and to deploy the method effectively on a set of five identified challenges addressed by FTA. The studies also set out to identify lessons learned for monitoring and evaluation and for research in general terms, but more specifically for FTA post 2021.

This study, which provides a synthesis of the five studies, provided opportunities to test novel ways to assess collective research efforts (i.e., composite and nested ToCs) and procured new insights on how research influences change across different impact pathways to address complex, inter-related societal issues. Such learning informed a set of 10 lessons and related recommendations to improve future change-making research and M&E practices of similar research-for-development projects and programs.

Lesson 1: Programmatic approaches to research add critical value.

Recommendation 1: While projects remain an effective operational tool to fund and organize R4D work in practice, donors and research for development actors should resist the tendency to consider it sufficient and team up to develop and optimize programmatic approaches to support a cohesive strategy spanning and delivery mechanisms going beyond individual projects, around topics and geographies, and to enhance the cohesion and positioning of research effort – including learning on implementation - towards transformation and global problem-solving.

Lesson 2: Design and implement programs and projects using "3-spheres" theories of change and use both ex-ante and ex-post approaches to ToCs.

Recommendation 2: The 3 spheres approach should be used by partners and funders when

developing ex-ante the theories of changes of the new FTA, for the whole program but also for the initiatives within. The ToC should be used in the design, planning, implementation, monitoring, evaluation, impact assessment. Use nested ToCs for program and strategy design and to identify relations between program and project level intentions, between projects, and to set targets. Ex-post integrated assessments could follow the model by set by the FTA MELIA integrated studies (e.g. based on reconstructed ToCs) and should be planned from the onset so that the methodology (and related data collection) is easily rolled out over time.

Lesson 3: Ensure versatility and usefulness of impact assessment studies for multiple audiences.

Recommendation 3: Ensure that MELIA studies, their design, methods and outputs are accessible and contain messages targeting the different audiences (leadership, scientists, stakeholders, donors). If need be MELIA products need to be tailored and differentiated to different audiences.

Lesson 4: Use the Quality of Research for Development Framework both for research and for MELIA.

Recommendation 4: Use the QoR4D framework (relevance, credibility, legitimacy and effectiveness) to guide the design and appraisal of research proposals and for ex post assessment of design and implementation.

Lesson 5: The MELIA-research interaction processes are as important as their product.

Recommendation 5: Make sure that there is systematic, continuous interaction between research teams and MELIA in a research cycle. Make sure these interactions help projects to set-up and document impact targets, when possible through solid ex-ante analysis and methods. Make sure that the MELIA study process (methodology and design) involves research leadership and scientists (and the case being stakeholders) from the ground up and at key steps, and not be rolled out in silo.

Lesson 6: Design and implement well sized, robust approaches and systems for project data documentation and management.

Recommendation 6: Design ex-ante a cost-effective program-level data management framework and plan, that is based on a minimal set of data systematically collected, with definitions and units compatible across projects and initiatives. This should address the 3 spheres from outputs to outcomes and impacts (see lesson 2). Collect disaggregated data on gender and youth in projects where appropriate. Make sure there is consistency in the documentation and monitoring of projects and programmes, as well as in M&E terminology . Make sure projects, their documentation and reporting abide to this minimal frame, and to enable this, develop and use a consistent MELIA database system. To be attractive to scientists, such systems should be used to demonstrate what research delivered and to track delivery overtime to help build the case for research quality and effectiveness.

Lesson 7: Ensure an inclusive and transparent piloting mechanism for strategic focus and coordination, both thematic and geographic.

Recommendation 7: Any partnership needs a specific, inclusive and transparent piloting mechanism. This mechanism should be based on a structure and processes (including leadership, management and communication) that are able to bring together projects around clusters, to generate, integrate and provide usable lessons from individual projects. This should enable to improve individual project design, so that it integrates learning from previous, connected projects within the program. Coordination on clusters of projects should be based on integrative impact pathways, and on long term place-based partnerships. The piloting mechanism should lead integrative, cross cutting studies that contribute to impact and generate lessons learned on research positioning and effectiveness.

Lesson 8: Pay adequate attention to research but ensure demand-driven, place-relevant positioning and actively test/ challenge assumptions for development impact.

Recommendation 8: Make sure that the projects and programs are based on explicit research questions, with well-specified evidence-based methods and outputs. The Scientific Credibility of R4D cannot be compromised and must be maintained and built up. The “R” in the R4D mandate and approach is unique and needed, but research positioning needs to be grounded in stakeholders needs. This needs a right positioning of the partnership within the overall R4D spectrum, and well-defined relations of FTA partners with external partners on both ends of the R4D spectrum, both upstream research and downstream development. The new FTA needs to make sure it is appropriately comprehensive and balanced in that regard. Set realistic targets and develop plans for achieving and measuring them. Build R4D place based portfolios on solid, long term, engagement with local stakeholders and local institutions, including local universities.

Lesson 9: Addressing global challenges with research requires integration of a diversity of impact pathways in context, including a mix of technical innovations, policies, and capacity building pathways, and the right partnerships.

Recommendation 9: The new FTA needs to be appropriately comprehensive and balanced from the upstream to downstream domains, across a diversity of impact pathways based on a sound analysis of knowledge gaps and bottlenecks/ constraints for change/adoption at scale, including identification of key boundary partners, from international levels down to local scales. It is important to have the right partners, including boundary partners, and FTA should undertake a systematic effort to identify the most appropriate partners, based on lessons drawn about effectiveness of working with them. There is scope to more actively involve national and local financial institutions, and extension services should be included in the diffusion pathways, including with farmer-to-farmer, women and youth associations. More emphasis could be given on leveraging and influencing the general public (and consumers) with evidence-based behaviour options. There is scope for more strategic engagement of and active relationship-building with private sector actors.

Lesson 10: Nurture soft personal, social and institutional knowledge, build trust, and organize management for these objectives.

Recommendation 10: Integrate, up to a desired level, transparency and inclusiveness in program design and processes. Build appropriate partnership and program collaboration procedures in management and delivery. Make sure partnerships are documented for institutional memory. Identify actors of change and develop institutional relationships and partnerships with government agencies or departments, that enhance institutional capacity -including those of extensionists-, collaboration, trust, and build momentum for continued political commitment.

Introduction and background

In 2021, the CGIAR Research Program on Forests, Trees and Agroforestry (FTA) completed a set of studies focused on documenting progress of the program's contribution in addressing five key global challenges. These studies had the following purposes: (i) to design a workable approach and operational method to assess impacts at scale at the level of the FTA program on development challenges, since 2011; (ii) to deploy the method effectively on a set of five identified challenges addressed by FTA; (iii) to learn lessons from the exercise both for MELIA and for research, in general terms but more specifically for FTA post 2021. This document provides a synthesis of the five studies and draws lessons learned and recommendations for research for development programs.

Background

The CGIAR Research Program on Forests, Trees and Agroforestry (FTA) was established in 2011 to help maintain and increase the value and contributions of forests and trees to sustainable development. The program was led by CIFOR in partnership with ICRAF, Bioversity, and four non-CGIAR research organizations: Tropical Resources Institute (CATIE), the French Agricultural Research Centre for International Development (CIRAD), the International Network for Bamboo and Rattan (INBAR), and Tropenbos.

The FTA CRP represents a substantial investment of approximately 850 million USD over the past ten years. Its research agenda aimed to understand and help develop solutions to major societal and environmental problems as a way to contribute to developmental and environmental impacts on a large scale.

In 2020, following a workshop called by its Independent Steering Committee (ISC) in November 2019, FTA launched a set of studies focused on documenting progress of the program's contribution in addressing five key global challenges. These challenges were identified together with the management team and leadership of FTA, highlighting five important areas of commitments relevant to many countries and actors, donors' priorities, the Sustainable Development Goals, and CGIAR Strategy and Results Framework (SRF) targets.[1]

To generate evidence of FTA's contributions to the SRF targets, an integrated impact estimation strategy was developed. This strategy considers that FTA addresses five challenges (Figure 1):

- Challenge 1: Accelerating rates of deforestation and forest degradation;
- Challenge 2: High prevalence of degraded land and ecosystem services;
- Challenge 3: Widespread unsustainable land use practices;
- 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

1 In 2016, at the beginning of the second round of CRPs, the CGIAR set aspirational targets which were expected to be achieved by 2022. All CRPs were requested to estimate their potential contribution to these targets. CRPs, initially designed to end in 2022, were eventually brought to an end one year earlier, in 2021.

Table 1. FTA's Expected Results (as noted in FTA's Phase II Proposal (FTA, 2016a))

End-of-Program Outcomes	Intermediary Development Outcomes (IDOs)	CGIAR SRF aspirational Targets	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 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. Improved ecological integrity, equitable mgt. & protection of forests & non-forest-based tree resources (IDOs 3.1 & 3.3) 2. Enhanced ecosystem service provision (e.g., carbon storage, nutrient cycling, water filtration & soil health) (IDOs 2.3 & 3.2) 3. Increased resilience of female, male & poor smallholders & other forest/tree users to climate change & other shocks (IDO 1.1) 4. 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. 30.1845% 4. 17 million 5. 0.225% 6. 0.2 Gt CO_2-e yr^{-1} 7. 30 million 8. 2.5 million

For each of these challenges were conducted integrative studies (FTA 2021a,b,c,d,e) with the objectives to: i) prepare an overview and catalogue of the research-for-development efforts of FTA and its partner institutions; ii) assess whether and how this work has contributed to changes in policy and practice (i.e., outcomes), and; iii) estimate the potential impacts.

The analysis explicitly recognizes the limits to FTA's influence in addressing the five global challenges. That is, the relative control and influence of any program declines as it progresses from its activities and outputs (the products of a research process) (sphere of control), through the responses and actions of partners and other actors who are informed, supported, or otherwise influenced by those outputs (outcomes) (sphere of influence), to its impact on social, economic and environmental conditions (sphere of interest), as other actors and processes become relatively more influential (Figure 2).

The studies traced program activities and outputs, assessing the extent to which and how intended outcome contributions were realized using a set of composite theories of change (ToCs) as the main analytical framework. Evidence of progress along the impact pathways provides some confidence that the ToC is sound, and therefore that higher-level outcomes and impacts may potentially be

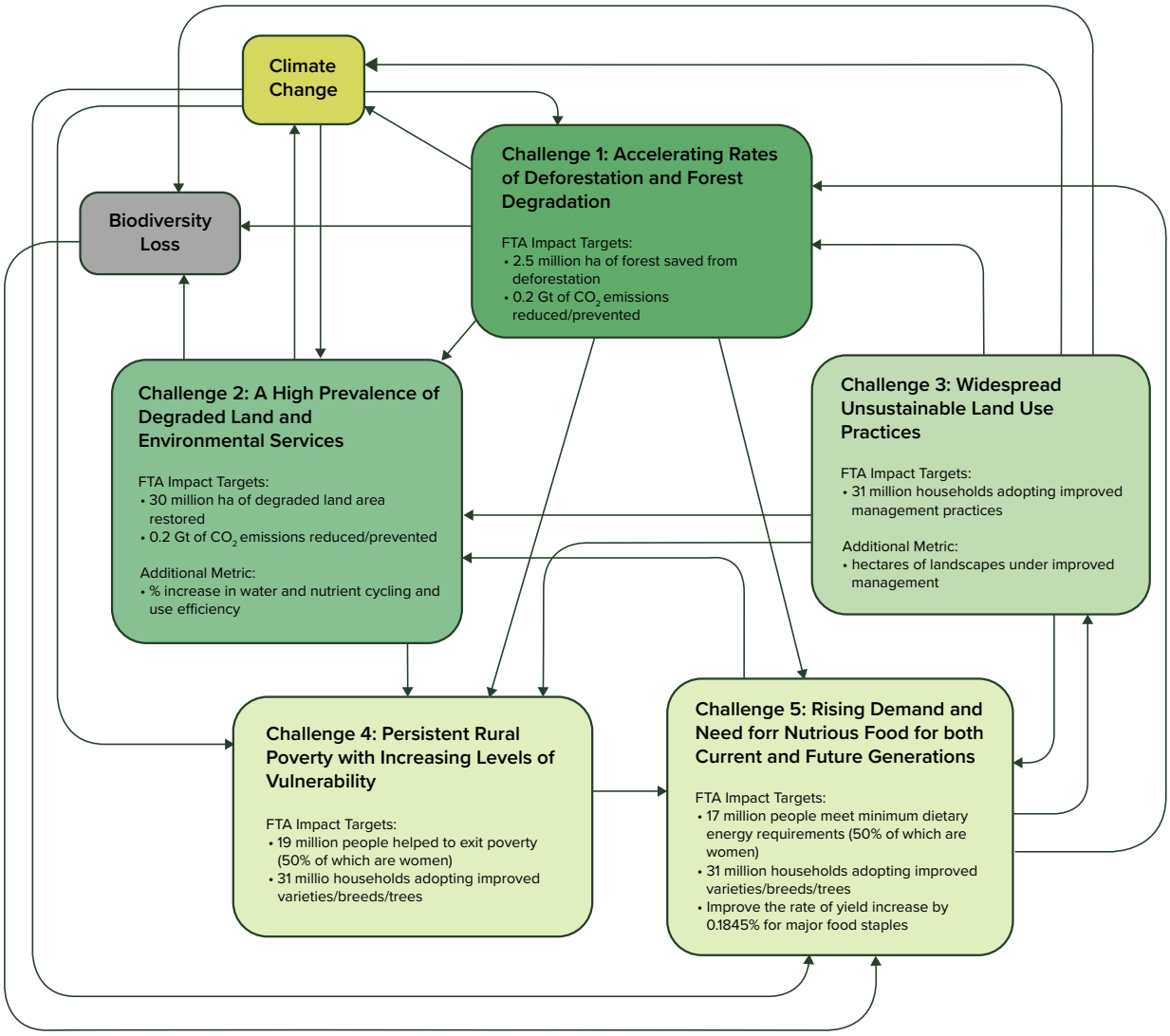

Figure 1. Complex interactions between the five key global challenges FTA aims to address

realized over time. The evaluation was guided by the following questions:

1. Research Outcome Evaluation: To what extent and how did FTA's research portfolio contribute to outcomes in each of the five challenges?
2. Impact Estimation: What is the scope and scale of impacts to which FTA's research portfolio has contributed for each of the five challenges?

Methods

FTA's contributions to addressing key global challenges were assessed by:

Step 1. Comprehensive mapping of projects and initiatives addressing the challenges:

Over 100 completed and ongoing FTA-funded projects were mapped to one or more of the five challenges. A review of available project documents, supplemented by interviews with project scientists, identified thematic and geographic clusters of projects (Table 2).

Table 2. Number of Clusters and Projects by Challenge

Challenge	Number of Projects Mapped	Number of Clusters Identified
1	45	11
2	55	13
3	59	19
4	58	14
5	14	4

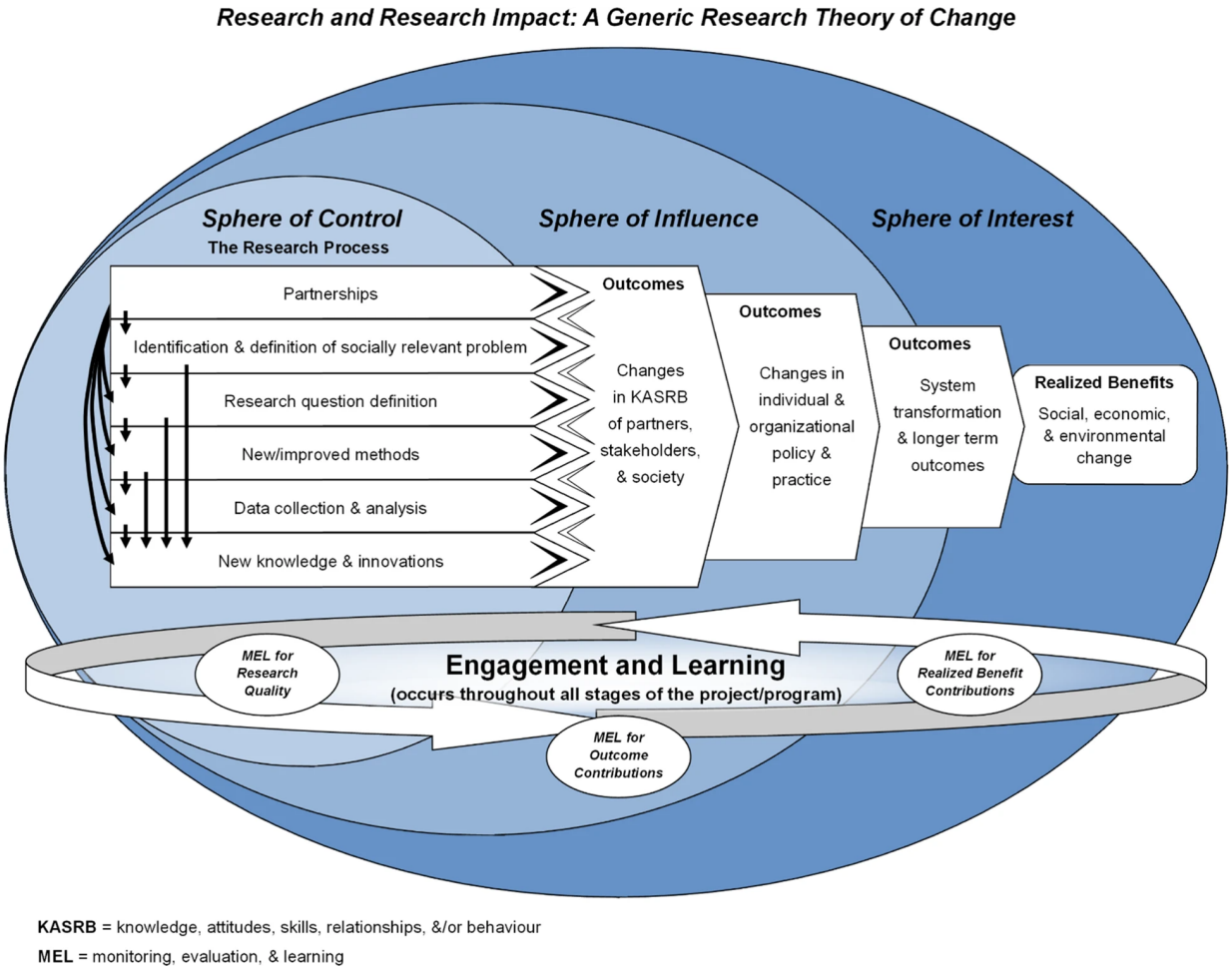

Figure 2. Research-for-development theory of change, with spheres of control, influence, and interest (Belcher & Halliwell, 2021)

Step 2. Documenting composite ToCs at cluster and challenge scales: Available information from pre-existing ToCs and project proposals on key activities, outputs, outcomes, and impacts at the project-level was organized in thematic and geographic clusters. All available information was then used to develop and document composite ToCs (i.e., combining ToCs for related initiatives/projects), to determine how FTA's activities and outputs were expected to contribute to outcomes and impacts respective to each challenge. Each challenge documented a set of cluster ToCs that could be nested into an overarching ToC.[2]

Step 3. Collating existing evidence by cluster: FTA had commissioned theory-based evaluations and impact assessments of several of its projects, which provided an initial base of evidence that could be built upon. Available evaluation evidence (i.e., use/uptake of outputs, outcomes, impacts) was systematically reviewed and appraised for each project. In cases where external evaluations were not available, other documents (annual reports, outcome stories, midterm/quarterly reports, final reports, peer-reviewed articles, theses, briefs, etc.) were reviewed for evidence of outcomes and impacts.

Step 4. Assessing outcomes for each cluster of research: Available data were used to assess outcomes. Additional data were collected as needed and when possible to assess outcomes by reviewing documents and consulting with project scientists.

Step 5. Deep dive selection and analyses: To provide more in-depth analysis and to better illustrate the broad range of impact pathways

2 These ToCs can be found in the respective challenge reports or through Miro.

and outcomes, we conducted "deep dives" on one cluster from each challenge. Clusters were purposively selected to include sets of projects with relatively large combined budgets, high potential for realized outcomes, and high potential to source additional data. Preference was given to clusters that related to more than one challenge, and that, when taken as a set, represented the range of FTA geographies as well as FTA main partners. For each deep dive, we completed additional literature review, bibliometric analyses, and interviews with project scientists, partners, and other stakeholders to better assess what outcomes were realized and how, and to understand potential longer-term outcomes and impacts.

Step 6. Estimation of Potential Impact: Individual FTA projects defined and reported the actual or potential adoption, use, and impact of their work in many different ways and in many different units of measure, including:

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

In some cases, the methods and/or assumptions used to estimate adoption, use, or impact, were unclear or not reported. Many projects did not report on uptake, use, or impact at all.

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 ranges of potential impact of FTA's work.

We took the following steps to estimate the potential impact of the entire portfolio:

1. Available impact data for each project reviewed were classified as either a low-end (i.e., actually realized) or high-end

Table 3. Impact indicators and units per challenge

Challenge	Indicators (units)
1. Accelerating rates of deforestation and forest degradation	• ha of forested landscapes and peatlands considered to be under enhanced protection • Tons CO_2 avoided from enhanced protection of forests
2. High prevalence of land and ecosystem service degradation	• ha of land considered to be under restoration • Tons CO_2 sequestration potential from land restoration • M3 of water and soil conservation potential • % increase in biodiversity
3. Widespread unsustainable land use practices	• ha of landscapes under improved management • Number of households adopting improved management practice
4. Persistent rural poverty with increasing levels of vulnerability	• Number of people with additional means to exit poverty or reduced vulnerability of falling into poverty
5. Rising demand and need for nutritious food for both current and future generations	• Number of people provided with additional means to improve their food and nutritional security

(i.e., potential) estimate. Note that some projects might report both kinds of data, one kind of data, and some projects report neither.
2. Impact data were converted to standard units of measure (e.g., numbers of people; millions of hectares for area of land or forest; tons of CO_2), using appropriate conversion factors.
3. Project-level data were summed to produce low-end and high-end cluster-level impact estimates, and then further aggregated to derive low-end and high-end challenge-level impact estimates.

While some low-end estimates may still not have been realized (i.e., 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 policy targets to be realized, policies must be formed or reformed and implemented effectively. For example, one of the high-level estimates of reduced deforestation is based on the assumption that a policy influenced by FTA research would prevent forest fires over the entire area covered by the policy. Moreover, given the long lag times inherent to forests, trees, and agroforestry research, and to some of the impact pathways considered, the high-end estimates are highly uncertain. All of these factors and more affect the degree to which FTA has contributed and will contribute to impact.

Limitations

Interpretation of the results should consider the following limitations.[3]

1. Variability in data availability and reliability
2. Inconsistency in reporting gender-disaggregated data
3. Risk of double-counting
4. Risk of under-reporting
5. Time lags to impacts
6. Practical limitations on the scope of the study

3 More detailed explanations of these limitations can be found in the individual studies https://www.foreststreesagroforestry.org/fta-integrative-studies/

1 How and to what extent has FTA addressed the 5 Global Challenges?

The following section summarizes the extent to which outcomes in each of the challenge ToCs were realized. It presents FTA's main contributions to outcomes across actor-specific impact pathways in terms of policy[4] influence, practice influence, and research (i.e., knowledge generation) influence that have been realized. The main impact pathways that supported the achievement of the outcomes and impacts presented in this section are described in section 3 below. FTA's targeted policy influence predominantly focused on addressing deforestation and unsustainable landscape management issues, while FTA's targeted practice influence focused on enhancing restoration and extension practices for ecosystem services as well as communities' practices that would support more sustainable livelihoods and enhance food security. The results presented here answer the guiding evaluation question for the FTA integrative studies: To what extent and how did FTA's research portfolio realize outcomes in each of the five challenges? Select impact pathways and examples are given for each challenge; other and more detailed examples can be found in the respective challenge reports.

1.1 Challenge 1: Addressing accelerating rates of deforestation and forest degradation

The accelerating rates of deforestation and forest degradation is an important challenge for research-for-development…

Deforestation is interconnected with FTA's other four challenges as it negatively affects biodiversity, ecosystems, the climate, and in some cases, access to sustainable livelihoods for communities. The FAO's Global Forest Resource Assessment estimates that 10 million hectares of forest were cut down each year between 2015-2020 (FRA, 2020). Over 2015-2017, the average global loss of tropical forests contributed approximately 4.4 Gt of carbon dioxide per year (Global Forest Watch, 2021). Global deforestation is driven by multiple factors, from inadequate land use policies to poor forest management to the underlying social, economic, political, cultural, and technological interactions at multiple scales (Kissenger et al., 2012). At UNFCCC COP26, 141 nations signed the Declaration on Forests and Land Use and pledged to halt and reverse deforestation and land degradation by 2030 across 3.7 billion hectares of forests worldwide, paving the way for future research investment.

We conceptualize deforestation using FAO's (2020) definition: "the conversion of forest to other land use independently whether human-induced or not, including permanent reduction of the tree canopy cover below the minimum 10% threshold, but excluding areas where trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silviculture measures" (p.6). Part of FTA's work addressing this challenge is focused on the protection of peatlands, wetlands, and mangroves. Although these land-types do not fall entirely under the FAO definition of forests, they have been included within the assessment due to the focus on the conservation of these land types which closely aligns with the aims of Challenge 1.

4 This study uses a broad definition of policy, which is defined as a decision or commitment to a particular course of action (adapted from Pielke, 2007).

In response...

FTA worked globally to support research across Asia, Africa, and Latin America, addressing drivers of deforestation and forest degradation. FTA provides knowledge that frames issues, generates data on forests to understand current conditions and trends over time, develops innovations, and builds the capacities of actor groups to implement solutions through targeted engagement. FTA's research also informs the development of policies at global, national, and sub-national levels, including policies focused on providing incentives for more sustainable practices by communities, smallholders, and the private sector. FTA fosters support from development NGOs and other organizations with similarly aligned objectives to orient governments and the private sector to reduce deforestation related practices. FTA undertook targeted knowledge-sharing through the media, to encourage the public to hold governments and large corporations accountable for deforestation practices. FTA also contributes to the climate change agenda by improving tools and policies for climate mitigation through reduced deforestation and forest degradation (i.e., REDD+). FTA's research aimed to enhance forest protection, improve forest monitoring systems, support the effective implementation of policies and practices, reduce instances and extent of forest fires, and reduce agricultural expansion into natural forests to decrease deforestation, forest degradation, and related effects (e.g., carbon emissions, health impacts from anthropogenic forest fires, livelihood impacts from forest resource scarcity).

FTA influenced researchers by...

FTA built the capacity of researchers, partners, local universities, government research agencies, and international research organizations to advocate for science-based decision-making; advance research, methods, and tools on the topic; and strengthen the capacities of the next generation of researchers. FTA supported the capacity-building of staff, masters, and doctoral students through collaborative activities and completed training to encourage continued future research. For example, FTA provided training to participants from various institutions (e.g., 1,200 researchers in the DRC) and built the capacities of over 120 students globally on the topic of deforestation and forest degradation (e.g., Guatemala: 6 students; DRC: >70 graduate students; Indonesia: 38 students; Mozambique: 15 students). There is evidence that eleven of the students in Indonesia continue to work in forest and natural resource management (NRM). Hence, FTA strengthened local and in-country capacity for further research on deforestation and forest degradation across many contexts.

FTA influenced international and national governments by...

Through knowledge-sharing and capacity-building, FTA worked to increase understanding and subsequent action by governments to address accelerating rates of deforestation and forest degradation. FTA supported members of government staff in Indonesia to increase their capacities and conduct below ground biomass calculations to facilitate an increased understanding of the value of conserving wetlands. In Cameroon and the DRC, FTA brought governmental attention to the domestic timber market issues and helped equip the governments to implement policy measures and monitoring systems for FLEGT. In Vietnam, FTA normalized the concept of Monitoring & Evaluation (M&E) among central and provincial governments who became more aware of the need for methods to carry out rigorous Payment for Forest Environmental Services (PFES) impact assessments and ensure payments are made to the right people with the high-end potential to better protect 6.7 million ha of forest with the successful scaling up on the M&E tool. In Peru, FTA built coalitions with key government agencies to align objectives and coordinate action so that mechanisms to reduce deforestation and forest degradation would realize their full potential (e.g., agroforestry concessions (AFC) with the high-end potential to better protect 450,000 ha of forest).

FTA influenced international and national policy by...

FTA's influence on policy was key in addressing Challenge 1 at the global, national, and sub-national levels and was primarily

achieved by increasing the capacity of government actors and policy-makers to make evidence-informed decisions. FTA influenced international instruments, policies, and standards related to the protection of forests (e.g., REDD+, the global forest goals, Green Climate fund, etc.), by direct partnership with UN agencies or through policy reports that were then taken up to various extents by international processes. FTA also contributed to advocacy and engagement in numerous platforms and events where commitments were made and action plans devised (e.g., forest action days of the UNFCCC COPs, COFO, etc.). Projects led by scientists with established relationships with policy-makers were more likely to contribute to policy outcomes. For example, in Indonesia, the credibility of FTA's research convinced policymakers to reflect on research findings during the development of the Forest Concession Moratorium (i.e. PIPPIB) which has the higher-end potential to better protect up to 52.1 million ha of primary forests and peatlands.

FTA influenced partners and allies by...

FTA supported NGOs, partners, and project collaborators to develop their knowledge of solutions and build their capacities. Partnerships with NGOs and organizations (e.g., WWF) were strengthened through collaborative activities such as planting, research collaborations, and research training and capacity-building. FTA stimulated partner NGOs to implement agroforestry plantations and restore and manage degraded forests in the Congo Basin. With NGOs and allies supporting FTA research and awareness-raising activities, as well as using FTA's outputs in their advocacy, there is increased pressure on governments and the private sector to reduce deforestation and forest degradation by implementing and enforcing policies or upholding zero deforestation commitments. In Indonesia for instance, NGOs are using data generated by the Borneo Atlas to advocate for more sustainable management practices in the oil palm sector, put pressure on governments, and hold the private sector accountable to their deforestation commitments (Davel et al., 2020). Greenpeace used the Atlas in two of its campaign reports – one of which was submitted to RSPO in a claim to the Roundtable on Sustainable Palm Oil (RSPO) against a private company's deforestation. Using the data, Greenpeace was able to show how the forest cover on the company's plantation changed over time. The company which Greenpeace filed their complaint against responded by offering to compensate for the land that had been illegally deforested.

FTA influenced the private sector by...

By appropriately disseminating knowledge to private sector actors, some engaged industries became aware of and used credible scientific information to support sustainable management and reduce deforestation. FTA facilitated and participated in multi-level stakeholder engagement platforms to engage the private sector at national and sub-national levels in efforts to encourage the adoption of more sustainable and inclusive business models in Indonesia. For example, in Indonesia, FTA shared findings through the PIPPIB consultation process on the causes of deforestation, which led the government to restrict the awarding of concessions to companies on primary forest and peatlands. As a result, some large-scale plantation companies stopped converting natural forests to plantations and committed to zero-deforestation. This has been a big step forward, although many loopholes within the PIPPIB remain. In Cameroon, FTA engagement with private sector actors involved with timber supply chain management (e.g., SGS, Helveta) influenced revisions of companies' existing traceability contracts, which now feature smallholders, chainsaw millers, and traders as part of the formal supply chain. FTA also shared knowledge with 17 construction companies, enhancing their understanding of legal timber supply.

FTA influenced donors/investors by...

FTA's research strengthened donors' understanding of improved approaches for forest management whilst supporting new collaborations with donors and investment in future research on deforestation and forest degradation issues. On wetlands, FTA researchers were actively involved in formal

discussions, activities, guidance, and expert meetings on wetland issues to improve the awareness of governments in the UNFCCC. Since the UNFCCC began to discuss wetland issues in 2008, the number of wetland studies has increased. FTA's research has helped to raise academic, donor and policy interest, and allocate specific resources to advance the research agenda in wetlands, mangroves, and peat forests as carbon reservoirs through the variety of highly cited and influential research outputs. However, direct evidence of influence on donors was minimal.

FTA influenced the public by...

Targeted dissemination through national media and advocacy support from partner NGOs garnered public attention for issues related to deforestation and forest degradation. The global oil palm sector and forests fires in Indonesia are two major issues that received international media coverage in recent years, affecting public behavior and public demand for change. FTA's research on oil palm advocated for a balanced view on the matter of oil palm plantations (Rival & Levang, 2014) while some research outputs and findings were taken up and used by environmental NGOs to advocate for more sustainable practices as well as ethical consumption of forest products. Yet, the evaluation was not able to fully assess the influence of public and NGO advocacy for change. FTA researchers raised public awareness of the importance of forest and land fires prevention in Indonesia by gaining media attention on the large fires of 2015. FTA's strong positioning on the issue was also supported by the credibility of the findings and a scientist's pre-existing personal and professional relationships with government officials, who placed it high on the agenda and out in the public realm. Invitations to speak on national media brought greater understanding to journalists, the public, the corporate sector, and affected parties in Indonesia, Singapore, and Malaysia about on-the-ground realities of contemporary fires. This public awareness supported increased pressure on policy-makers to instigate policy change and reduce deforestation by tackling fire and haze issues in Indonesia.

The realization of outcomes supported potential for impacts...

Outcomes realized within the ToC imply potential impact through collective action by a range of actors including national governments and international organizations, NGOs, communities, smallholders, researchers, and the private sector. Many outcomes also rest on the perfect implementation of, and private sector compliance to policies. However, conflicting policy agendas and differing private sector commitments and compliance have resulted in some potential impacts having lower likelihood for future realization. The outcome evaluation indicates that FTA's research is likely to contribute to further potential impact in the future. FTA's potential impact on deforestation and forest degradation is largely observed over areas where the research contributed to actionable and implemented policies.

Overall, there is evidence that FTA research and engagement has contributed to the enhanced protection of 25.6m ha (low-end estimate) of forests from deforestation and forest degradation in the countries assessed to date (e.g., area under and influenced by FTA projects, and area of land newly covered under forest protection policies and tools to which FTA directly contributed) (Figure 3). There is the potential for 133.4m ha (high-end potential) of forests to be under enhanced protection if all assumptions are sustained in the countries assessed to date. Based on these estimates, between 24 Gt and 125.3 Gt of CO_2 emissions may be avoided as a result of FTA contribution to enhanced forest protection.

Looking to the future for research in deforestation and forest degradation...

The findings illustrate how FTA contributed to key outcomes with potential for impact across Asia, Africa, and Latin America in addressing accelerating rates of deforestation and forest degradation. The assessment highlighted a number of lessons for future research on the topic.

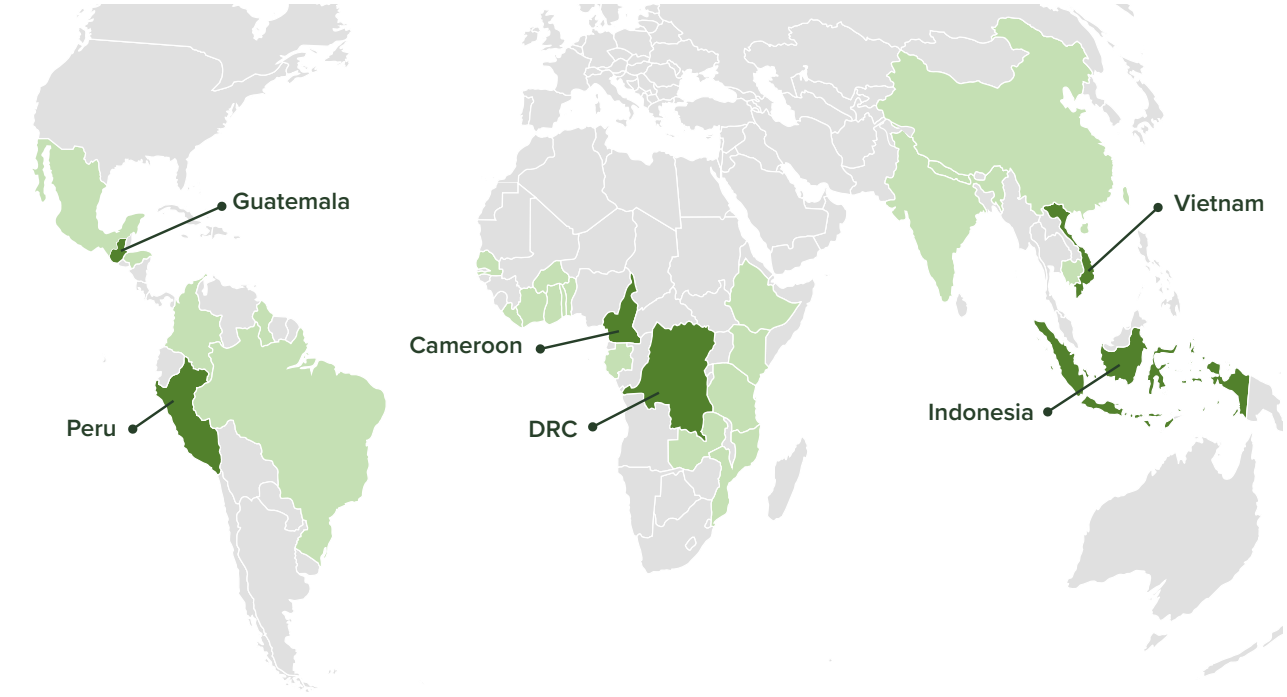

Figure 3. Countries where FTA has carried out research on topics mapped to Challenge 1

What worked well...

- Many of the impact pathways intersect with and are influenced by policy change on deforestation and forest degradation, making policy a key way through which FTA contributed to potential impact.
- Positive pre-existing relationships between scientists and government actors supported knowledge-sharing and trust in research outputs for their uptake and use within national policy, particularly within REDD+ and fire and haze in Indonesia.
- By being an objective source of knowledge and assuming the role of an effective knowledge broker, FTA provides evidence-based advice in a mutually beneficial and non-confrontational manner to governments.
- For future research in deforestation and forest degradation, it is important that ongoing institutional and individual relationships with policymakers remain to support the continuous promotion and use of research outputs to contribute to policy outcomes.

What could be improved...

- With much deforestation resulting from land use change, particularly for agriculture (e.g., oil palm), future work on combatting deforestation and forest degradation should make links with the agricultural sector, including policy development and implementation. This could be considered when planning future projects and programs by finding and collaborating with more partners engaged in agriculture.
- The public pathway could have been more prevalent within FTA's research on Challenge 1. To support policy implementation and compliance, future research should increase public awareness by disseminating knowledge to national media and collaborating further with NGOs who can act as advocates to increase public attention.

1.2 Challenge 2: Restoring degraded land and ecosystem services

The high prevalence of degraded land and ecosystem services requires research...

Productive land is vital to sustain life. Approximately 25 percent of the Earth's land was considered degraded by 2016; 95 percent of Earth's land mass could be degraded by 2050 (Sutton et al., 2016). Current estimates value lost ecosystem services from land and forest degradation between $6.3–10.6 trillion/year (Kaija, 2021; ELD, 2015). Global land and ecosystem services degradation experience positive feedback loops, increasing its negative effects. It is caused by deforestation and unsustainable land use, and threatens to exacerbate poverty, vulnerability, and food insecurity.

Global efforts are underway to reverse and prevent land degradation in order to sustain ecosystem services. FAO's Global Plan of Action for the Conservation, Sustainable Use and Development of Forest Genetic Resources outlines critical priority areas to improve the availability of, and access to, information on forest and genetic resources, in situ and ex situ conservation, as well as sustainable use, development, and management of forest resources. Under the Bonn Challenge, signatory countries committed to restore 350 million hectares of land by 2030. In Africa alone, the Africa Forest Restoration Initiative (AFR100) led countries to pledge the restoration of 125 million hectares. However, there is no silver bullet solution to land and corresponding ecosystem services degradation. To mitigate the risk of restoration done wrong, recent advances in agronomic research demonstrated the fine variability of suitable innovations according to contextual socio-economic and environmental conditions (Sinclair, 2019).

In response...

FTA pursued research and engagement that co-generated necessary goods and services to reverse degradation and restore land and ecosystem services at scale. FTA's research tackles several interconnected drivers, including unsustainable agricultural practices, overexploitation of natural resources, diminishing stocks of resilient and diverse tree genetic resources, expansion of monocultures, deforestation, and climate change. FTA also aims to address the compounding effects of land and ecosystem services degradation leading to poor ecosystem functions, such as soil erosion and water scarcity, biodiversity loss, and loss of provisioning ecosystem services to sustain livelihoods. The drivers and effects of the problem serve as entry points for FTA's research and engagement.

FTA's approach appreciates that, to be effective, interventions must be appropriate for specific conditions. The options-by-context (OxC) paradigm aims to ensure that planting material, agroforestry practices, and restoration approaches are well suited to site conditions, community needs, and local context. FTA also conducted analyses and developed tools and information to support context-appropriate restoration. For example, the Diversity for Restoration (D4R) Tool recommends appropriate tree species for user-specified restoration program objectives and site conditions. It links the user to seed suppliers and resources for optimal propagation and management of the species combinations. FTA also convened and participated in multi-stakeholder fora to inform policy processes. For example, FTA researchers participate in technical working groups on rewards for ecosystem services policies in Vietnam, as well as in a global multi-stakeholder forum on sustainable rubber to guide industry and channel research findings on green alternatives to rubber monocultures (e.g., understorey regrowth). Such fora bring stakeholders together to advocate for a policy environment that will enable and incentivize widespread adoption of new practices to increase the health of land and ecosystem services. FTA also worked on the ground to build the capacities of smallholder farmers and extensionists to adopt new practices, and supported the development of seed delivery infrastructure to ensure optimal germplasm is used in active planting. For example, in Ethiopia, FTA measured the impacts of introducing exotic

and native species into different land use systems, and supported the establishment of 30 Breeding Seedling Orchards (BSOs) to facilitate land restoration over specified priority areas. To ensure sustainable use of natural resources over the long term, FTA contributed to protocols for preserving and promoting the sustainable use of key genetic resources, optimizing climate resilience (e.g., cacao) and genetic diversity (e.g., coconut cryopreservation).

FTA influenced governments by...

FTA's influence on policy supporting the enabling environment for land restoration across Latin America, Africa, and Asia was achieved through representation in technical working groups, directly supporting policy development (e.g., white paper preparations), and participating in policy dialogues and events. In Vietnam, FTA scientists have been members of technical working groups to provide key policy advice on the design and implementation of reward for environmental services schemes. FTA supported the development of multiple RES policies and piloted models with communities to incentivize tree planting and climate smart agriculture. 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 have contributed to a decline in the area of degraded forests in the country. At the sub-national level, FTA's integrated home-garden and sloping-land scheme was incorporated into policy. In Ha Tinh and Quang Binh, land planting activities were incorporated into development strategies and policy decisions to support climate-smart agriculture. Through knowledge-sharing and involvement in policy dialogues with provincial policy-makers in Yen Bai province, FTA also influenced the implementation of three provincial policies aimed at supporting son tra (H'mong apple) development to boost ecosystem services and subsidies. In Malaysia, 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. 200,000 ha of land in Sarawak were identified as priority areas for restoration. As a result of these contributions, the Forest Department 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. Over the course of two years, the Sarawak government supported the planting of 10 million trees of over 50 species over the priority area, covering 9,732 ha. Through the adoption of FTA's recommendations, the Sarawak government established 6 forest tree nurseries and 27 seed production areas. FTA also contributed to the implementation of AFCs in Peru, low-emission development strategies in Indonesia, and many others.

FTA influenced practitioners by...

Globally, FTA contributed to a CBD COP12 decision to consider genetics in restoration. This unexpected uptake of research by the Convention of Biological Diversity inspired the development of the Diversity for Restoration Tool. The tool provides the necessary practical information to ensure that globally recognized importance is translated into effective restoration on the ground. Researchers involved in the tool's development have successfully reached restoration program funders (e.g., GEF) and implementers (e.g., IUCN, FAO) to apply it. As a result, the tool is being used in restoration projects funded in Colombia, Peru, Madagascar, Kenya, Cameroon, and India. While these programs are underway and expected to have positive impacts over their own targeted areas (totaling 23,778 ha), the realization of this potential (high-end) impact hinges on their successful implementation.

FTA influenced smallholders by...

FTA's influence on smallholder land management practices was achieved in part through an enabling policy environment. The implementation of demonstration trials, training to support seed system infrastructure development, nursery establishment, and management, and the introduction of resilient species suitable to local context for restoration were more direct ways in which FTA achieved influence in partnership. These activities all built the necessary capacities

for variable farmer adoption of improved practices across different areas. Adoption surveys from the Drylands Development Programme implemented in Burkina Faso, Mali, Niger, Kenya, and Ethiopia showed that trainings with farmers on climate-smart agriculture, soil and water conservation, and OxC agroforestry resulted in a total of 100,000 farmers applying new technologies and practices promoted by FTA and partners. New practices adopted include soil erosion control, water harvesting and conservation structures, soil fertility management, and agroforestry practices. These practices have been applied to restore a total of 265,902 ha. Capacity-building and direct engagement with smallholder farmers was a key impact pathway to restore land and ecosystem services in dryland areas. The impacts were largely observed over areas and study sites where improved practices (e.g., understorey regrowth, intercropping, OxC agroforestry, soil and water management practices, farmer managed natural regeneration, etc.) have been tested, applied, and proven to be adopted in project evaluations.

FTA influenced researchers by...

FTA's influence on a trajectory of research that recognizes the critical role of trees, agroforestry and forests on landscape restoration was achieved through its academic rapport, broad and far-reaching networks, mutually beneficial partnerships, and opportunities provided for local research capacity-building. For example, through sustained partnerships with the University of Kisangani (UNKIS) in the DRC, 220 post-graduate students carried out research in 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 capacities for research. 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 which informed restoration activities implemented over 8,000 ha in the DRC.

The realization of outcomes supported potential for impacts...

Multiple research projects made contributions to the realization of the intended outcomes, but they manifested differently across contexts. The effects of restoration of land

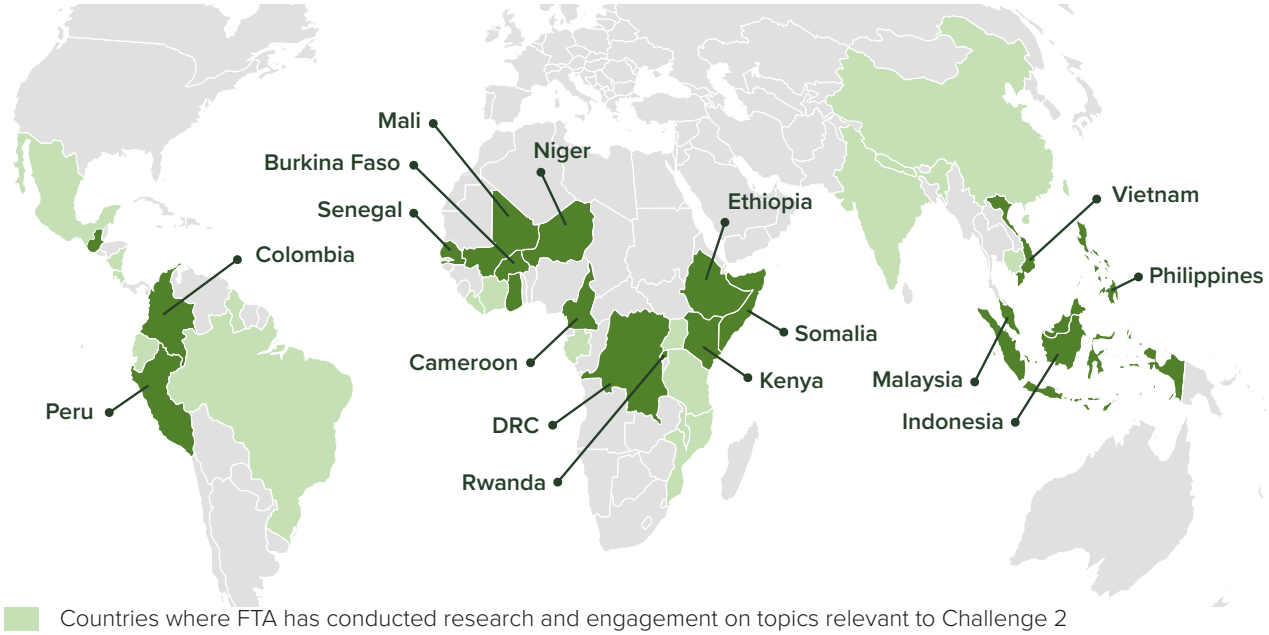

Figure 4. Countries where FTA has carried out research on topics mapped to Challenge 2

and ecosystem services require time to be fully observable. Forests, trees, and agroforestry system innovation takes time for full benefits to be realized as trees mature to produce goods and services. However, estimated carbon sequestration potential of active planting initiatives supported by FTA were available for some projects.

We estimate that the cumulative effects of FTA's research and engagement contributed to placing at least 2.1 million ha under restoration (Figure 4), with the potential for up to 34.4 million ha to be under restoration in the future. Projected carbon sequestration effects of active planting facilitated by FTA is estimated to be from 1.4 million tons CO_2 to reach the potential of 511.5 million tons of CO_2. High end impact estimates of the projected effects on soil and water conservation and biodiversity were only available for one project.

Looking to the future of research for development in the UN Decade for Restoration...

FTA contributed to a number of key outcomes with potential for impact across Latin America, Africa, and Asia to support progress on this challenge, but much remains to be done. Time is of the essence to continue progress, mobilize contextually-appropriate innovations, and increase ecosystems' capacity to provide goods and services. Available data and tools must be put into widespread use to inform decisions and program design as we enter the UN Decade on Restoration.

What worked well...

- Relationships and sustained engagement in policy processes are key to policy influence. Policy influence is most likely to occur through a sustained and long-term engagement with decision-makers. This is a condition for building the necessary rapport to be invited to serve as technical advisors and to contribute to policy processes. Contributing to national (e.g., RES) and international policy mechanisms (e.g., COP decisions, REDD+) are key pathways by which FTA can facilitate a favourable policy environment for restoration of land and ecosystem services. Many of the other impact pathways intersect with and are influenced by policy change on land and ecosystem services restoration.
- Effective capacity development is a critical social process contribution to support the uptake of research findings. 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. 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. Direct engagement with communities and smallholders supported the uptake of research outputs and the formalization of recommendations into practice. This was variably illustrated through the use of 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 with practical information were key to scaling efforts.

What could be improved...

- Addressing barriers to adoption of improved practices is needed. Adoption rates of FTA-promoted innovations were variable. This was due to lack of extension services post-project, lack of market linkages, and external factors like pests and natural disasters (e.g., fires, floods, climatic events). Systematically addressing adoption barriers as part of the research objectives will be key for future research to better support the uptake of innovations at scale.
- Explicit consideration for contingencies of research impact is needed. The realization of estimated potential impacts hinges upon many factors. These include (i) successful implementation and enforcement of policies to which FTA contributed, (ii) sustained adoption of new practices and application of learned skills; and (iii) scaling of promoted practices, the

survival of species planted, and effective management of restoration initiatives. More explicit recognition, integration, and testing of these conditions throughout the research process would increase the likelihood of sustained impact at scale.
- Establishing a clear baseline to support systematic monitoring of progress on the challenges the program seeks to address in context. FTA's targets do not match the broad range of ecosystem services; despite interest in reporting (i.e., biodiversity increases, soil fertility), and clear relevance of additional indicators of ecosystems' capacity to provide goods and services, the data was not available. This data is collected in some cases during research projects (e.g., via LDSF), but is not always systematically reported for monitoring and evaluation purposes. Moreover, some tools are not leveraged to establish project baseline scenarios to enable end-of-project comparison or robust impact assessments of these variables. Stronger collaboration between research managers and MELIA could better facilitate communication and impact measurement to facilitate research uptake and use, and support adaptive management.

1.3 Challenge 3: Widespread Unsustainable Land Use Practices

Addressing unsustainable land use and management is important because...

With growing populations and developing economies, the exacerbation of climate change, incompatible land uses, rising pressures on lands and forests for food production, and unsustainable exploitation of natural resources all threaten the very landscapes on which we depend (Diamond, 2005; FAO, 2021; Howe et al., 2014; OECD, 2020; Olsson et al., 2019; Vlek et al., 2017). Historically, conservation efforts have focused on the management of protected areas. Yet, most of the world's biodiversity occurs outside of protected areas, primarily in fragmented landscape mosaics with a variety of different land uses (FTA, 2021; IUCN, 2021; Lele et al., 2010). Formal land-use planning traditionally excludes sustainable forest use and agroforestry. The institutional dichotomy between forest and non-forest land therefore poses a central challenge for integrated landscape management, and has environmental and social consequences (Chazdon et al., 2016; Fischer, 2018; FTA, 2021; Reed et al., 2020).

In response...

Governance and the management of different landscapes (e.g., forests, drylands, wetlands, etc.) became important focal areas of FTA's research. The research tackles several drivers, including poor governance and oversight, weak institutions, agricultural expansion, and unsustainable land use practices at the industrial and small-scale. FTA's research also aims to address the resulting compounding effects of mismanaged landscapes, such as climate change, damaged ecosystem services, land degradation, natural resources scarcity, food insecurity, poverty, and poor health.

FTA tackled the challenge using a combination of approaches, targeting both high-level decision-makers at the international and national scales, as well as lower-level sub-national and local decision-makers and system actors working on-the-ground (e.g., communities, SMEs, etc.). Part of FTA's research focused on providing knowledge to frame issues, such as the consequences of unsustainable practices, contextual barriers, and opportunities for landscape governance, and generating data on land and forest use to understand current conditions and trends over time. FTA also developed tools and methods for context-appropriate and inclusive decision-making, land use planning, and monitoring (e.g., Adaptive Collaborative Management (ACM), OxC approach, Land Use Planning for Low Emission Development Strategy (LUWES), Land Use Planning for Multiple Environmental Services (LUMENS) framework, Information System for Sustainable Land Development (INSTANT) framework, Community-based Peatland Restoration Monitoring System (CO-PROMISE), etc.). FTA also proposed policy solutions and innovations (e.g., landscape governance frameworks,

incentive schemes, co-investment models, etc.), providing guidance and support for policy implementation through its research outputs and engagements. FTA participated in multi-stakeholder fora, task forces, and working groups to contribute to the creation of an enabling policy environment, as well as support and inform decision-making on the sustainable management of landscapes and natural resources. At the international level, FTA aimed to improve mechanisms for climate mitigation (e.g., Reducing Emissions from Deforestation and Forest Degradation (REDD+), wetlands, agroforestry, payment for environmental services (PFES), etc.) and advance the climate agenda. FTA also offered training to government staff, practitioners (e.g., extensionists), and communities in the application of FTA's data and tools, as well as improved management and monitoring practices.

FTA influenced government actors by...

Through Challenge 3 alone, FTA contributed to over 300 policies, strategies and action plans, development and land use plans, and governance arrangements at multiple levels (international, regional, national, sub-national) across 29 countries. For example, through involvement with the Association of South East Asian Nations (ASEAN) to support regional climate change policy processes, FTA provided technical assistance to and helped devise high-level policies, plans, and guidelines to incorporate agroforestry as a climate management strategy. Much of FTA's contributions to ASEAN-level policy also influenced national forest laws, policies, and guidelines in eight ASEAN member states. As a result of these contributions, 7.22 million ha are covered by social forestry arrangements.

FTA's research also supported policy revisions. For example, in Guatemala, FTA shared findings demonstrating the viability of community forest concessions with government officials from the National Council of Protected Areas (CONAP), who used the research to inform the revisions for the concession renewal process. To date, one concession contract was successfully renewed using the revised technical norms, placing over 50,000 ha under community management for another 25 years. Eight additional contracts are due for renewal over the next several years, covering a potential total of over 350,000 ha.

FTA also supported policy implementation processes through technical assistance and offered capacity-building to support the day-to-day work of government staff. For example, in Peru, national and sub-national governments have a greater understanding of AFC implementation options and compliance barriers facing smallholders as a result of FTA's research. Through FTA's training, regional governments became better equipped to identify areas eligible for AFCs using meso- and micro-zoning methods, estimating that up to 1 million ha of land and over 450,000 ha of forests have potential to become AFCs. FTA researchers and partners continue to engage governments in two follow-up projects to enhance institutional coordination and capacity for more effective implementation of AFCs on-the-ground.

To address Challenge 3, FTA supported other policy processes to advance national capacities for REDD+, FLEGT and sustainable forest management (SFM), the management of different landscapes (e.g., forested lands, drylands, wetlands, sloping lands, etc.) and NTFPs (e.g., Brazil nuts, oil palm, cocoa, coffee, etc.), agroforestry, and fire prevention, among others. FTA researchers made contributions to knowledge and institutional processes through one-on-one engagements, dedicated working groups, and multi-stakeholder decision-making platforms.

FTA influenced practitioners by...

To enhance the delivery of extension services and monitoring, FTA provided diverse training in decision-support and land use planning tools, agroforestry techniques, landscape management practices, and monitoring systems to practitioners and extensionists. For example, throughout Latin America, CATIE trains practitioners to apply tools like ShadeMotion and TonFanalyzer to inform the design and management of on-farm trees and agroforestry systems. To date, close to 600 practitioners gained skills to apply these tools and these supports have enhanced

extension delivery to support improvements to farmer practices on-the-ground. In the National Niassa Reserve in Mozambique, FTA drew upon traditional hive management practices from local honey gatherers to share with reserve managers as a viable management solution. Through engagements and training, reserve managers gained enhanced capacities for conservation and the monitoring of honey and timber extraction within the Reserve.

FTA influenced communities by...

In support of bottom-up management practices, FTA dedicated extensive resources to support community learning and capacity-building regarding FTA's improved options in agroforestry and landscape management. Over 280,000 farmers or small producers across 18 countries are better equipped to take up and apply FTA's tools, recommended technologies, and/or techniques to better manage their land, forests, natural resources, ecosystem services, and surrounding landscapes. Many communities learned through and benefitted from the pilots, farmer demonstration trials (FDT), and exemplar landscapes (EL) FTA implemented over the last decade. These strategies supported community learning, showcased local application, and encouraged uptake. For example, in Indonesia, more than 30,000 farmers built their skills in agroforestry management, nursery management, and tree propagation through FTA's training and FDTs to enhance community forest management practices. Taking an example from Africa, local partners in the Drylands Development Programme trained close to 220,000 farmers to better manage dryland areas. On-farm, over 140,000 of these people are applying soil and water conservation management options to over 100,000 ha of land.

FTA also helped communities negotiate, renew, and implement community-led and/or participatory governance arrangements, such as the community forest concessions in Guatemala, as well as others in Uganda and Indonesia. In many of these examples, a key area of FTA's focus was to strengthen the participation and leadership of women and youth in community forest governance.

In Uganda, FTA's research and Prospective Participatory Analysis (PPA) approach served to enhance stakeholder engagement, coordination, and advocacy for tenure issues. These inputs supported and informed negotiations for land tenure for six community groups – to date, 70 ha of land have been granted to two of these groups. In Indonesia, FTA and partners promoted participatory governance structures and helped facilitate land use planning exercises for all villages in Bantaeng district. These activities assisted the formal re-establishment of boundaries of the Kajang peoples' customary lands (amounting to nearly 314 ha).

FTA influenced NGOs by...

Enhancing the knowledge and capacities of NGOs served to inform and support both governmental and bottom-up landscape management processes. Sharing FTA's findings with NGOs has better equipped these organizations with empirical data and evidence-based recommendations to employ in their policy lobbying and advocacy campaigns. For example, as part of FTA's research on oil palm in Indonesia, NGOs used FTA's research to strengthen advocacy for forest sustainability and gender. The example of Greenpeace's use of spatial data from the Borneo Atlas demonstrates the effectiveness of a well-positioned NGO's use of FTA's outputs to stimulate company practice change. Taking another example from Indonesia, FTA collaborated with Jikalahari (a local NGO) and the World Wildlife Fund to deliver community training and support the implementation of fire prevention and peatland restoration activities (e.g., sago planting, canal blocking).

Influencing NGOs was a reinforcing pathway to stimulate changes in other pathways, particularly governmental decision-making, private sector practice, and community practice. NGOs were a key boundary partner to support FTA's activities and capacity-building, gain access to various networks, promote FTA's outputs, advocate for policy or practice change, and continue momentum post-project. For example, FTA's ongoing work to support better implementation of AFCs in Peru is propelled by the advocacy

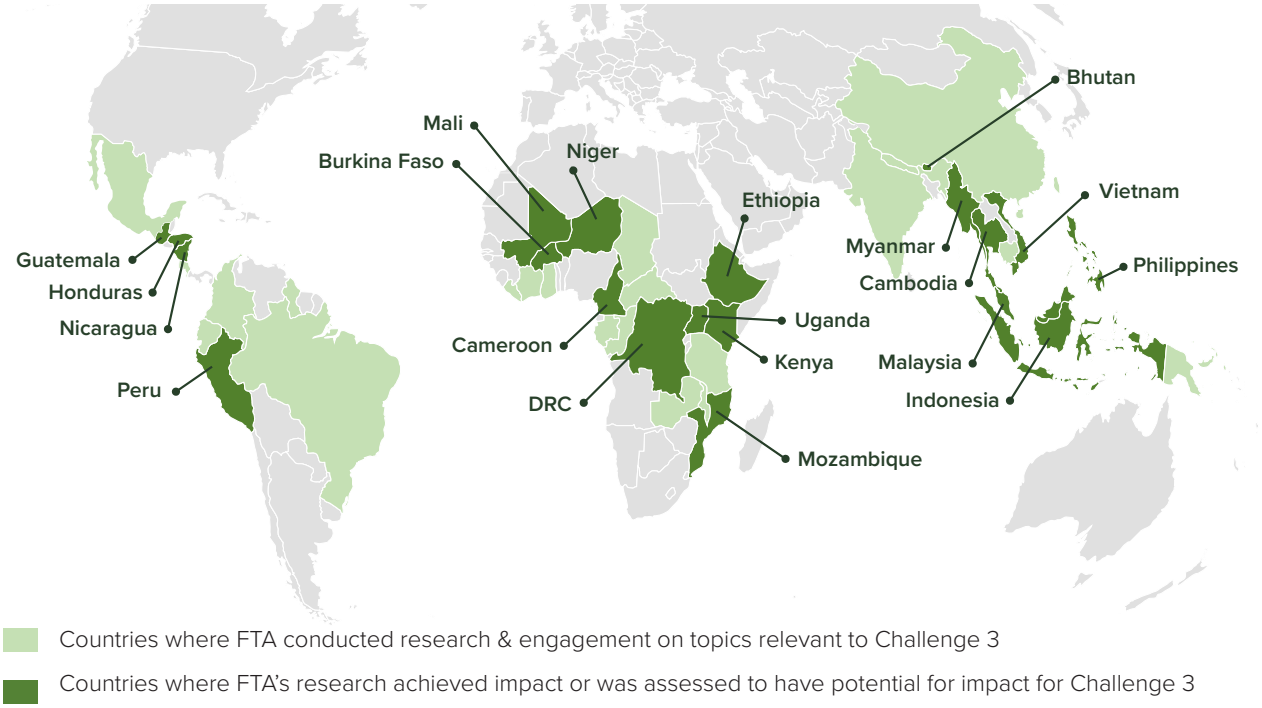

Figure 5. Countries where FTA carried out research on topics mapped to Challenge 3. The range of impact estimates correspond to the countries coloured in dark green

and commitments of local and international NGO partners to improve capacities and institutions.

The realization of outcomes supported potential for impacts...

The outcome assessment provides supporting evidence and illustrates how FTA's contributions to outcomes have already resulted in realized impacts on-the-ground in Latin America, Africa, and Asia, and/or are likely to catalyze further impacts in the future.

We estimate that 59.5 million ha (low-end estimate) of landscapes are now under improved management as a result of policy mechanisms, monitoring systems, and changes in on-the-ground management and land use practices influenced by FTA (Figure 5). In addition, we project that if other relevant FTA-influenced policies, action plans, and monitoring systems are effectively implemented and/or scaled in the future, a total of 204 million ha (high-end estimate) of landscapes have the potential to be better managed.

The realization of impacts relies on several conditions and caveats, including the effective enforcement of policies, the full adoption and implementation of new practices, the scaling of initiatives, and continuity of collective action post-project and post-FTA – all of which remain largely outside of FTA's sphere of control. FTA is one contributor among many organizations that aim to address this complex challenge. Impact estimates are also sensitive to a number of key conditions that vary on the basis of the research initiative, contextual factors in which the research is taking place (e.g., geography), and specific contributions of the research.

Looking forward for the future of research-for-development for sustainable landscape management...

FTA made notable contributions to policy, practice, and research over the past ten years in an effort to enhance landscape governance and reduce unsustainable land use practices that drive global deforestation, degrade landscapes, damage ecosystem services, and exacerbate poverty and food insecurity. The findings illustrate how FTA's research addressing unsustainable land

use practices contributed to outcomes and impacts, and highlighted several lessons for future research.

What worked well...

- Context-appropriate and integrated landscape approaches are key. There is growing recognition of and interest in integrated landscape approaches by governments, practitioners, and researchers to tackle the political, economic, social, and ecological inter-complexities of landscape governance and land use. Landscape approaches aim to reconcile competing interests, gain a systems perspective, and collectively negotiate solutions and trade-offs with relevant stakeholders (FTA, 2016b; Reed et al., 2020). For example, the OxC approach was effective in the research on AFCs and the Drylands Development Programme. Future research-for-development programmes should continue to develop and refine inclusive approaches and decision-making tools that can be adapted to diverse local contexts.
- Pursue diverse and reinforcing impact pathways to optimize influence. FTA's research projects that built in multiple pathways to influence change tended to be more successful at achieving and sustaining changes (or at least building momentum for future high-level outcomes and increasing the potential for the realization of impacts) than projects that relied on a single pathway. These considerations are crucial at the planning stage for both a research-for-development programme and its individual research projects. Projects need to target their engagement to diverse actor groups and aim to stimulate multiple processes. Such planning would benefit from collaborative processes that involve the very stakeholders that FTA or any other research-for-development programme aims to influence. Co-developing ToCs would be a strategic way to do this.

What could be improved...

- Supporting social process contributions is equally or more important than knowledge contributions. While many FTA research outputs (e.g., maps, data, scenarios, technical inputs, tools) were successfully taken up by governments to inform decision-making or policy change, projects that supported social processes (e.g., systems-thinking, more equitable/multi-perspective decision-making, collaborative problem-solving and solution development, coordination, capacity-building, implementation processes, etc.) were more effective at sustaining policy change and ultimately contributing to institutional or systemic changes. Governments may not have the skills to use the outputs, or they may lack the infrastructure and/or resources to apply the outputs effectively. Supporting social processes can help overcome these barriers.
- Research outputs need to be strategically aligned, tailored, and translated to diverse target audiences and stakeholders to support uptake and behaviour change. Sometimes government actors did not take up FTA's findings because the information was not tailored or appropriately translated for their understanding or according to their priorities. While some outputs are useful for understanding, they cannot always be leveraged by the target audience if the output is too technical or they lack the means to apply the data, the tool, or the recommendation as FTA researchers intend. Research findings should also be timely and responsive to other system processes (e.g., policy windows) as well as aligned with political interests and parallel issues in order to increase the likelihood that outputs will be taken up.
- Short-term projects experienced more challenges in trust-building and behaviour change amongst forest communities and smallholders. Investments in relationship-building and community buy-in are key. Evidence shows that trust often takes time to build, which can affect the likelihood of smallholder and community uptake of recommended approaches. For sustainable practice change at the community-level, community leadership and community members need to be equipped to manage and maintain their lands and forests well-beyond the project lifespan. Therefore, more investments are

needed to support longer project cycles as well as follow-up projects for continuity.

1.4 Challenge 4: Persistent Rural Poverty with Increasing Levels of Vulnerability

Addressing rural poverty is important because...

689 million people live in extreme poverty worldwide, surviving on less than $1.90 per day (World Bank, 2020). Poverty is conceptualized not only in terms of monetary value, but also as an obstacle that keeps people from attaining a certain level of well-being and participating fully in society. Therefore, considering the global Multidimensional Poverty Index[5], about 84.3 percent of multidimensionally poor people live in Sub-Saharan Africa (558 million) and South Asia (530 million) (UNDP & OPHI, 2020). As of 2020, across developing countries, 1.2 billion people lack access to clean cooking fuel, 687 million lack electricity, and 1.03 billion have substandard housing materials (UNDP & OPHI, 2020). Deforestation, land degradation and climate change have increased the vulnerability of forest- and agriculture-dependent livelihoods, affecting the income-generating activities of rural and natural resource-based communities in particular. COVID-19 has caused further economic turmoil, pushing millions of workers into unemployment, underemployment, and working poverty. Sustainable Development Goal 1: 'No poverty' reflects the global commitment to addressing this complex challenge. Interactions and tradeoffs among food systems, environmental services, and social welfare at different scales are important focal areas of scientific and applied research worldwide (Ericksen, 2007), and a key focus of FTA research over the last decade.

5 The Multidimensional Poverty Index complements the international $1.90/day poverty rate by showing the nature and extent of overlapping deprivations across 10 indicators in three equally weighted dimensions—health, education and standard of living (e.g., child mortality, nutrition, years of schooling, school attendance, cooking fuel, sanitation, drinking water, electricity, housing, assets).

In response...

Taking a people-centred approach, FTA's research tackled several drivers of rural poverty, including land-tenure insecurity, lack of education and government support, vulnerability to market conditions and climate change, poor market linkages, and unemployment. FTA's research also aimed to address the compounding effects of poverty, such as food insecurity, poor health, and the resulting overexploitation of forested landscapes and their natural resources to supplement livelihoods and cash income.

FTA contributed to addressing the challenge at different levels from on-the-ground farming to national- and international-level policies to help alleviate rural poverty and increase smallholders' and forest-dependent communities' resilience. FTA's research focused on the management and conservation of forest and tree resources, the interconnections between provisioning environmental services and livelihoods, climate change adaptation and mitigation, smallholder production systems and markets, and impacts of trade and investments on forests and people.

Through its research, FTA framed issues to draw attention to the socio-ecological and economic contributions of SMEs for SFM, as well as barriers, trade-offs, and opportunities for timber- and NTFP-based livelihoods. FTA also generated data on changing land use, trade flows, and socio-economic status of rural and vulnerable populations. FTA developed tools and methods for socio-ecological monitoring and to assess vulnerabilities. FTA prepared technical inputs, proposed policy solutions, and offered guidance to support the integration of agroforestry, timber, and NTFPs into cross-sectoral policy agendas and support policy implementation. FTA also made social process contributions via strategic training and knowledge exchange to build the capacities of governments, NGOs, community-based organizations, SMEs, and communities.

FTA influenced government actors by...

To enhance coordination among multiple levels of governments, FTA informed cross-sectoral policies, strategies, and plans to create a conducive policy environment and incentives for community forestry and agroforestry development at scale. In Ethiopia, FTA's successful alignment of research activities with national and regional governments' key policies and strategies (e.g., National Regreening Programme) helped leverage resources (i.e., technical, financial, and material) to support market development, and enabled stronger coordination among key government sectors. Through the establishment of multi-stakeholder fora, such as the National Agroforestry Platform formed under the chairmanship of the Ministry of Agriculture and Natural Resources and co-chaired by FTA (ICRAF), the Ethiopian government became better equipped to manage natural resources and improve market access for forestry and agroforestry-based products. In Kenya, an FTA-informed National Bamboo Policy legalized bamboo growing and exploitation for timber, biochar, and bioenergy, contributing to livelihoods of tens of thousands of community members in the bamboo-charcoal value chain while simultaneously reducing human pressure on natural forests for household cooking fuel needs.

FTA influenced the private sector by...

Most of FTA's achieved influence on private sector practices occurred at the SME scale, enhancing households' and communities' participation in forest- and agroforestry-based income-generating activities. FTA supported communities' uptake of business models, established thousands of SMEs, and strengthened pro-poor value chains across twelve African countries (Burkina Faso, Cameroon, Ghana, Kenya, Ethiopia, Madagascar, Malawi, Mali, Niger, Tanzania, Uganda, Zambia) and in Indonesia. For example, in Cameroon, FTA established 34 community-based forest enterprises from initial business ideas to fully functioning enterprises, 29 of which reported growth after two years. FTA supported an additional 84 business cases for investment. In Malawi, FTA built the capacities of forest-dependent community members in forest resources entrepreneurship and commercialization, equipping over twenty thousand households with skills to operate forest-based enterprises.

FTA influenced partners and allies by...

Capacity-building was central to this pathway for Challenge 4. FTA's research, training, and engagement increased NGOs', partners', and allies' capacities for enhanced advocacy for equitable forest governance arrangements, integration of tree-planting and agroforestry practices in cross-sectoral policy frameworks, smallholders' practices, and corporate accountability. Across several projects in Africa, Asia, and Latin America, FTA engaged with international and local NGOs, influencing the uptake of FTA's tools and methods to support the co-development of locally-appropriate solutions for livelihoods and household income. In many cases, FTA's capacity-building of NGOs served to influence practice changes in other pathways – particularly for communities. In India, FTA equipped NGOs to establish 26 nutri-gardens, distribute seeds, and provide extension support to communities. In Kenya, with FTA support, Feed the Children successfully established community nurseries and two agroforestry and nutrition innovation hubs to serve as convergence points for local communities' capacity-building. Successful engagement of over 500 households using a pilot school approach influenced the adoption of FTA-informed food tree portfolios and integration of agroforestry and nutrition programmes into NGO's activities in schools in other regions.

FTA influenced practitioners by...

Influence on practitioners' practices (e.g., extension agents) was achieved through capacity-building on co-created, climate-smart, and context-appropriate seed management systems and agroforestry and the development of targeted knowledge products for the provision of enhanced extension services to farmers and producers in nine African countries (Burkina Faso, Ethiopia, Kenya, Mali, Malawi, Niger, Tanzania, Uganda, Zambia) and three Asian

countries (India, Indonesia, Vietnam). In Indonesia, extensionists learned about silviculture, apiculture, and market issues, and developed skills to provide technical advice and extension to farmers to produce and/or process timber and NTFPs. Through this extension, Indonesian farmers are better equipped with knowledge and skills to diversify their production and add value, enabling them to get better prices for their products and increase household income. In Vietnam, extensionists learned about context-appropriate agroforestry systems, son tra value chains, and on-farm tree nursery management. FTA helped translate extension materials for specific species such as son tra into the traditional community language, which extensionists have taken up and distributed.

FTA influenced community-based organizations by...

FTA assisted community organizations to formalize, build institutional capacity, and access equipment and inputs. Community organizations and producer associations were also key boundary partners that helped link farmers and small producers to markets. For example, across Burkina Faso, Ethiopia, Ghana, Kenya, Mali, Niger, Uganda, and Zambia nearly 1,500 farmer organizations were established as formally-recognized cooperatives or associations. With increased capacity, most of these organizations improved the quality of services delivered to their members, supported new economic activities, developed linkages with input suppliers and markets, established sustainable input supply systems, improved management, and provided group sales and insurance services.

FTA influenced communities by...

Through FTA's introduction of resilient and context-adapted species, demonstration trials, supports to seed system infrastructure, the establishment of nurseries and learning centres, and capacity-building activities, communities became better equipped for participatory management of natural resources and to apply FTA options on-farm. FTA's contributions enhanced the necessary capacities to support communities' adoption of sustainable tree-based and agroforestry systems and improved management practices at the local level. For example, by adopting these practices, smallholder farmers increased and diversified their production for better livelihoods and household income in seven African countries (Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Tanzania, Uganda) and two Asian countries (India, Vietnam). By adopting improved tree-fodder technologies (e.g., dry season feeding practices and climate-smart agricultural interventions) and linking to new markets, over 100,000 farmers across Ethiopia, Kenya, Tanzania, and Uganda increased milk production at household level, which in turn increased their income. Taking an example from Zambia, over 18,000 smallholders adopted drought tolerant agroforestry seeds and integrated soil fertility management into their practices. Farmers benefited from reduced costs and had the potential to increase their yields with favourable rainfall conditions. Through the establishment of several community nurseries, Farmer Field Schools, and Common Production and Treatment Centers for bamboo across Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Tanzania, and Uganda, FTA raised awareness of bamboo as a sustainable and climate-smart alternative for energy production. Over 2,000 women built capacities for growing and processing bamboo, providing them with additional sources of household income and decreased expenses for cooking fuel (to redirect to other expenses like food and education). Farmer-to-farmer extension was another successful strategy to disseminate FTA technologies, support agroforestry adoption, and boost productivity where governmental extension services were limited. For example, in Malawi, over 300 farmers and extension agents trained a further 11,000 farmers to build skills in agroforestry techniques and FTA-promoted technologies.

FTA influenced researchers by....

FTA made diverse knowledge contributions to advance the research agenda on forest-based livelihoods and build research capacities of partners to support poverty

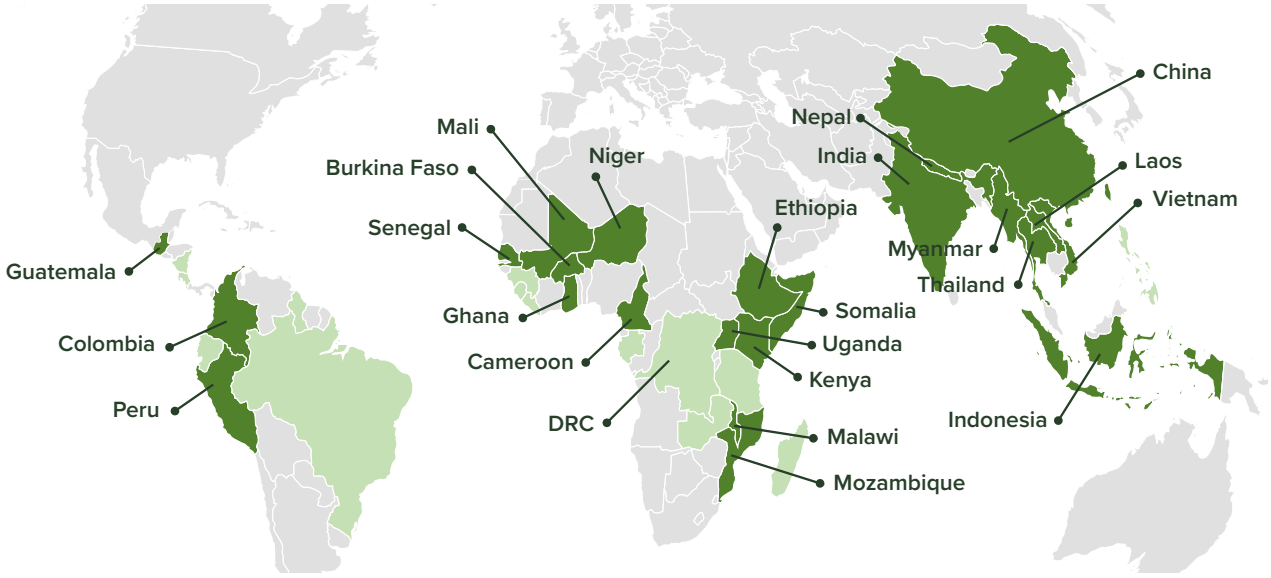

Figure 6. Countries where FTA carried out research on topics mapped to Challenge 4. The range of impact estimates correspond to the countries coloured in dark green

alleviation through forest research. For example, through the establishment of the Poverty Environment Network (PEN), FTA engaged 30 graduate student researchers to collect socio-economic data across 8,300 households in 24 countries. PEN findings filled a knowledge gap on the role of tropical forests for household income. PEN was effective in engaging multilateral actors (e.g., World Bank, UNEP, IFAD, FAO), raising the profile of environmental incomes and rural livelihoods in global strategies. PEN's contributions to knowledge generation in the research pathway also influenced the government pathway. For example, national governments (e.g., Indonesia, Tanzania) piloted surveys using methods developed in PEN to better assess the contributions of forest-based livelihoods to improve national-level policies.

Multiple FTA projects contributed to the realization of the intended outcomes with variable levels of success across context. Most policy and practice changes to which FTA contributed have occurred at the local level and small-scale. We assessed that FTA's interventions were successful in equipping the people reached with better means to exit poverty, such as acquiring new procurement skills, access to inputs, capacity to apply better management techniques to enhance productivity for more resilient livelihoods. Enhanced market linkages and stronger domestic markets have stabilized and diversified communities' sources of household income.

The realization of outcomes supported potential for impacts...

Overall, we estimate that 5.1m people (1.3 million people directly and 3.8 million household members indirectly) have additional means to exit poverty or have increased resilience to impoverishment as a result of FTA's contributions (Figure 6). This estimate includes people with increased access to inputs for tree- and agroforestry-based production; people who adopted enhanced management or diversified production practices to increase yields; people who adopted low-cost processing techniques and value-addition; people with enhanced access to formal markets and/or business and marketing skills. We project that if all individuals reached by FTA adopt FTA-promoted options and technologies into their practice, in addition to the effective implementation of FTA-influenced policies,

strategies, and action plans, 19m people (5.7 million people directly and 13.3 household members indirectly) have the potential to benefit from additional means to exit poverty or reduce their vulnerability of falling into poverty.

The realization of impacts relies on several conditions and caveats, including the effective enforcement of policies; the full adoption and implementation of new practices (i.e., reduced barriers for smallholders, increased incentives); adopted practices produce higher yields and high plant survival rates; scaling of successful technologies, practices, and policies; and continuity of collective action post-project and post-FTA.

What worked well...

- Enhanced provision of extension services increased the likelihood of increased yields and uptake of FTA-promoted options and technologies. However, guaranteeing communities' adoption of agroforestry practices at scale (for timber, fruit-tree, and NTFP production) is not straightforward. Poor farmers are more vulnerable to shocks and have narrower economic margins, which prevent them from investing in long-term economic returns as they must prioritize immediate food security and other household expenses. The provision of adequate and on-going extension services to smallholders and communities in the long-term is a critical condition for the realization of high-end impact estimates, whereby promoted agroforestry systems and management practices are actually adopted by farmers on-the-ground. Often, inadequate or low levels of extension are limited by the availability of human resources. Farmer-to-farmer extension was a cost-effective and successful approach to substitute governmental or NGO delivery of extension services, and support farmers' uptake and enhanced productivity. There is scope for more participation of women in extension as well as closer collaboration with private and voluntary extension institutions to increase the availability of extension services to farmers at the local level.
- Approaches to support knowledge exchange and increased social capital among farmers (e.g., farmer-to-farmer extension, farmer/producer associations) were effective means to influence practice changes at the community-level. Communities benefitted from learning and exchanging good agricultural practices and/or value-addition techniques with other farmers and producers through community-based organizations and cooperatives. As part of an association, members could expand their networks and foster social capital with other members, access extension support, establish market linkages, and purchase inputs as well as sell products as a group. These are vital spaces and actor groups for research-for-development programmes to engage, support, and exert influence.

What could be improved...

- Need more mixed approaches to accommodate both short- and long-term economic returns. FTA's promotion of technologies, different species, and more sustainable practices through pilots and FDT focused on demonstrating both the short-term increases in yields and value-addition, as well as potential returns from agroforestry-based production in the long-term. While adoption of agroforestry practices at scale has been observed in several African countries with the adoption of fast-growing species (e.g., bamboo) for fodder and household bioenergy production, most species do not have such advantageous short or lag-free returns. Moreover, agroforestry systems require upfront investment costs to establish, maintain, and manage them effectively. For poor farmers, these high costs are not economically viable in the short-term and can potentially generate net losses in the first few years. Time lags, uncertain tenure security, unclear availability of long-term extension services, and under-developed market linkages present additional obstacles to the adoption of forest- and agroforestry-based options and the alleviation of entrenched poverty. These are barriers which future research-for-development programmes need to target and address.

- There is scope for greater inclusion and participation of women and youth. In recent years, gender and social inclusion have become more prominent priorities within FTA (Elias et al., 2021); however, prioritization was to slow to transition into gender expertise within research teams, research design, project activities and engagements, and realized outcomes on-the-ground. While there is a growing "number of gender specialists working across FTA, [...] gender expertise in research teams was generally one-person deep, if that, and unevenly distributed across FPs and FTA managing partners" (Elias et al., 2021, p.40). The projects where gender featured prominently, and where opportunities were created for greater inclusion of women and youth in participatory processes or decision-making, were overall highly successful in supporting outcomes for these groups (e.g., research on forest tenure reform, REDD+, oil palm in Indonesia, fair trade). However, in projects where gender considerations were absent, so too were the outcomes. Greater efforts need to be made to apply gendered lenses and approaches in research; collect and report gender-disaggregated data; engage more women and youth in projects; facilitate processes for the participation of women, youth, indigenous groups, and other minorities; develop tools for inclusive decision-making; build the knowledge and capacities of other actors in gender and social inclusion; propose solutions and policy recommendations to enhance gender-responsiveness; target capacity-building for minority groups; and adapt and translate outputs for women and minority groups.

1.5 Challenge 5: Rising Demand and Need for Nutritious Food for both Current and Future Generations

The Challenge

It is estimated that agricultural production will need to increase by 60 percent by 2050 in order to meet the demands of a larger, more urbanized population of the Global South (Alexandratos and Bruinsma, 2012). While population growth is one factor, rising income levels (albeit unequal), together with urbanization, has also coincided with changes in dietary habits (e.g., increased animal product consumption) and increased demand for energy, thereby intensifying non-food crop production, i.e. for animal feed and biofuels (Silva, 2018). Moreover, despite years of progress, the 'Prevalence of Undernourishment' (PoU) has been steadily increasing since 2014, standing at 768 million (9.9 percent of the world's population) in 2020 and with the highest prevalence in Africa at 21 percent. The current COVID-19 pandemic has significantly accelerated this concerning trend (FAO, 2021). A key global challenge of our times is therefore how to feed and nourish a growing population while minimizing the impact on the environment (Petersen et al., 2015), against a backdrop of persistent rural poverty and rising levels

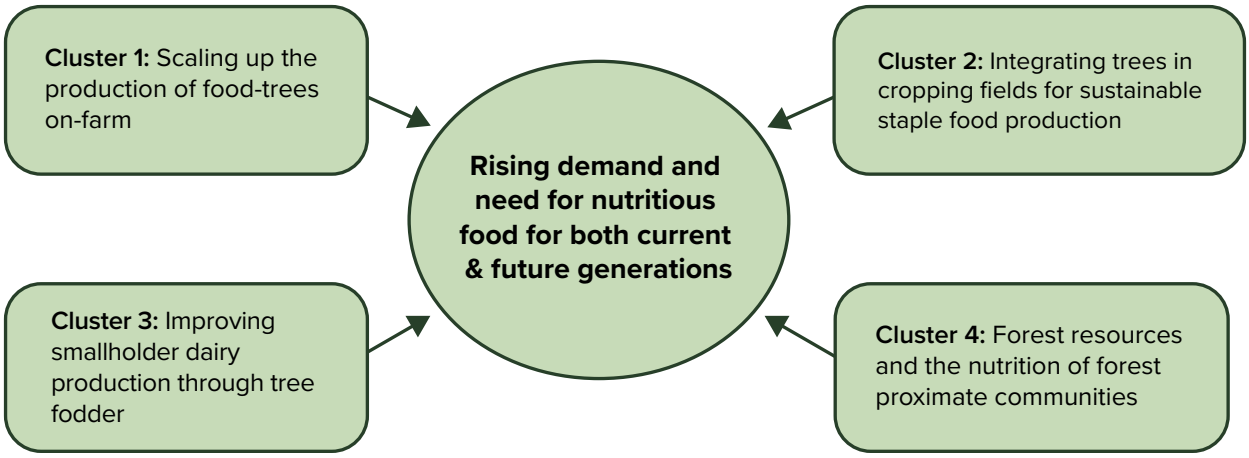

Figure 7. Clusters of FTA's work identified and reviewed vis-à-vis Challenge 5

of inequality. FTA has undertaken significant work—both research and scaling related—to address this challenge, which we refer to as FTA Challenge 5: Rising demand and need for nutritious food for both current and future generations.

How has FTA responded to this challenge over the last 10 years?

Our review identified 14 FTA projects and one large initiative—the Bushmeat Research Initiative (BRI)—directly targeting food security and nutrition. We grouped these into four clusters (Figure 7).

The impact logic of each of these clusters is as follows: For cluster 1—scaling up the production of food-trees on-farm—increasing the number of food trees leads directly to improved diets, while enhanced income diversification indirectly improves diets. Donors and implementing partners are critical in scaling up food trees in order to achieve nutritional impacts at scale.

For cluster 2—integrating trees in cropping fields for sustainable staple food production—such integration is expected to both enhance a) crop productivity, e.g. by improving soil health; and b) total farm productivity, i.e. through increasing the scale and diversity of products produced on farm. Strategic engagement with local government agencies and other partners enhances agroforestry scaling work, which, in turn, accelerates the integration of trees into cropping systems.

For cluster 3—improving smallholder dairy production through tree fodder—fodder tree technologies that are effectively produced and utilized on farms lead to milk yield gains. Effective communication and training are required to ensure their successful establishment, management, and utilization, e.g. through improved extension services.

For cluster 4—forest resources and the nutrition of forest proximate communities—national and local engagement leads to improved policies and interventions for promoting the safe and secure food provisioning role of forests. Simultaneous engagement at the global level to influence global policy processes and donor priorities strengthens the enabling environment at

Table 4. Summary of Key Findings for Challenge 5

Key Achievements	Evidence of Reach	Evidence of Uptake and Use
Cluster 1: Scaling up the production of food-trees on-farm		
Food trees promoted under nine different projects in 11 countries.	206,045 farming households (927,201 individuals)	139,045 farming households (625,702 individuals)
Cluster 2: Integrating trees in cropping fields for sustainable staple food production		
Work undertaken to support farmers to appropriately integrate trees into their cropping systems in 12 countries.	442,392 farming households (1,990,764 individuals)	85,240 households (383,578 individuals)
Cluster 4: Forest resources and the nutrition of forest proximate communities		
Primary research undertaken to evidence nutrition contribution of forests at the global level and in 5 countries. Bushmeat research database and engagement in key international bodies (CBD, OACPS) and with governments of Brazil, Colombia, Ecuador, and Peru.	Stakeholder engagement in 4 countries, disseminating research findings & co-development of policy & intervention options; inputs feed into3 global fora. Website set-up and operational, with various policy documents and scientific publications (138)	Anecdotal interest in taking on board research findings. Ethiopia used FTA research to design its nutrition sensitive interventions 12 policies influenced, with 10 being decisions or regulations adopted by official bodies & national gov.
Totals (non-double counted)	761,996 households (3,428,982 individuals)	248,398 households (1,117,770 individuals)

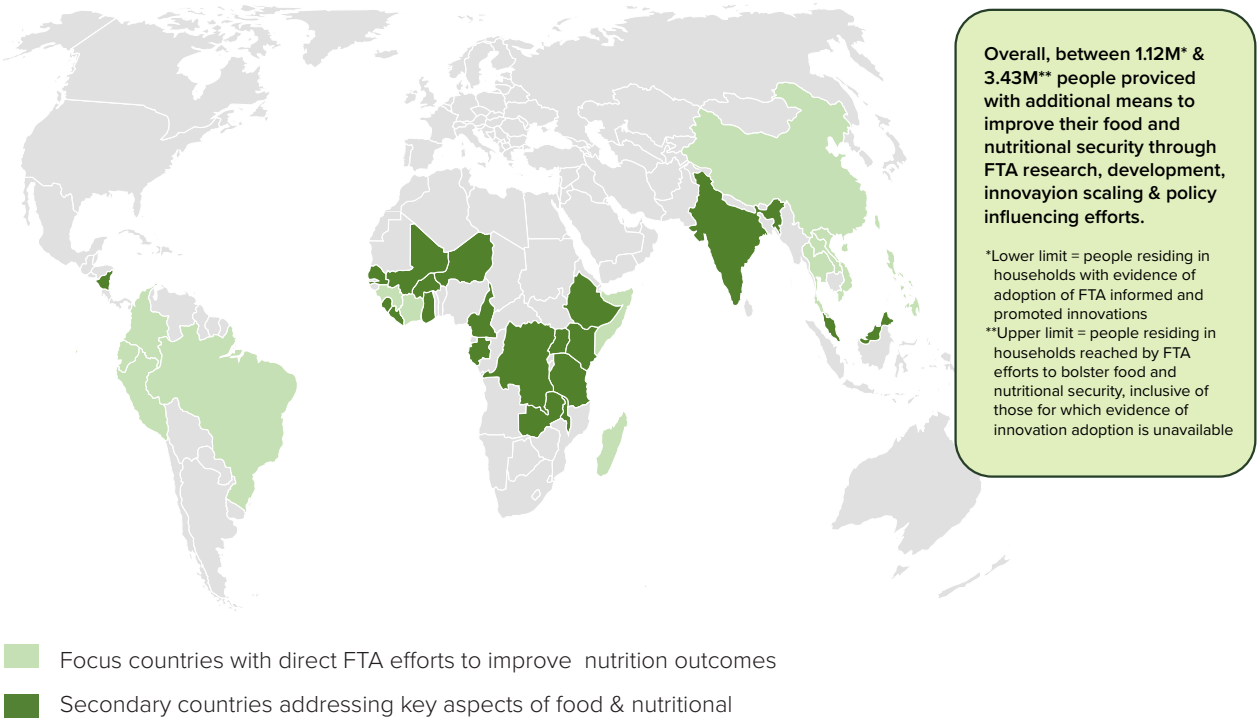

Figure 8. Countries where FTA carried out research on topics mapped to Challenge 5

the national level by increasing access to resources, capacity development, and supportive policy frameworks.

What were FTA's key contributions to addressing Challenge 5?

Overall, we found that FTA—through the first three clusters—reached over 760,000 households with additional means to improve their food security and nutritional status, with evidence—primarily gathered via household surveys—of uptake of FTA innovations among one-third of these households (248,398). We further found evidence of significant FTA contributions to several policy-related outcomes under cluster 4. Table 4 summarizes our results, with primary and secondary countries shown in Figure 8.

Food & Tree Crop Portfolios (FTCPs): A promising innovation to be scaled up

We identified a relatively new and promising approach: developing and scaling Food Tree and Crop Portfolios (FTCPs). This approach involves co-developing locally appropriate FTCPs with communities, while building the necessary partnerships and capacities and mobilising resources to support their scaling. With such portfolios in place, the household in question has a 'bank' of accessible and nutritious food on farm which it can sustainably withdraw from all year round. We conducted an ex-ante impact simulation exercise to estimate potential impacts if the FTCP concept was taken to scale in 12 African countries, focusing on a key impact metric used in the health sector: Disability Adjusted Life Years (DALYs). Background work for this exercise revealed that the disease burden due to Iron Deficiency Anaemia (IDA) and Vitamin A Deficiency (VAD) in the 12 study countries currently amounts to an annual loss of 6.8 million DALYs, and children under five are disproportionately affected. These losses can potentially be reduced by effectively scaling up the FTCP concept. Indeed, our simulation exercise revealed that such implementation will be effective in mitigating IDA and VAD deficiencies among children and women of reproductive age, with the health benefit gain of 2.17 million DALYs per year and approximately 30,866 deaths per year among reproductive aged women (1,722) and children under five (29,144) potentially averted.

What are key lessons for improving related work on food security and nutrition going forward?

1. Improving food security and nutrition outcomes through tree-based solutions has considerable potential but requires context-specific, inter-disciplinary, and iterative research and adaptive scaling with implementing partners, local communities, and other stakeholders.
2. Given the inherent complexity of bolstering nutrition, carefully thinking through impact pathways and the assumptions that need to hold true for one step in the causal chain to proceed to the next is critical for informing research and intervention design.
3. Integrating ex-ante impact modelling approaches in research and scaling efforts would be useful for both informing these efforts and estimating longer-term potential impacts.

2 Which Impact Pathways supported the realization of the impacts achieved?

There were four main impact pathways that supported the achievement of the outcomes and impacts described above: the government pathway, the NGO and allies pathway, the community pathway, and the private sector pathway.

2.1 Government Pathway

This pathway was consistently strong across all challenges – with the exception of Challenge 5 –to stimulate outcomes whereby policy-makers and other governmental actors became better equipped to develop and revise policies using evidence and improve policy implementation. Contributing to sub-national, national, and international policy was a predominant means by which FTA contributed to outcomes and large-scale impacts. A key focus of FTA's policy engagements across the challenges was to share data, tools, approaches, and evidence-based recommendations with national and international policy-makers, ensuring research outputs were appropriate for use and aligned with political priorities. This was clearly demonstrated in examples like the placement of tree genetic diversity on the restoration agenda in CBD COP12, the integration of bamboo into policy to support rural development objectives in Ethiopia, and alignment of the AFC mechanism with national forestry objectives and climate change commitments in Peru. To enhance REDD+ commitments and coordination, FTA supported knowledge-sharing and coalition-building between the governments of Indonesia and Norway. FTA's findings were timely and useful for Guatemalan policy-makers tasked with the renewal of community forest concessions in the Maya Biosphere Reserve.

The establishment of or participation in dedicated working groups or task forces were also key means by which FTA supported policy outcomes. FTA positioned itself as a trusted and valued source of evidence-based recommendations for policy change to support more SFM, promote restoration, and decrease deforestation. FTA participated in working groups at the sub-national level (e.g., to co-develop the Strategy and Action Plan for Forest and Landscape Restoration in Sarawak province in Indonesia), the national level (e.g., to assist social forestry, community forestry, and/or village forestry decision-making in five ASEAN member states; to devise national agroforestry policies in Nepal[6] and India; to support FLEGT in Cameroon, etc.), and the international level (e.g., to assist the monitoring of tropical peat swamp and mangrove forest stocks by the UNFCCC Task Force on National Greenhouse Gas Inventories).

Projects led by scientists with established positive relationships with policy-makers were more likely to contribute to policy outcomes. For example, through research on REDD+ in Indonesia, FTA leveraged CIFOR's position and scientists' pre-existing relationships with the Ministry of Environment and Forestry to broach other forest-based topics such as peatlands and wetlands, fire and haze, and oil palm, among others. FTA was also able to leverage some of these mutually beneficial

6 A scientist from ICRAF remains the only non-governmental member of the inter-ministerial coordination committee overseeing the implementation of the policy in Nepal.

relationships with government champions in other parts of the world, such as with the Peruvian government on AFCs and bamboo bioenergy in Africa.

FTA also supported the capacity-building of government staff to enhance governance and governments' day-to-day practices. Outcomes targeting governments' skills featured in all the challenges, but were pivotal for informing the implementation of restoration programmes (e.g., Sarawak, Malaysia), monitoring frameworks (e.g., M&E for PFES implementation Vietnam; forest monitoring systems in Central Africa), and value chain development (e.g., timber in Cameroon; bamboo in Ethiopia and Ghana; NTFPs in Indonesia). In another set of examples from Indonesia, FTA training equipped over 2,000 government staff in GIS, spatial analysis, carbon stock and biodiversity monitoring, and/or FTA tools (e.g., Capacity Strengthening Approach to Vulnerability Assessment (CaSAVA) method, LUMENS tool) for land use planning.

Through the government impact pathway, FTA was also able to enhance the involvement of communities in governance processes and decision-making. Giving voice to and supporting the empowerment of farmers, women, youth, indigenous groups, and other marginalized groups were key foci of FTA's contributions in multi-stakeholder fora. FTA created many opportunities to involve communities in policy dialogues, meetings, and workshops, and sought ways to build more participatory research and governance processes into its projects. For example, to give greater voice to forest-dependent people, marginalized and vulnerable groups, youth, and indigenous peoples, FTA regularly convened a multi-stakeholder forum to enrich ASEAN policy development processes and expand understanding of communities' relationships with forests in the context of climate change. As a result, many community groups have newfound access and agency to articulate their needs. For example, women and youth have greater knowledge, skills, and confidence to participate in and lead forest user groups, forest tenure governance, and resource management (e.g., ACM training in Uganda and Nicaragua). Through the DRYAD Project in Cameroon, the capacity-building and establishment of viable community forest enterprises equipped women and minorities to become more involved in community forest management.

2.2 NGO and Allies Pathway

This pathway was also consistently strong across all challenges. The NGO pathway was a reinforcing way to support and influence governmental decision-making, institution-building, and capacity-building.

FTA often engaged NGOs to support policy development, as they are well positioned to lobby governments. For example, an NGO partner lobbied provincial governments in Indonesia using FTA's data in a tailored set of recommendations for improved water management. This eventually influenced the development of a provincial-level regulation to prevent exploitation of natural resources in the Nipa-Nipa Forest Reserve. In another example from the Congo Basin, NGOs promoted FTA's research and assisted awareness-raising activities on SFM. As a result, pressure is increasing for governments to draft, implement, and enforce policies to reduce deforestation and forest ecosystem degradation in the region.

FTA also leveraged opportunities to influence governance, institution-building, cooperation, and coordination through the NGO pathway, because of the role that NGOs play in multi-stakeholder fora. In Indonesia, NGO boundary partners used FTA's co-produced knowledge to bring scientific credibility to their campaigns and raise attention to the network of actors responsible for forest fires. In Kenya, NGOs advocated for the inclusion of charcoal in national dialogues and co-developed local environmental management plans in support of charcoal producer associations and sustainable wood-fuel value-chains. In Peru, the alignment of FTA's research findings with topics high on the political agenda (e.g., climate change, sustainable development, tenure) captured the interest of NGOs in the AFC mechanism. As a result, one NGO successfully lobbied the regional government in San Martín for concession

pilots and supported the ongoing training of governmental staff to use FTA's micro-zoning approach.

Across all challenges, FTA incorporated opportunities to build the skills and capacities of NGO partners and project collaborators to support the implementation of government programmes, the provision of extension services, and tree-planting campaigns, among others. The Drylands Development Programme fostered NGO partners' continued support in the adoption and scaling of dryland management practices in Ethiopia, Ghana, Mali, Niger, and Burkina Faso post-project. In the Philippines, close to 500 NGO staff from local partnering organizations built capacities for watershed management, learning to use and apply FTA's Environment and Social Safeguards (ESS) monitoring tool. NGO partners went on to apply these monitoring skills and other NRM practices in over 1,200 sub-projects related to agroforestry and forest management. An additional example from the Philippines resulted from FTA's technical assistance in rewards for ecosystem services (RES), which equipped local NGO staff to support communities' and companies' business cases, negotiations, and contracts for RES with the government. In Indonesia, local and international NGOs were trained to support communities' sago planting and canal blocking. Without the support of NGOs, communities would be less likely to maintain these fire prevention practices.

Influencing NGOs was a prevalent and reinforcing pathway to stimulate changes in other pathways, particularly for community practice. A local NGO in the Philippines assumed the role of a seed fund manager, supporting the establishment of nurseries, community capacity-building, and linking farmers to potential co-investors within their network. With the NGO's support, farmers became better equipped to adopt and apply tree-planting practices. Returning to the Drylands Development Programme example, implementing partners provided ongoing support to engage and train farmers and assist value chain development and market linkages. Farmers were able to learn and apply NRM and climate-smart agricultural practices on- and off-farm as a result. Without the commitments of these local partners to support capacity-building and other forms of assistance following the end of the project cycle, likely FTA would neither have been able to reach the close to 220,000 farmers nor achieve the high rates of farmer adoption.

2.3 Community Pathway

As a consistently strong impact pathway across the challenges, FTA influenced smallholders and communities to adopt more sustainable practices by demonstrating the benefits through FDTs, EL, and providing training and guidance on propagation, agroforestry, and management techniques to enhance ecosystem services and improve yields. The nature of Challenge 4 and 5's target impacts relied heavily on the realization of outcomes for the uptake and use of FTA's technologies and sustainable practice changes by farmers.

Community engagement, participatory activities, and presenting knowledge in ways that are appropriate for the target audience increased the utility of FTA's research processes and outputs for smallholders and communities to build understanding and apply in local contexts. In Peru, 200 smallholders learned about the AFC mechanism and its requirements, how to register, and gained know-how for more sustainable agroforestry-based management practices through FTA's workshops and participatory activities. FTA's research supported eligible smallholders to better understand the AFC process and view the mechanism as an attractive option. The issuing of 33 concessions in San Martín to date is a preliminary indicator of smallholder change.

FTA also supported smallholders across Asia and Africa to plant, tend, and develop enterprises for bamboo that would support livelihoods and restore degraded land. Through focused promotion of bioenergy practices, thousands of community members across Cameroon, Ethiopia, Ghana, Kenya, Madagascar, Tanzania, and Uganda gained increased awareness of bamboo as a sustainable and climate-smart alternative to wood and fossil fuels for household energy

production. Such exposure influenced the uptake of alternative approaches in communities' practices on a large- -scale.

Capacity-building and training were other key means to influence communities' practice change, and were a common strategy employed by all five challenges. Using the above example, over 20,000 individuals developed planting and processing skills via participation in farmer field schools and training centers. As a result, community members – especially women – benefited from income-generating micro-enterprises (e.g., nurseries, furniture, and crafts), and are now able to use bamboo plants for consumption, fodder, and produce high-quality bamboo-based charcoal.

2.4 Private Sector Pathway

The extent to which FTA was able to influence private sector policy and practice varied across the challenges. Some successful private sector change was often influenced by changes in other pathways, such as the government (e.g., policy change) or NGO pathways (e.g., advocacy). Strategically engaging private sector actors and equipping them with knowledge and capacities supported practice change in some contexts, but often it was difficult to get private sector actors in the room if they did not already have a vested interest. In Challenges 1, 3, and 4, most evidence of changes in company practices was observed in individual companies or SMEs, indicating there are likely many barriers and competing economic interests limiting change at the industrial or sector-wide scale.

There were few examples of successful changes in private sector policy. The strongest took place at the international level, whereby FTA researchers were able to channel findings on the role of women in Indonesia's oil palm sector to inform the incorporation of gender considerations into the Roundtable on Sustainable Palm Oil (RSPO)'s Principles and Criteria. This policy change revised the requirements to which member companies must comply. In response, a few RSPO member companies in Indonesia established gender committees to increase women's representation in company decision-making and two companies introduced contract innovation pilots targeted to women growers. This demonstrates the value of identifying private sector champions who are truly committed to international and/or private sector commitments and are sensitive to social and environmental values increasingly demanded by consumers. As part of the REDD+ portfolio, FTA also influenced a change in company policy in Jambi, Indonesia. FTA calculated a company's reference emission levels (REL), which the company subsequently used to define mitigation actions that were integrated into the company's annual work plan.

FTA's influence on private sector practices was much more prevalent. Strong examples of industrial-scale company practice change are associated with FTA's research on oil palm in Indonesia (e.g., company compensation for deforestation following Greenpeace's complaint using FTA's spatial data). Without crucial evidence to track and monitor changes in plantation boundaries and deforestation over time, past transgressions would go unnoticed. Such tools like the Borneo and Papua atlases also encourage and enable companies to self-monitor to ensure their plantations do not expand into forests outside their concession area. As part of the FLEGT research in Africa, more private companies utilize their purchasing power to support legal timber markets, increasing the likelihood for forests to be sustainably managed to ensure profitability and longevity of the sector. In Cameroon and DRC, construction companies are better equipped to source legal timber supply, with greater sensitivity to and consideration of timber origin. In Ghana, FTA helped establish a multi-stakeholder learning platform and piloted different business models and independent monitoring and traceability systems with three NTFP companies to improve management, supply chain monitoring, and good agricultural practices.

FTA also facilitated private sector linkages to expand market opportunities, as seen in Vietnam for son tra growers. Simple, low-investment mass production technologies,

co-developed by FTA and local stakeholders, were adopted by a private company through a technology transfer agreement. As a result, the company began to develop non-perishable products (e.g., dried tea extracts) for the urban market, potentially creating sustainable demand for future son tra production.

At the small-scale, and applicable to most of the challenges, training was a successful way to increase awareness of the economic effects and implications of unsustainable land use practices, deforestation, and degradation. Through training, SMEs also became incentivized to adopt more sustainable ways of working to make greater profits in the long-term. Moreover, working through or helping to establish farmer or producer associations were influential strategies to build capacities, support formalization and empowerment, and enhance practice change from the bottom-up. Approximately 1,500 farmers groups were established throughout nine countries in Africa, which supported knowledge exchange between members on good agricultural practices and/or value-addition. As a group, members could more easily link to other parts of the value chain (i.e., to access inputs, group-selling, etc.), which broadened their livelihood options and increased their income.

While there are one-off successes, many intended private sector outcomes were not realized. For example, in Indonesia, despite efforts by FTA researchers to build in targeted engagement with influential oil palm companies through dedicated private sector-led oil palm platforms (e.g., Indonesian Palm Oil Pledge (IPOP)), political tensions halted the process. With the disbandment of the platform, companies became less willing to engage in the topic for fear of retribution. This affected FTA's ability to effectively engage and partner with private sector actors to influence outcomes more broadly across the sector.

3 Lessons Learned and Recommendations

The global challenges investigated in the studies are complex and interconnected. Unsustainable land use management is a key cause of deforestation, which degrades land and ecosystem services. Forests, trees, and agroforestry are key sources of livelihoods and nutrition for natural resources-dependent communities in the tropics. FTA's strategy addresses the integrative nature of the challenges, as multiple research interventions cut across the challenges. Using FTA's research on AFCs in Peru as an example illustrates well how a single policy mechanism, if properly implemented and regulated, has the potential to be a viable holistic solution to limit deforestation and agricultural expansion into forested areas (Challenge 1), halt and reverse degradation (Challenge 2), sustainably manage public forest lands (Challenge 3), support livelihoods to address vulnerabilities to poverty and shocks (Challenge 4), and support increased and more sustainable food production for personal sustenance as well as increased income to purchase nutritious food (Challenge 5).

This study provided opportunities to test novel ways to assess collective research efforts (i.e., composite and nested ToCs) and procured new insights on how research influences change across different impact pathways to address complex, inter-related societal issues. Such learning informed a set of lessons to improve future change-making research and M&E practices of similar research-for-development projects and programs.

Lesson 1: Programmatic approaches to research add critical value

Traditional project cycles are far too short to allow for a systematic solving of global integrated challenges. R4D programs should help to plan coherent and strategic research portfolios with clear and consistent thematic and geographic foci, priorities, realistic impact targets, and well-developed theories of change, creating a framework for single projects to add more value. Effective research program design and implementation enables long-term engagement in targeted research topics and the establishment of strategic institutional partnerships. Such partnerships are key to increase contributions to outcomes and impacts. FTA's influence was most apparent in contexts where activities were consistent and pursued over a longer period of time and where holistic and multi-dimensional approaches were used to successfully influence systems change and transformation.

Recommendation 1: While projects remain an effective operational tool to fund and organize R4D work in practice, donors and research for development actors should resist the tendency to consider it sufficient and team up to develop and optimize programmatic approaches to support a cohesive strategy spanning and delivery mechanisms going beyond individual projects, around topics and geographies, and to enhance the cohesion and positioning of research effort – including learning on implementation - towards transformation and global problem-solving.

Lesson 2: Design and implement programs and projects using "3-spheres" theories of change, and use both ex-ante and ex-post approaches to ToCs

FTA's theories of change (ToC) from outputs to outcomes and impact are complex, with varied impact pathways (including a range of technological, social and institutional innovations pathways, and policy pathways). These are not linear and include internal feedback loops involving a multitude of actors: the pathways do influence downstream on outcomes and changes, but there are also upstream feedbacks, on the very definition and positioning of research. The 3 spheres approach (sphere of control, influence, and interest) and the interrelations between them has proven to be a good framework under which the different theories of change and roles of actors can be organized, understood, and assessed, and upon which the dialogue between MELIA, scientists, and stakeholders can be organized.

However there were few projects which used explicit ToCs. The few that had explicit ToCs did show results aligned with the ToC. When implicit ToCs were documented retrospectively in case studies, there was some evidence that many outcomes were realized. Impact potential hinges on various conditions or assumptions on the chain of changes where research can make a difference This should be made explicit and continuously tested during research design and implementation processes, to both serve formative evaluation and continuous adaptive research management. Ex-post construction of ToCs as done in the integrative impact studies is a powerful tool to reflect on effectiveness of research, assess impact, and learn, especially given today's reality where research programs are constructed piece-by-piece over time.

Recommendation 2: The 3 spheres approach should be used by partners and funders when developing ex-ante the theories of changes of the new FTA, for the whole program but also for the initiatives within. The ToC should be used in the design, planning, implementation, monitoring, evaluation, impact assessment. Use nested ToCs for program and strategy design and to identify relations between program and project level intentions, between projects, and to set targets. Ex-post integrated assessments could follow the model by set by the FTA MELIA integrated studies (e.g. based on reconstructed ToCs) and should be planned from the onset so that the methodology (and related data collection) is easily rolled out over time

Lesson 3: Ensure versatility and usefulness of impact assessment studies for multiple audiences

Measures of performance and success of research for development programs are important for many different audiences, at multiple levels. This brings versatility requirements on the outputs that needs to be fully taken into account in the design and implementation of MELIA studies. The objectives indeed go beyond the MELIA or IA community of experts. Measures of performance are also important for (i) the leadership and management of the program, to prioritize research topics, geographies and partners to engage with, to learn and improve, and to ensure quality of research, (ii) for researchers, to better assess how a piece of research contributes individually to a particular pathway towards impact, including understanding what are the key hypothesis and levers, (iii) for stakeholders, to understand the potential changes that their relation with research can bring, (iv) for donors, in terms of accountability, and to build a track record of effectiveness to attract new support. Often MELIA studies are written by MELIA experts, for MELIA experts, and don't necessarily mean much to these other audiences. This can undermine their usefulness and effectiveness.

Recommendation 3: Ensure that MELIA studies, their design, methods and outputs are accessible and contain messages targeting the different audiences (leadership, scientists, stakeholders, donors). If need be MELIA products need to be tailored and differentiated to different audiences.

Lesson 4: Use the Quality of Research for Development Framework both for research and for MELIA

The QoR4D principles (relevance, credibility, legitimacy, effectiveness) are a good framework to guide the design, appraisal, and evaluation of solutions-oriented research. Research design and implementation must be done in a way that considers and represents the priorities, interests and values of intended users, produces credible knowledge, and is well positioned to be useful and used. The issue of measuring impact of research is in itself a research question, therefore the work of MELIA needs to follow the same "quality of research" principles. This may need a combination of different cultures; approaches and methods for measuring impacts (not just randomized control trials). We are developing new approaches to use research to support transformative change; we need to be scientific in doing it and in learning from the experience. Theory-based evaluation offers the opportunity for both summative and formative assessments, and can facilitate both continuous learning and accountability for intended outcomes.

Recommendation 4: Use the QoR4D framework (relevance, credibility, legitimacy and effectiveness) to guide the design and appraisal of research proposals and for ex post assessment of design and implementation.

Lesson 5: The MELIA-research interaction processes are as important as their product

The FTA MELIA integrative studies process helped create connections between MELIA-scientists, with a productive confrontation on objectives and methods of MELIA, to co-construct the approaches given the constraints, interests and motivations of the two parties. Effective involvement and continuous dialogue between MELIA and researchers along the project cycle (not just within MELIA studies, at their beginning and at their end) facilitates the effectiveness of learning, towards the objective of increasing research quality. Collaboratively developing ToCs and setting outcome/impact targets for research projects, can lay the ground for more reasonable and credible ex-ante claims, and is necessary for a better data management plan (see Lesson 6), to collect output, outcome and impact data throughout the research, and to enable adaptive management. Integrating ex-ante impact modelling approaches in research and scaling efforts vis-à-vis forest, agroforestry and tree-based options would be useful for both informing these efforts and estimating longer-term potential impacts.

Recommendation 5: Make sure that there is systematic, continuous interaction between research teams and MELIA in a research cycle. Make sure these interactions help projects to set-up and document impact targets, when possible through solid ex-ante analysis and methods. Make sure that the MELIA study process (methodology and design) involves research leadership and scientists (and the case being stakeholders) from the ground up and at key steps, and not be rolled out in silo.

Lesson 6: Design and implement well sized, robust approaches and systems for project data documentation and management

While it is desirable that all projects and initiatives have a robust data management plan, this is often not the case. Variable progress reporting occurring at sporadic points in the project cycle is detrimental to effective monitoring, demonstration of impact and learning. On the other end, large scale, rigid, too ambitious data collection plans are bound to fail as data collection rates will be very low. There is a need to keep harmonized records of project activities and outputs, partnerships and engagement. Often, reporting focuses on documenting project activities and outputs, rather than contributions to outcomes, impacts, or other changes in the wider system. One should also ensure that terms and concepts are consistent with MELIA; and to build M&E data into project reporting (not add these ex-post). Project-level impact targets should also align with program-level targets for impact and be reported consistently in projects' midterm and final reports. Specific outputs of interventions should clearly link to intended outcomes and impacts. An identified bottleneck was the need for the development of a consistent MELIA database system at the centre-level, 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.

Recommendation 6: Design ex-ante a cost-effective program-level data management framework and plan, that is based on a minimal set of data systematically collected, with definitions and units compatible across projects and initiatives. This should address the 3 spheres from outputs to outcomes and impacts (see lesson 2). Collect disaggregated data on gender and youth in projects where appropriate. Make sure there is consistency in the documentation and monitoring of projects and programmes, as well as in M&E terminology . Make sure projects, their documentation and reporting abide to this minimal frame, and to enable this, develop and use a consistent MELIA database system. To be attractive to scientists, such systems should be used to demonstrate what research delivered and to track delivery overtime to help build the case for research quality and effectiveness.

Lesson 7: Ensure an inclusive and transparent piloting mechanism for strategic focus and coordination, both thematic and geographic

Even in a well-articulated program, the way bilateral projects are generated may lead to misalignment or sub-optimized positioning. The way to provide information and lessons learned from one project to the next or between parallel projects, is not always thought through. This requires specific piloting, as for instance in FTA undertaken by the Management Support Unit and by the Program Management Team. Experience shows that longer-term place-based engagement and relationships between research institutions and actors (ministries, sub-national jurisdictions, development agencies, private sector associations, associations of producers and cooperatives etc) on the ground result in better focus and coordination.

Recommendation 7: Any partnership needs a specific, inclusive and transparent piloting mechanism. This mechanism should be based on a structure and processes (including leadership, management and communication) that are able to bring together projects around clusters, to generate, integrate and provide usable lessons from individual projects. This should enable to improve individual project design, so that it integrates learning from previous, connected projects within the program. Coordination on clusters of projects should be based on integrative impact pathways, and on long term place-based partnerships. The piloting mechanism should lead integrative, cross cutting studies that contribute to impact and generate lessons learned on research positioning and effectiveness.

Lesson 8: Pay adequate attention to research but ensure demand-driven, place-relevant positioning and actively test/ challenge assumptions for development impact

When development objectives become the primary objective of research and the reason why it is funded, there is a risk that scientific credibility is relegated to a secondary objective. However, there is also often a tendency for supply-driven design. Such a tendency needs to be replaced with demand-driven, engaged, systems-oriented research and intervention design. Short-term projects experienced more challenges in achieving behaviour change at community level. With development-oriented projects, it may be difficult to explicitly frame the project proposal only around research questions. Many donors and partners will just refuse engaging in supply driven R4D. However, it should be possible to use every project to help answer research questions, especially if recommendations 1,2,4 &7 are followed.

Recommendation 8: Make sure that the projects and programs are based on explicit research questions, with well-specified evidence-based methods and outputs. The Scientific Credibility of R4D cannot be compromised and must be maintained and built up. The “R” in the R4D mandate and approach is unique and needed, but research positioning needs to be grounded in stakeholders needs. This needs a right positioning of the partnership within the overall R4D spectrum, and well-defined relations of FTA partners with external

partners on both ends of the R4D spectrum, both upstream research and downstream development. The new FTA needs to make sure it is appropriately comprehensive and balanced in that regard. Set realistic targets and develop plans for achieving and measuring them. Build R4D place based portfolios on solid, long term, engagement with local stakeholders and local institutions, including local universities.

Lesson 9: Addressing global challenges with research requires integration of a diversity of impact pathways in context, including a mix of technical innovations, policies, and capacity building pathways, and the right partnerships

Experience from current evaluation shows successful projects/clusters employ multiple impact pathways and mechanisms. Influence on the enabling environment and policies at national and international level is a key impact pathway for FTA, that has proved critical. Building capacity, addressing uptake barriers, and developing partnerships with intended audiences for and beneficiaries of research is critical for positioning research for use. Moreover, boundary partners should be identified based on their ability to use research solutions to support progress towards intended outcomes. Supporting local/national social processes (e.g., systems-thinking, more equitable/multi-perspective decision-making, collaborative problem-solving and solution development, coordination, capacity-building, implementation processes, etc.) is very effective at sustaining momentum for policy change, complementing knowledge contributions. This should include influencing NGOs based on evidence but avoiding political and institutional contexts that can polarize issues and limit progress. Participatory selection, including with women, of suitable options for local communities and participatory market appraisal and market support play an important role in scaling up. The public opinion pathway was less predominant in FTA, though targeted dissemination through local and national media, sensitization campaigns, and NGO advocacy garnered public attention on specific issues on sustainability and markets. Changes in consumer's behaviour may take time to appear and are conditioned by external and contextual factors.

Recommendation 9: The new FTA needs to be appropriately comprehensive and balanced from the upstream to downstream domains, across a diversity of impact pathways based on a sound analysis of knowledge gaps and bottlenecks/ constraints for change/adoption at scale, including identification of key boundary partners, from international levels down to local scales. It is important to have the right partners, including boundary partners, and FTA should undertake a systematic effort to identify the most appropriate partners, based on lessons drawn about effectiveness of working with them. There is scope to more actively involve national and local financial institutions, and extension services should be included in the diffusion pathways, including with farmer-to-farmer, women and youth associations. More emphasis could be given on leveraging and influencing the general public (and consumers) with evidence-based behaviour options. There is scope for more strategic engagement of and active relationship-building with private sector actors.

Lesson 10: Nurture soft personal, social and institutional knowledge, build trust, and organize management for these objectives

In a program like FTA, collaboration and new projects often leverage pre-existing personal and institutional relationships. It is important to leverage this knowledge and these relations. Overlooking these networks means bypassing the valuable institutional memory of the relationships, which can be a source of valuable learning and efficiency for new research initiatives as well as serve to reinforce and strengthen existing relationships. FTA influence was the greatest in areas where it developed long term personal or institutional relationships with policy-makers, and obtained invitations to join policy-processes, working groups, multi-stakeholder fora. In turn, relatively frequent government turnover led to loss of knowledge, particularly when restructuring occurs.

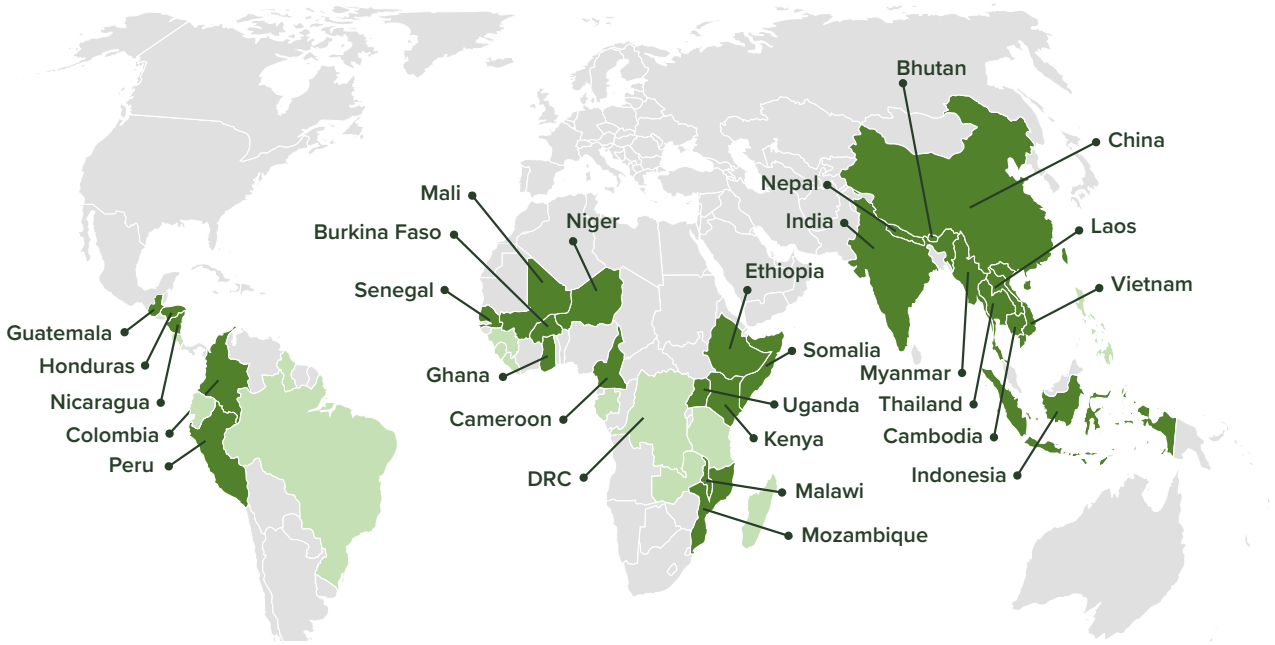

Figure 9. All countries where FTA conducted research for this impact assessment

Recommendation 10: Integrate, up to a desired level, transparency and inclusiveness in program design and processes. Build appropriate partnership and program collaboration procedures in management and delivery. Make sure partnerships are documented for institutional memory.

Identify actors of change and develop institutional relationships and partnerships with government agencies or departments, that enhance institutional capacity -including those of extensionists-, collaboration, trust, and build momentum for continued political commitment.

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WORKING PAPER

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In 2021, the CGIAR Research Program on Forests, Trees and Agroforestry (FTA) completed a set of studies, under the guidance and oversight of its Independent Steering Committee (ISC), to document its progress in addressing five key global challenges. These studies had the following purposes: (i) to design a workable approach and operational method to assess impacts at scale at the level of the FTA program, since 2011; (ii) to deploy the method effectively on a set of five identified development challenges addressed by FTA; (iii) to learn lessons from the exercise for FTA post 2021. This document provides a synthesis of the five studies and draws lessons and recommendations for research for development programs.

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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RESEARCH PROGRAM ON Forests, Trees and Agroforestry

foreststreesagroforestry.org

cgiarforestsandtrees@cgiar.org

@FTA_CGIAR

foreststreesagroforestry