2.5 Flagship 5. Climate change mitigation and adaptation opportunities in forests, trees and agroforestry

2.5.1 Flagship Project Narrative

2.5.1.1 Rationale and scope

Flagship Program 5 (FP5) is a unique, globally renowned and impactful international partnership implementing a research-for-development program on the use of forest, tree and agroforestry (FT&A) resources for climate change mitigation and adaptation focused on developing countries. Complementary to the *CGIAR Research Program on Climate Change and Food Security* (CCAFS) in many ways (as explained in Annex 3.17), FP5 is the only CGIAR program addressing FT&A resources. These resources have become crucially important in the context of the Paris Climate Agreement. The Paris Agreement has put heightened emphasis on the land sector as it is the only sector with a significant potential sink size, which is key to achieve the ambitious Paris objectives of keeping global warming below 2.0/1.5 °C. Furthermore, FT&A resources are central to adaptation efforts and provide a key means of achieving bioenergy targets in the context of low-emission development strategies. FP5 has a strong, tested ToC and demonstrated policy impact that potentially can reach a large number of people, thus underpinning future significant achievements in the land sector for mitigation. FP5 is integrated in FTA through direct links to FPs 2, 3 and 4, an indirect strong link to FP1 and significant contributions to FTA's gender and capacity development agenda.

The importance of forests in climate change mitigation and adaptation has strongly been recognized in the Paris Climate Agreement. It endorses Reducing Emissions from Deforestation and forest Degradation (REDD+), allows for alternative (nonmarket) policy approaches such as joint mitigation and adaptation and emphasizes the importance of non-carbon benefits and equity for sustainable development. Countries should develop capacities and grow national ambitions through their Intended Nationally Determined Contributions (INDCs) (to eventually become Nationally Determined Contributions [NDCs])[1] towards reaching the 2.0/1.5°C goal. Likewise, the United Nations (UN) Sustainable Development Goals (SDGs) emphasize climate, forests and bioenergy (see Section 2.5.1.2). The Green Climate Fund has begun its work but much needs to be done before large, results-based funds will flow with transparency and accountability. But the Paris Agreement is also less clear on important areas such as the key role of sustainable energy in reducing emissions, or that of agriculture as a major deforestation driver; both of these areas require more knowledge support.

In this ambiguous political context, decision-makers at all levels need information and guidance for policy and action. They need to know how to achieve climate mitigation and adaptation through the implementation of NDCs and how to increase ambition. They will need to mainstream climate policies across the sectors and levels of government. They will need to inform the UNFCCC Facilitative Dialogue in 2018 and the 5-yearly Global Stock Takes starting in 2023. Aiming for these goals, they will increasingly look for tested, trusted and reliable information and for cost-efficient (policy) performance assessment methods and procedures that allow them to assess the state, dynamics and drivers of change of land resources, livelihoods, social protections and equity indicators. FTA research can effectively fill the gap and engage meaningfully with boundary partners working at all levels towards these goals.

Thus, the Paris Agreement (and the gaps therein) sets the stage for climate change research in FTA. We have designed Flagship Program 5 (FP5) to address four research questions:

- How can we achieve effective land-based **mitigation** of climate change?
- How can people and forests effectively **adapt** to climate change?
- How can we sustainably produce **bioenergy** in developing countries?
- How can we reliably assess the **performance** of policy and practice addressing these goals?

Deforestation and forest degradation (mainly agricultural expansion) produce 70% of tropical land-use

emissions and account for 10–11% of net global greenhouse gas (GHG) emissions[2]. But forests also absorb 4–6 gigatonnes (Gt) of carbon annually[3], part of it from fossil fuel emissions; the Paris Agreement's *mitigation goal* (see Section 2.5.1.4) includes 'sinks' and needs 'negative emissions' (removals), where afforestation/reforestation will be crucial[4]. If countries continue on their fossil-fuel economy pathways, land-use emission reductions and forest restoration will not be enough to reach the 1.5–2.0°C target. Sustainable bioenergy production will be central for low-emission development.

FT&A ecosystem services are vital for the Paris *adaptation goal* (see Section 2.5.1.4). They support the livelihoods of approx. 1 billion directly forest-dependent people worldwide and provide goods and services (timber, energy, tourism, etc.) to billions more. Ecosystem-based adaptation can increase the climate resilience of forest-dependent people, smallholder agroforestry farmers and the world as a whole[5]. Measures will be more durable if they also reduce harmful inequalities based on gender, ethnicity and economy.

FP5 research will operate under the following **hypothesis:**

Effective, cost-efficient and equitable (3E+ criteria)[6] policies and practices make use of FT&A resources and combine climate change mitigation and adaptation with economic development. They are enabled by major shifts in enabling governance, economic and policy incentives, values, discursive practices, power relations and technologies; they depend on multi-purpose, climate-resilient landscapes and their performance can be assessed, measured and documented.

2.5.1.2 Objectives and targets

FP5 research tests this hypothesis and provides, under the 3E+ criteria, evidence on policies and measures that address: (i) mitigation of land-based emissions (i.e. emissions reduction and increased GHG sinks through landscape management with a focus on avoided deforestation and forest degradation, ecosystem restoration and conservation of FT&A resources combined with livelihood and development objectives); (ii) adaptation (of people and forests) to climate change through ecosystem-based actions that reduce risk and increase resilience; and (iii) low-emission development pathways including sustainable bioenergy supply to support development. Climate mitigation and adaptation, sustainable energy production and economic development activities must be integrated in policy and action to provide coherent, sustainable outcomes for people and the environment at local, national and global levels. This supports a fourth point: (iv) the success or failure of these policy interventions needs to be vigorously assessed to inform future policy options.

Outcomes. The expected outcomes of FP5 are integrated, equality- (gender-, youth-) sensitive climate change mitigation, adaptation and development strategies that follow the 3E+ criteria. We work towards four end-of-program outcomes, one for each of the clusters of activity (CoA; see Section 2.5.1.6). The outcomes are:

1. Efficient, effective and equitable national and international climate mitigation policies and funding, aligned with development objectives (3E+ goals);
2. Risk-assessed ecosystem-based adaptation (EbA) policy and practice including joint mitigation and adaptation approaches;
3. Integrated food and bioenergy production policy and practice;
4. Widely implemented performance assessment of mitigation and adaptation policy and practice.

These outcomes contribute to the Paris goals, the UN Sustainable Development Goals (SDGs) and CGIAR research outcomes (sub-IDOs[7]). The supported SDGs are:

- Urgent action to combat climate change and its impacts (SDG = 13) (this includes achievement of the adaptation and mitigation goals agreed in Paris and the implementation of NDCs by countries);
- Access to affordable, reliable, sustainable and modern energy for all (SDG 7)
- Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss (SDG 15); and

- Sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all (SDG 8).

In the CGIAR context, FP5 work supports five key sub-IDOs:

- 10.3/A.1: Reduced net GHG emissions from agriculture, forests and other forms of land use;
- A.4: Enhanced adaptive capacity to climate risks;
- 3.2: Increased livelihood opportunities;
- B.1: Gender-equitable control of productive assets and resources; and
- D.2: Enhanced individual capacity in partner research organizations.

Targets. FP5 efforts address 3E+ *mitigation policies* that should contribute to reducing deforestation by 10–30% in six countries with 55% of global tropical forest cover (Brazil, Cameroon, Democratic Republic of the Congo [DRC], Indonesia, Peru and Vietnam). Users of the knowledge generated in the program would achieve this through better policy formulation and more efficient climate action. Through this, 0.5–1.6 million ha of forests could be saved annually, resulting in annual avoided emissions of approximately 0.2–0.6 Gt CO_2 (5–15% of the total annual land-use emissions of 3.3 Gt CO_2) positively affecting at least 0.5 million forest-dependent people directly and 1.5 million people indirectly (i.e. those depending on remote forest products and services). We expect our *adaptation* research to support 1 million rural poor people and our *bioenergy* research to support 0.5 million directly bioenergy dependent people and 0.7 million indirectly dependent people. The corresponding annual FTA expenses amount to only 3% of the cost of emissions reduction strategies[8].

FP5 supports gender outcomes by considering important gender aspects as these relate to decision-making power and asset and resource control (cf. Section 2.5.1.9). Capacity development (Section 2.5.1.10) in developing countries is central to our ToC (Section 2.5.1.3) – it represents an important long-term impact of FTA that is often overlooked when the expectation horizon for research programs or projects (such as the CRP program) is drawn too close.

Tables 1 and 2 show the anticipated allocations of funds to the outcomes and to the CGIAR sub-IDOs, both as percentages and in US dollars. In the wake of the Paris Agreement, we assume that bilateral climate funding will increase, but our current plans are using conservative estimates for bilateral funding. The bulk of funding will be from bilateral funding. Window 1 and 2 funding will cover 21% of the overall FP budget and will be used for three purposes: (i) to partially cover staff time of CoA coordinators (see Section 2.5.1.13) working on flagship integration, coordination, fundraising and reporting; (ii) to cover expenses of FP5 integration and partner engagement (e.g. in-country meetings and workshops); and (iii) to cover expenses to undertake framing research (e.g. how to raise ambitions under the Agreement), initiate strategic approaches (e.g. novel approaches to tenure and rights holding) and scoping research. Given that the Paris Agreement has just been concluded, the pathways to and pitfalls in its implementation are not yet fully evident; in this 6-year program we are likely to see many policy swings and may need to refine our targets and the pathways towards them, under the changing circumstances.

Table 1. Outcomes by windows of funding.

Outcomes	Amount needed (million USD)	W1/W2 (%)	W3 (%)	Bilateral (%)
5.1 Efficient, effective and equitable climate national and international mitigation policies and funding, aligned with development objectives (3E+ goals)	40	21	0	79
5.2 Risk-assessed ecosystem-based adaptation (EbA) policy and practice in place including joint mitigation and adaptation approaches	19	21	0	79
5.3 Integrated food and bioenergy production policy and practice realized	9	21	0	79
5.4 Performance assessment of mitigation and adaptation policy and practice widely implemented	9	21	0	79
Total	**77 million**	21%	0%	79%

Table 2. Investments by sub-IDOs.

Sub-IDOs	Amount needed (million USD)	W1/W2 (%)	W3 (%)	Bilateral (%)
10.3/A1: Reduced net GHG emissions from agriculture, forests and other forms of land use	34	21.2	0	78.8
10.2: Enhanced adaptive capacity to climate risks	21	21.2	0	78.8
3.2: Increased livelihood opportunities	9	21.2	0	78.8
B.1: Gender equitable control of productive assets and resources	5	21.2	0	78.8
D.2: Enhanced individual capacity in partner research organizations	8	21.2	0	78.8

2.5.1.3 Impact pathway and theory of change

Our policy-learning framework applies to developing countries and the international arena that frames national implementation (e.g. UNFCCC, IPCC). Actors make (policy) decisions based on the information (and technologies) they have access to and the interests and ideas that structure their understanding of the (policy) problem and how to solve it (Figure 1). Change is enabled or hindered by institutions at multiple levels of governance – they often show structural biases disfavoring marginalized groups or preserving inequalities (see Section 2.5.1.9). Shifts in incentives, discourses and power relations are needed to transform current unsustainable practices into sustainable ones. Identifying how these shifts can be initiated in national policy arenas, multi-stakeholder and international fora is key to understanding how lasting transformational change can be achieved. The right choice of actors is essential (see Section 2.5.1.7).

In this context and given the need to interpret and bridge globally defined climate change policies and targets with effective, efficient and equitable local actions, our ToC requires leveraging political economy and governance dynamics at national and subnational levels.

The new knowledge generated in FP5 helps to: (i) identify options for more equitable and effective incentive structures; (ii) ensure well-informed decisions based on evidence; and (iii) contribute to rebalancing power by working in partnership with and providing evidence to potential agents of change in developing countries ('information is the new currency'). To achieve this, FP5 works along a clear impact pathway in our successfully evaluated[5] 'co-production of science' model (Figure 2):

1. **Early engagement** and trust-building with various types of collaborating partners from all levels and sectors (see Section 2.5.1.7) in developing countries (identifying and understanding needs), e.g. through multi-stakeholder consultations
2. **Joint definition** of relevant research questions (responding to needs);
3. **Co-development** of robust and salient, credible and legitimate research (output);
4. **Delivery**, directly or through the collaborating partners, **of knowledge and tools** to knowledge-using partners, i.e. national and global policy-makers and practitioners within the parameters needed to achieve the required transformational change (e.g. expected policy change) that represents the end-of-program outcomes in national and global policy and practice towards the intended goals (sub-IDOs, SDGs) (these changes happen within the 'boundary partners').

We envisage a stepwise or spiraling feedback process (Figure 3). First, boundary partners, research partners, policy-makers (at national and international levels, e.g. negotiators) and practitioners (mostly operating at subnational level) are contacted and consulted for a joint definition of relevant research questions ('targeted engagement' in Figure 2). Early participation will facilitate the internalization of the 3E+ principles of more efficient, effective and equitable climate policies and practices that are aligned with development and equity considerations. Once the knowledge becomes available, they then can start to use it in their day-to-day practice and apply it to climate change policy-making and practice. This is a complex process grounded in trust and mediated by debate, interaction and feedback. In this process we make use of national champions and national research partners that become emboldened through the interaction to operate in the national arena, but we will also works directly and early on with policy-makers at the various levels of administration. As an end point, we expect the generated knowledge to become (more) reflected in policy and practice at subnational, national and international levels. The process encompasses a 'spiraling' engagement with increasing levels of intensity, building on feedback loops, continuous engagement and iterative adaptation.

We operate in a development environment in parallel to many other actors of change and we work closely with many of them. We are acutely aware of the attribution problem, but we also have evidence[6] that our knowledge has been taken up at various levels of policy and practice.

The FP5 theory of change is, furthermore, supported by proactive, visible and significant communications, outreach and capacity development (see Section 1.0.14). It is accompanied by continuous policy analysis to identify current and anticipate emerging policy trends. The politics of developing countries are highly dynamic: anticipating trends helps to prioritize our research agenda and stay relevant to our partners. Some degree of flexibility is needed in order to respond to these rapid changes.

In summary, rather than trying to be 'predictive and prescriptive'[9], we see our role as 'honest brokers' of knowledge, committed to transdisciplinary biophysical, social and economic research with sound problem analysis that provides evidence-based policy options to target users – options that are based on an identification of what their needs are.

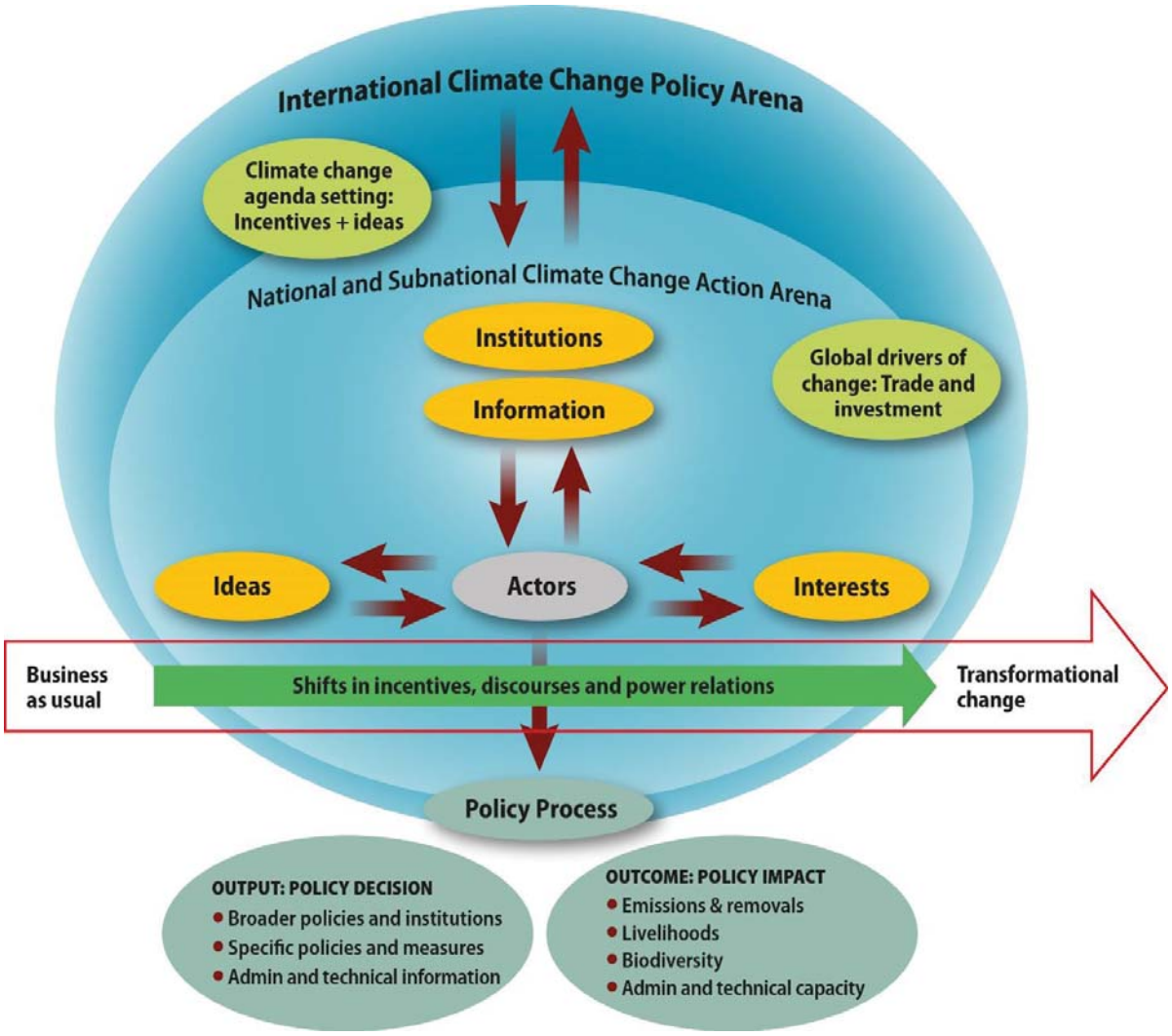

Figure 1. FP5's theory of climate change policy transformation.

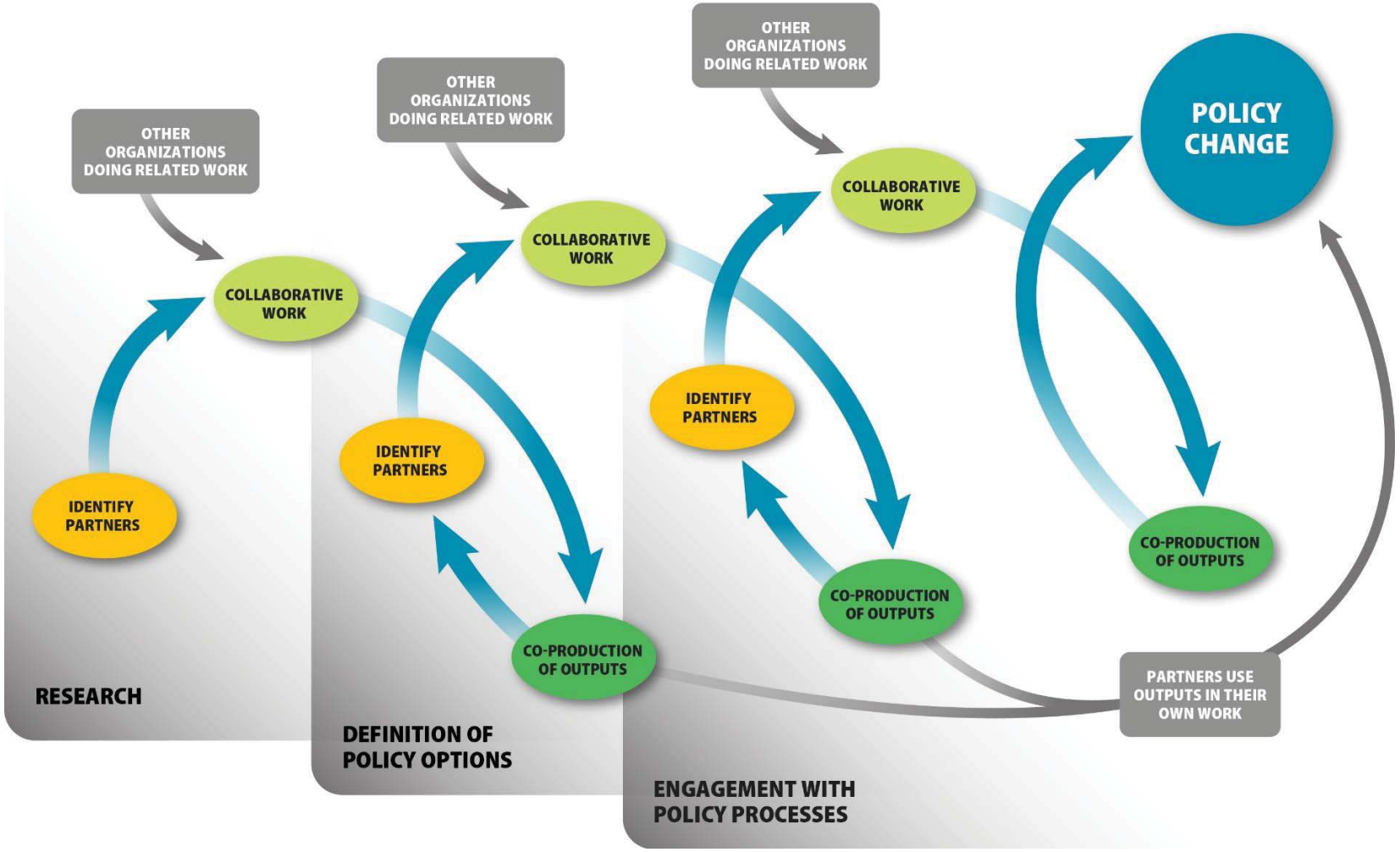

Figure 2. Linking research activities to end-of-program outcomes, policy change and sub-IDOs in FP5 through multiple partner engagement in our co-production of science model (for details on CoAs see Section 2.5.1.6; for details on which sub-IDOs are addressed see Figure 4).

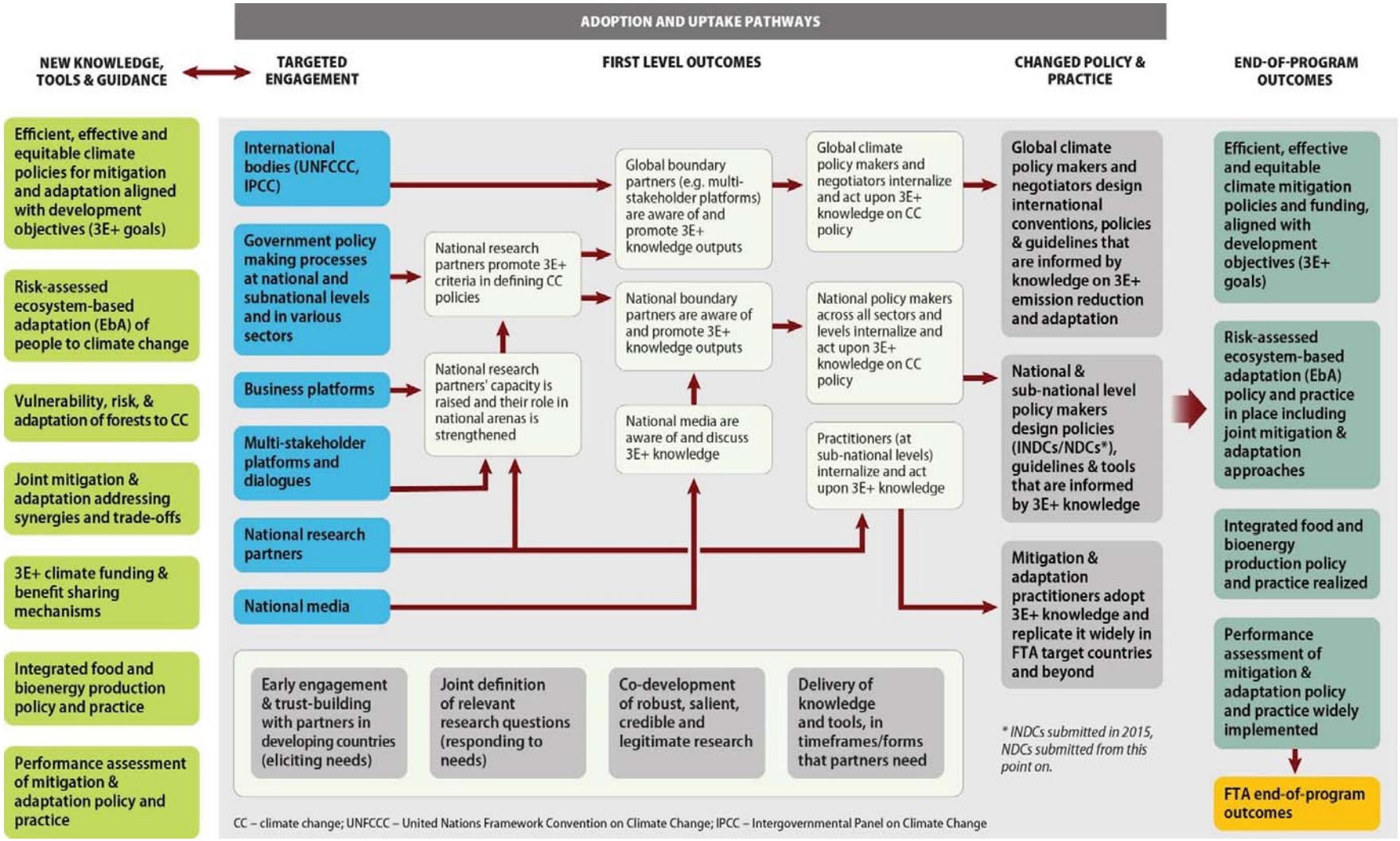

Figure 3. FP5 theory of change.

2.5.1.4 Science quality

Quality of science in FP5 is defined by (a) the identification of major gaps in theory, analysis and policy practice (innovation); (b) the research that we propose to fill these gaps (soundness of research and of the team); and (c) our competitive advantage to address these gaps (see also Sections 2.5.1.3 and 2.5.1.5). We relate this discussion to the topics addressed in the four CoAs (see Section 2.5.1.6).

Mitigation: A current debate declaring REDD+ "dead" seems premature, as REDD+ is now part of the Paris Agreement; the Green Climate Fund (GCF) is developing its results-based payment strategy and early anecdotal evidence indicates that developing countries are gearing up for REDD+. Instead, this seems the right time to address the identified operational challenges by testing REDD+ in practice. Our successful Global Comparative Study on REDD+ in FTA phase 1 is seen as pioneering and has had demonstrated impact[10]. It has created a substantial body of work on the elements of REDD+ (national strategies, baselines and emission factors, monitoring, reporting & verification [MRV] systems and safeguard information, multi-level and multi-sectoral governance challenges, equity, benefit-sharing and livelihood effects) – documented in over 350 publications (www.CIFOR.org/GCS). The key to this impact was our innovative approach coupling comparative, standardized research with enough flexibility to address new issues coming up in the fast-changing policy environments, together with our effective partner engagement approach based on our 4i approach (Figure 1) explained in Section 2.5.1.3. The Paris Agreement now also explicitly stipulates sustainable forest management and joint mitigation–adaptation approaches as additional mitigation options. After Paris, the GCF and many country partners are looking to research for answers and the FP5 partnership is strategically placed at the heart of the debate.

Adaptation: The Paris Agreement establishes adaptation (i.e. enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change) as a global goal of subnational, national and international dimensions that needs to contribute to sustainable development and support the 2.0/1.5°C goal effectively. Paris also prioritizes safeguarding food security and ending hunger and addressing the vulnerabilities of food production to climate change. Countries and the Green Climate Fund are now beginning to implement Joint Mitigation–Adaptation projects and further policy developments are expected from the UNFCCC. FTA has a long history of successful work on agriculture as a deforestation driver, on synergies between mitigation and adaptation and on climate finance/benefit-sharing; these were all innovative themes at the time we started them and we are recognized as discussion leaders in these areas which, to achieve the 3E+ criteria, need much more support from research. We have developed the understanding of policy environments enabling transformational change by leveraging a political economy approach (see Section 2.5.1.3) and will continue to do so. Multidisciplinary in nature, embedded in the broader context of FTA and building on well-defined ties to the *CGIAR Research Program on Climate Change, Agriculture and Food Security* (CCAFS) and other CRPs (see Figure 4), FP5 is well placed to develop system-oriented innovative landscape approaches to integrated climate and development policy.

Bioenergy: The Paris Agreement emphasizes, "the enhanced deployment of renewable energy"…"in particular in Africa" and fossil fuel consumption is central to the current global climate crisis. Bioenergy is expected to play a large, yet uncharted role in carbon removal, improving the balance between carbon sources and sinks. FTA has been working on biofuels, particularly fuelwood and charcoal production in Africa and is now ramping up its engagement by setting aside work in a specific CoA and developing an innovative, integrative policy approach supporting policy and practice of bioenergy development in developing countries, in collaboration with partners in research and capacity development.

Performance assessment: Once the stumbling blocks for policy change are removed, we believe that 3E+ policy development can include a more interactive approach to policy-making where decision-makers act upon feedback on policies. This is not the reality in many countries and requires a paradigm shift. Performance assessment based on evidence is at the heart of this shift. We need to develop rigorous performance assessment methods for climate policy and practice that can: (i) be done efficiently; and (ii) be used for effective policy-making. We are leaders in MRV of forest and carbon for REDD+, having supported the development of reference levels for many countries and we have developed a sophisticated approach to

performance assessment in our comparative 'difference-in-difference' approach (BACI: before-after/control-intervention) used in our global comparative study on REDD+. This will be continued in Phase 2 – we are working to reduce the efforts, emphasizing efficiency of data collection. It too holds great promise for broader implementation beyond climate policies, but expanding into that area will only be possible under an 'uplift' budget scenario.

In development research, the quality of science is also determined by its applicability to real-world development problems. We leverage this through our capacity to partner with advanced research institutes and think tanks for high-level analysis and advanced technologies (see Section 2.5.1.7) and through our close partnerships with research partners and policy-makers in developing countries (see Section 2.5.1.3). Our comparative advantage lies in the strong links to partners in environment, development and climate policy arenas in developing countries, giving us a head start over other actors in identifying the most pressing problems and effectively addressing them through these partnerships. FP5 pays significant attention to capacity development, offering postdoctoral positions and PhD and MSc studentships, in addition to conducting regular seminars and knowledge-sharing events with partners. This has been and is an important part of the impact pathway.

We strongly rely (but do not rest) on the achievements of FTA FP5 in phase 1, exemplified in approx. 900 scientific and policy publications to date (February 2016). Our achievements were positively assessed in the CGIAR-required FTA assessment[11] as well as the assessment of our global comparative REDD+ study[12]. Science quality in development is also defined by the accessibility and comprehensibility of science. We make great efforts to translate our work – making science accessible through short and readable policy briefs (many policy-makers request this!) in the native languages of our target countries.

Our approach to research and impact is based on accumulated experience and lessons from previous engagement and achievements, including many large-scale comparative projects. This includes a decade of well-regarded research on deforestation drivers, sustainable land management and policy analysis. This experience, combined with legitimacy as an independent global research partner, operating through country offices and long-established partnerships worldwide, puts us in a unique position to achieve the results outlined in this proposal. FP5's comparative advantage is derived from:

- the quality of staff from many nationalities and cultures with expertise in a wide range of disciplines
- the skills and networks of diverse delivery partners both in developing countries and globally
- our brand – the FP5 team is associated with credible, high-quality analysis, independent thinking, a reputation for tackling difficult and controversial issues and an ability to convene diverse actors
- a global mandate and local relevance – we are empowered to address global issues with the legitimacy to engage in international, national and local fora
- a distinct perspective: our interdisciplinary, global perspective is informed by the views of multiple stakeholders, emphasizing our commitment to understanding issues from the viewpoint of resource poor people and forest users.

Staff with lead positions (cf. Section 2.5.1.12) in FP5 are listed in Table 3, with an overview of their Google citation indices and rank in CGIAR Google Scholar. CoA leaders and scientists have been carefully selected based on criteria such as scientific expertise, partnerships they bring into the team and center representation.

Table 3. List of names, roles and H-index, number of citations and FTE (full-time equivalent).

Name, institution	Original discipline	H	No of citations	Rank in CGIAR	FP5 role	FTE
Christopher Martius, CIFOR	Ecology, climate change, land use	28	3027	71	FP5 lead and CoA FP5.2 lead	0.6
Bruno Locatelli, CIFOR	Forest climate change adaptation	23	1551	n.a.	CoA FP5.2 lead	0.04
Navin Sharma, ICRAF	Bioenergy	7	168	n.a.	CoA FP5.3 lead	0.3
Maria Brockhaus, CIFOR	Forest governance, REDD+, policy analysis	25	2245	111	CoA FP5.4 lead	0.5
Peter Minang, ICRAF	Agroforestry, REDD+, forestry, landscape approaches	18	1102	n.a.	CoA FP5.1 co-lead	0.3
Houria Djoudi, CIFOR	Climate change adaptation, gender	6	230	433	CoA FP5.2 co-lead	0.5
Lalisa Duguma, ICRAF	Climate change, sustainable landscapes, forest governance	9	271	400	CoA FP5.2 scientist	
Himlal Baral, CIFOR	Forestry, ecosystem services, landscape ecology, bioenergy	7	144	n.a.	CoA FP5.3 co-lead	0.5
Glenn Hyman, CIAT	Geography, tropical agriculture	17	1150	158	CoA FP5.4 co-lead	0.4
Arild Angelsen, UNMB	Economics, REDD+	47	13,970	n.a.	CoA FP5.1 partner	
Markku Kanninen, CIFOR	Tropical silviculture	32	4806	n.a.	CoA FP5.2 partner	
Eduardo Somarriba, CATIE	Agroforestry, trees on farms	30	3732	n.a.	CoA FP5.3 partner	
Martin Herold, Wageningen University	Remote sensing	42	8053	n.a.	CoA FP5.4 partner	

2.5.1.5 Lessons learned and unintended consequences

FP5 in Phase 2 has learned from the 2014 external FTA evaluation, the revised CGIAR portfolio, the ISPC's and other comments on the pre-proposal and global policy changes (including the Paris Climate Agreement), in several ways:

- We learned from years of successful REDD+ research:[13] e.g. we built a forest transition approach into the framework for setting reference GHG emission levels; our work on participatory MRV refocused from monitoring efficiency to empowering stakeholders. We see new multi-stakeholder policy processes emerging and we will study them. We are expanding work on adaptation and risk reduction (CoA 5.2) and introducing new research on forest degradation and restoration, climate finance (CoA 5.1), bioenergy (CoA 5.3) and performance assessment (CoA 5.4). We adapt to the Paris Agreement with a broader scope for REDD+ implementation and support to country-level implementation (NDCs). We are intensifying our work with CCAFS (see Section 2.5.1.8). Finally, our REDD+ experience enables much accelerated policy learning in other emission reduction approaches.
- Increasing focus on drivers of forest gains and losses to make interventions more effective: Research has shown that most large-scale deforestation is not driven by the value of the trees and forest resources harvested but by demand for land conversion to other uses (e.g. agriculture, livestock, timber, mining,

infrastructure, settlements and a rising developed-country demand for bio-products[11]). Land demand in developing countries grows with population growth and higher per-capita consumption of natural resources. We will address the underlying drivers of forest loss and will propagate work on the forest carbon sink capacity for mitigation that still needs to be better quantified and understood.

- Assessing performance as key to evidence-based policy-making that works: Our REDD+ research prepares us to assess the impact of mitigation and adaptation policy on non-carbon benefits that got greater focus in Paris (see Section 2.5.1.4).
- Constantly refining our theory of change, most recently in response to an internal evaluation of CIFOR's climate change program: Outcome mapping is now routine in new projects. Phase I demonstrated the catalytic potential of combining research, capacity development and partner engagement to bridge the science–policy divide (see Section 2.5.1.3). We will follow this approach in all CoAs.

We are well aware of **unintended consequences** and address them through our multidisciplinary work:

- Focusing too narrowly on mitigation could mean underemphasizing development and other, non-carbon objectives. This is addressed under the topic of safeguards, long a centerpiece of our climate policy research and by new, integrative research at the landscape level.
- Also, global emphasis on mitigation has often undercut adaptation as a topic in international debate. This has been somewhat repaired in the Paris Agreement in relation to REDD+,[14] the interaction between the long-term mitigation and adaptation goals[15] and the recognition that adaptation can contribute to mitigation outcomes[16]. We have focused on synergistic mitigation and adaptation approaches (FTA phase 1) contributing through our work to raising awareness of this topic and will continue this work. We are also addressing joint mitigation and adaptation by linking closely to CCAFS (see Section 2.5.1.8).

We are confident that the landscape-oriented systems approach that recognizes the multiple objectives of functional landscapes and that pervades FTA as a whole is safeguarding us against working on too narrow and non-adaptive premises for climate change policies and practices.

2.5.1.6 Clusters of activity (CoA)

Following on the research questions from Section 2.5.1.1, FP5 combines research, capacity development, technology transfer and policy engagement, to explore the following **hypotheses**:

1. Carbon-effective, cost-efficient and equitable emission reduction (mitigation) strategies and policies (Paris goals) can be attained involving FT&A resources and combined with development objectives (SDGs) through broad, integrative, cross-sectoral approaches using a political economy lens.
2. Strategies, policies, institutions and practices can be developed to preserve and manage FT&A resources for efficient and effective adaptation of people and landscapes to global environmental change and support joint mitigation–adaptation.
3. Renewable bioenergy from FT&A can effectively and efficiently support energy sufficiency and equity and generate rural income in developing country sustainable landscapes.
4. Methods to reliably and independently monitor and assess performance of mitigation and adaptation policy and practice can be developed, linking these to cost and benefit sharing.

Research is carried out in four clusters of activities integrated with research in other FPs and CRPs (Figure 4): FP5 links with FP2 on adaptation, with FP3 on private-sector approaches to mitigation and with FP4 on landscapes. We will work with CCAFS (see Section 2.5.1.8), the *CGIAR Research Program on Policies, Institutions and Markets* (PIM) on policy development and with the *CGIAR Research Program on Water, Land and Ecosystems* (WLE) on landscapes (Figure 4).

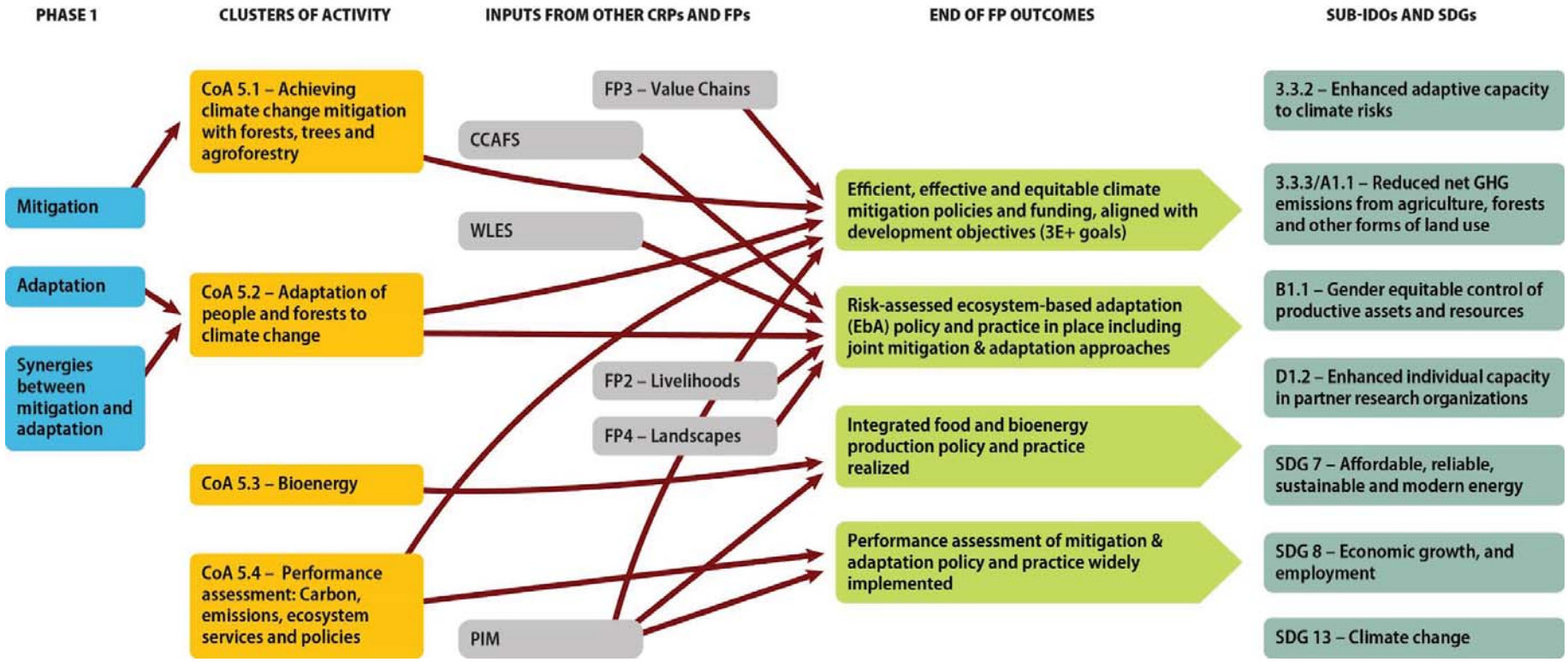

Figure 4. Clusters of activity in FP5 and links to other FPs and CRPs.

Geographic orientation. FP5 co-locates research with FTA FPs 3 and 4 and CCAFs to enhance the impact on climate change of CGIAR as a whole, at three levels: (1) joint regional approaches in all agroecological zones identified in FP4; (2) National-level research in countries with strong national climate strategies ((e.g. REDD+, Secured Landscapes, NDCs, LEDS) or large forest areas (e.g. Brazil, Indonesia, Peru, Vietnam, Cameroon, DRC) adding case studies where impact is promising (e.g. Myanmar); and (3) subnational-level work (e.g. in sentinel landscapes where work of various FPs converges towards joint landscape objectives [e.g. West Kalimantan, Peru, East Africa, Central America]) and collaborates with CCAFS on climate-smart villages. FP5 countries are shown in Figure 5.

Figure 5. FP5 research countries.

CoA 5.1 Achieving climate change mitigation with forests, trees and agroforestry

The Paris Agreement goals require immediate, coordinated efforts of all GHG-emitting sectors. CoA 5.1 will provide analysis and guidance on GHG emission reduction options for tropical landscapes using FT&A, integrated within economic and social development. National emission reduction and adaptation objectives come together in the NDCs and can be realized by various policy measures – REDD+, NAMAs, SFM or JMA[17]. These approaches share many elements: they account for GHG emissions and removals; some form of measuring, monitoring, reporting and verifying MMRV (see CoA 5.4) is required to establish baseline and reference points; funding can be domestic, international or mixed, public or private. All countries face the challenge of aligning climate and development objectives and integrating FT&A resources, emission reduction and sustainable bio-production in comprehensive, national, long-term LED strategies. We anticipate a growing demand for capacity development and analysis in support of LED implementation, realistic targets and a means of reaching them. CoA 5.1 builds on 8 years of comparative research on mitigation policy and practice (see Section 2.5.1.4) to accelerate policy learning on governance, benefit-sharing, MRV and finance. CoA 5.1 seeks to advance knowledge through country-specific, as well as global, comparative analysis of emission reduction options, incentives, policies, governance and partnership mechanisms for achieving mitigation through FT&A at global, national and landscape scales (linking to FP4). Guidance will be provided on policy design and architecture and there will be a focus on the political economy of enabling policies. Foresight studies on FT&A-based mitigation and adaptation with respect to SDGs and Paris Agreement targets will be undertaken.

CoA 5.1 addresses sub-IDOs 10.3/A.1, reduced net GHG emissions from agriculture, forests and other forms of land use; and 8.1, land water and forest degradation (including deforestation) minimized and reversed; and 9.1, more productive and equitable management of natural resources.

Key research activities (research questions):

- 5.1.1. **Comparative analysis of best, 3E+ options for policies and practices for emission reduction** in support of country-level development and implementation of NDCs (including REDD+[18], NAMAs, SFM, and JMA) and international climate change policy-making, using FT&A resources; and including analysis of ways to reduce complexity and 3E+ goals in LEDS (e.g. governance of multi-level and multi-sectoral integration of local, national and regional climate change, restoration and development agendas)
- 5.1.2. Research on policy and practice of **forest restoration** and on enhancing the forest carbon sink capacity (supporting the Bonn Challenge), e.g. in collaboration with the 20×20 initiative
- 5.1.3. Research on the complex challenge of **forest fire** policies, with particular reference to Indonesia
- 5.1.4. Research on the effectiveness and efficiency of **results-based climate finance** and incentive mechanisms, including through the Green Climate Fund, in affecting policy and behavioral change towards mitigation and adaptation outcomes
- 5.1.5. Studies of the **enabling policy architecture and public–private partnership mechanisms** that can enhance performance of corporate zero deforestation commitments and other mitigation initiatives, addressing standards and certification (with FP3)
- 5.1.6. Support for **evidence-based decision-making** in NDC planning and implementation (e.g. in support of the *Facilitative Dialogue* set in the Paris Agreement) and develop **policy learning from country-level to the international policy arena.**

Methods: a variety of biophysical and social methods, using our databases for long-term comparative research.

CoA 5.2 Adaptation of people and forests to climate change

Land-based economic activities in developing countries will continue to be vulnerable to climate change, which emphasizes the need for adaptation. Maintaining and managing FT&A resources can help people adapt to climate variability: e.g. adequate tree management in agriculture enhances food security, forests regulate the microclimate locally (e.g. in cities) and water regionally in watersheds, and mangroves buffer the impacts of extreme climate events in coastal areas. CoA 5.2 addresses two issues: (i) how can FT&A adapt to climate change; and (ii) how can FT&A help people and heterogeneous societies adapt to climate change. We will use empirical research supporting policy integration, practice and assessment at local, national and international levels, combining climate risk reduction with increased resilience (with FP2). In addition, in CoA 5.2 we seek to advance knowledge on nature-based solutions to climate change by analyzing the synergies between and incentives for mitigation and adaptation approaches, as recognized in the Paris Agreement.

CoA 5.2 targets sub-IDO 10.1, increased resilience of agroecosystems and communities especially those including smallholders; and bears on 10.2, enhance adaptive capacity to climate change risks; and 9.3, on enrichment of plant and animal biodiversity for multiple goods and services.

Key research activities (research questions):

- 5.2.1. Continued work on understanding the **synergies/trade-offs between mitigation and adaptation** in support of the Paris Agreement (link to CCAFS)
- 5.2.2. Assessment of potential impacts of climate change on biodiversity, ecological functions and ecosystem services to **assess risks and vulnerability of both people and forests**, systematize experiences where FT&A has strengthened local responses to climate change, equitably reducing risk and increasing resilience and to contributing analysis to the 'loss and damage' debate
- 5.2.3. Identifying options to reduce climate-related risks, analyzing trade-offs, exploring adaptation economics, using and demonstrating ecosystem-based adaptation (***EbA)***, developing adaptive capacity of social groups and exploring the interface to climate-smart agriculture (CSA)

- 5.2.4. Comparison of policy mechanisms that **strengthen local capacity to respond with *EbA*** to expected climate change and variability (e.g. land-use planning, multi-stakeholder dialogues, encounters of knowledge), and their integration into national development and adaptation plans (NAP, NAPAs) across scales
- 5.2.5. Development and testing of approaches to **measure and monitor effectiveness and efficiency of *EbA* actions** in reducing vulnerability and increasing resilience to inform national and international policies and priority setting. Setting apart unsuccessful, business-as-usual tree- and land-based interventions from successful *EbA* requires a tool set integrating vulnerability assessments of socioeconomic and ecological systems to increase resilience.
- 5.2.6. Experimentation with and development of **flexible, data-driven approaches** that emphasize flexibility and heterogeneity as risk reduction strategies and feedback-based policy responses.

Methods: risk and vulnerability assessments; meta-analysis and systematic reviews of case studies at household/landscape level (case studies are the preferred approach because adaptation is strongly place-based, depending on local practices and preferences, climate, crops and tree species); desk studies analyzing national policies and programs and the performance of existing adaptation projects; biophysical studies at landscape level on the management of ecosystem services to reduce climate-related risks.

CoA 5.3 Bioenergy

Bioenergy is key to improve the sustainability of the energy sector[19] and achieve the Paris goals[20]. Many governments have renewable energy targets and the Paris goal of balancing sources and sinks requires a thorough understanding of the role bioenergy can play. However, globally, the level of government subsidies to fossil fuels remains high[21]. Also, in many regions, biofuels are unsustainable, contribute to climate change and human health problems (e.g. open cooking fires; charcoal production), and are considered 'backwater technologies' by national actors.

In CoA 5.3 we analyze climate the benefits and disadvantages of bioenergy policies under current and plausible future scenarios. Renewable energy efficiency targets can be included in NDCs by developing countries, making for an interesting investment arena. We address bioenergy as part of a coherent approach across FTA that considers energy poverty, climate change and food and nutritional security through diverse production systems involving forest landscapes, with links to FP2 Livelihoods (smallholder production), FP34 Value Chains, and FP4 Landscapes (agroforestry production). We will integrate bioenergy in landscape mosaics by evaluating various production typologies (such as extractive system, integrated food and energy systems, abattoir waste from agriculture and forests and cellulosic material) and identify the conditions for these production systems to support livelihoods and examine the impacts of such systems on GHG emissions.

CoA 5.3 supports sub-IDOs 10.3/A.1, Reduced net GHG emissions from agriculture, forests and other forms of land use; and 3.2, Increased livelihood opportunities.

Key research activities (research questions):

- 5.3.1. Analysis of the **current status of bioenergy types**, including the relative benefits, disadvantages and the extent of their use in different regions
- 5.3.2. Analysis of **international and national drivers of bioenergy development** to understand how markets and standards (e.g. EU Renewable Energy Directive) affect land allocation for bioenergy production
- 5.3.3. Assessments of **potential of bioenergy production on degraded land** using spatially explicit data about the area, type and extent of degradation, tree species' suitability, growth and yield at national and subnational level in Indonesia

- 5.3.4. Analysis of the **impact of bioenergy on social and environmental outcomes** (e.g. health, poverty, migration, gender, biodiversity) to support equitable, sustainable energy generation
- 5.3.5. Studies of **demand and supply, costs, social and environmental impacts, carbon footprints and synergies/trade-offs with food production and variation** by region, feedstock types and scale of bioenergy production
- 5.3.6. **Scenario development:** Analysis of **how bioenergy extraction links to landscape configuration**, as people's practices of wood extraction depend on a landscape, but also shape it; assessment of how future energy developments may affect the role of biofuels, retaining flexibility to include new developments (e.g. lignocellulosic fuels) and investigate how they may benefit stakeholders.

CoA 5.3 will use bio-economic modeling, field-scale comparative analysis (e.g. life-cycle analysis) and political economy studies.

CoA 5.4 Performance assessment: Carbon, emissions, ecosystem services and policies

Performance assessment builds on the traditional MRV approach but includes policy performance assessment as the basis for evidence-based policy and practice. This is broader than the traditional MRV and it is known as MMRV (monitoring, measuring, reporting and verification). MMRV of practices and policies is needed to achieve intended emission and risk reduction effectively, in line with the Paris Agreement. REDD+ needs safeguarded information systems; NDCs need more transparency, clarification, time frames, implementation pathways, scope and coverage; and countries need to develop the technical MMRV details in a broad range of topics and sectors for LEDS[22]. Private-sector pledges also require performance assessments (linked to FP3). Data-driven approaches will improve confidence and enable effective and transparent policy implementation. In addition, independent monitoring data and systems based on existing or new data sets and initiatives at global (e.g. Global Forest Watch, ESA's biomass satellite, EC-Copernicus), national or subnational (e.g. jurisdictional, landscape, community-based) level can provide more transparency for performance-based MMRV but will require assessment and testing. Independent monitoring, in terms of carbon and non-carbon outcomes, can provide tailored approaches for specific users, e.g. civil society members can be empowered by new information and data to follow up with governments and private sector actors and their commitments.

Building on our expertise in performance assessment (see Section 2.5.1.4), this CoA can be expanded into broader performance assessment, e.g. for the SDGs, which also support other flagships.

CoA 5.4 supports all sub-IDOs directly addressed in FP5 through improved performance assessment and capacity development.

Key research activities (research questions):

- 5.4.1. **Determine reference levels:** Research that supports the setting of country targets, baselines/reference levels/points of departure regarding FT&A resources, carbon stocks and other ecosystem services for REDD+, NAMAs, INDCs and LEDS; develop criteria and tools to measure and contribute to private-sector assessment
- 5.4.2. Basic research to **understand carbon source/sink dynamics** to improve regional and global models (link to SP1) and feed into IPCC processes aiming to implement the Paris Agreement
- 5.4.3. Measuring **non-carbon benefits** (biodiversity, governance and livelihood outcomes, social equality, and informing the implementation of safeguarded information systems). Use of innovative methods, such as qualitative comparative analysis and quasi-experimental methods to identify causal change
- 5.4.4. **Impact assessment of REDD+** policy and practice, building on 8 years of comparative research and longitudinal data sets

- 5.4.5. **Identify and develop approaches to cost-efficient, transparent, reliable MMRV,** including independent monitoring approaches. We specifically aim for more integrated landscape monitoring approaches (e.g. including climate modeling) to assess multifunctional performance (linked to 5.4.3.) building on existing methods and approaches, so that countries find support in their multiple monitoring needs under Paris (INDCs), SDGs and the like. Linking MMRV for forest- and agriculture-related mitigation should create important synergies for mitigation planning and implementation
- 5.4.6. Coupled **bio-economic modeling** to understand emergent properties, complexity and conditions of landscape systems. Develop decision-making tools; e.g. landscape management for LEDS: models of future scenarios and climate/carbon outcomes under different land-use policies; spatial economic analyses to assess the cost and equity implications of policy mix options

Methods in CoA 5.4: biophysical assessments, social science, political economy, policy analyses.

2.5.1.7 Partnerships

Our outcome statement is that **climate change policy-makers and practitioner communities have access to and use of the information, analysis and tools needed to design and implement policies for mitigation, adaptation and bioenergy, create enabling conditions to assess the degree to which REDD+ has delivered effective, cost-efficient and equitable carbon and non-carbon benefits**. To achieve this goal, we build on tested and trusted relationships with key R&D/delivery government and non-government partners in a number of countries, following the principles outlined in FTA's overall partnership strategy (see Annex 3.2). We select our partners based on their competitive advantage for FP5 work using the following criteria: (i) they are addressing climate and development policy and practice; in which they play a key role or have the potential for such a role and (ii) they are highly engaged. We work either directly with the target agencies or with intermediate partners for which we identified the mandates, the capacity, the networks, or the potential, to effectively reach key national decision-makers and practitioners. We work with local, national and international partners to support all implementation levels. In the coming years, national implementation (e.g. INDCs) and subnational action will be key; we will temporarily increase the focus on these levels. But national and subnational experiences need to flow back to the international level to influence the development of the new Paris global framework, amongst others and we will actively support this policy learning process. These partnerships are essential for our ToC, as they ensure local ownership of research and results. We have evidence[23] that they were key to success of FTA's climate change mitigation and adaptation work over the past 4 years.

Experience in Phase 1 shows that partners are key in co-developing science (outputs) and that they use the knowledge generated in FP5 for their decision-making (outcomes) (Table 4). Regarding **outputs**, developing country research partners are central for capacity development and research in our co-production of the science model. World-renowned advanced research centers provide cutting-edge science and training to young academics from developing countries; they bring expertise and analytical capacity (including labs) into the practice-oriented research of the flagship program and they link us to international processes (i.e. Intergovernmental Panel on Climate Change [IPCC], Global Forest Observations Initiative [GFOI], Global Observation of Forestry and Land Cover Dynamics [GOFC-GOLD]). Networks such as Sustainable Wetlands Adaptation and Mitigation Program [SWAMP][24] (with over 200 partners in 20 countries working on tropical wetlands) or Global Forest Watch[25] (on forest resource monitoring) are important multipliers of our research output. Civil society organizations, including movements representing indigenous peoples and forest communities, link us to local contexts and the rights and equity debate.

Regarding **outcomes**, we work with national policy actors dealing with climate change mitigation and adaptation, e.g. line ministries and subnational agencies. NGOs and agricultural and development research and delivery partners (IUCN, CARE, GIZ; e.g. FORCLIME project, Indonesia); pilot project proponents and private-sector actors use our knowledge for implementation on the ground. We are currently expanding our partnerships with multi-stakeholder round tables and networks (e.g. Governor's Forests and Climate

Task Force) assessing their potential for broader multiplication and they have expressed interest in using this knowledge to inform their work. We provide knowledge and tools to donors and multilateral and agencies for technology transfer. We provide information and training to the media in developing countries. At the global level, we work with UNFCCC bodies to support their policy learning, knowledge management, transfer and implementation.

Table 4. Selected partners in FP5 and their roles.

Advanced research centers used for capacity development and underpinning FTA with world-class science	School of Economics and Business, Norwegian Univ. of Life Sciences (NMBU), NO; Dep. of Forestry & Environmental Resources, North Carolina State University, USA; Columbia Univ., New York, USA; Geoinformation Science & Remote Sensing, Wageningen Univ., NL; VITRI – Dep. of Forest Sciences – Univ. of Helsinki, FI; Center for Development Research (ZEF), Univ. of Bonn, DE; IIASA; Laxenburg, Austria; International Network for Bamboo and Rattan (INBAR), Beijing, China and external offices
Developing country research partners → local research, capacity building and out-scaling and multiplication	Bogor Agric. Univ. (IPB), Indonesia; Iwokrama Int. Ctr. for Rainforest Conservation & Dev. (IIC), Guyana; Wondo Genet College of Forestry & Nat. Res., Hawassa Univ., Ethiopia; Conseil p. la Défense Environnementale par la Légalité et la Traçabilité (CODELT), DRC; Indonesian Ctr. for Env. Law (ICEL); Libelula Comunicacion Ambiente y Desarrollo Sac (Libelula); Nat. Forest Inst., Myanmar; Vietn Acad. of Forest Sciences; Vietn. Forestry Univ.
National policy actors (line ministries) → national policy implementation	Ministry of Environment and Forestry, Indonesia; Bappenas (Planning), Indonesia; Vietnam Forest Protection and Development Fund; Ministry of Environment, Forest Service (Peru)
Civil society organizations → national/subn. research, dissemination, & implementation	Earth Observation Institute; Rights and Resources Initiative; Instituto de Mudanças Clímaticas (IMC); Instituto de Pesquisa Ambiental da Amazônia (IPAM) [Amazonian Environmental Res. Inst.]; Society of Indonesian Environmental Journalists (SIEJ); The Nature Conservancy (TNC)
Private sector → outcomes	DANONE Livelihoods Fund; Indonesian Estate Crop Fund for Palm Oil
Multi-stakeholder roundtables & networks → research outcomes	Roundtable for Sustainable Palm Oil (RSPO); Governor's Forests and Climate Task Force UN Sustainable Energy for All initiative; Global Initiative on Clean Cookstoves; REDD+ Roundtable, Peru; Global Forest Watch
Donors & agencies → technology transfer	Green Climate Fund; World Bank Indonesia; UNFCCC Climate Technology Centre and Network – CTCN, Copenhagen; UN-REDD; KfW (German Development Bank)
International policy actors → policy learning	UNFCCC COP; UNFCCC SBSTA; UNFCCC Paris Workgroup; Adaptation Board, IPCC

2.5.1.8 Climate change

FP5 provides knowledge on how to use FT&A resources for the mitigation of and adaptation of forests and people to climate change. This is an essential part of a landscapes approach that integrates the multiple functions of a productive and sustainable landscape, particularly with regard to regulating (climate change) and provisioning (food production) ecosystem services. FP5 focuses on deforestation and forest degradation that account for approximately 70% of tropical land-based emissions. CCAFS focuses on the remaining 30% of emissions from agriculture (from enteric fermentation, manure management, paddy rice and cropland soils). Work in both programs is complementary (see overall FTA description). CCAFS emphasizes CSA, enhanced food security and improved nutrition under climate change. FT&A focuses on integrated bioproduction and environmental services provision through FT&A resource management at the landscape scale, working on policies and practices that link climate mitigation and adaptation to development. FTA-FP5 is expanding work on sustainable supply chains. FTA adds work on bioenergy (CoA 5.3) to support adaptation, mitigation and rural income generation, addressing the trade-off in land demand for food and energy production by emphasizing the use of degraded lands for the latter. FTA's focus on performance assessment is unique. It will provide hard data of how climate aspirations translate into achievements and aspires to be of use to the CGIAR as a whole (CoA 5.4). Both programs work on LED(S): CCAFS as a broad strategy to encompass its mitigation work in Flagship 3 and FTA as a specific area of work related to the role of FT&A resources in LEDS (CoA 5.1). Together, FTA and CCAFS provide a coherent approach to climate change across the CGIAR.

2.5.1.9 Gender

Equity is one of our 3E+ objectives. In FP5, we study inequalities related to gender, indigenous people and local communities (IPLC), and the structural causes of gender-disaggregated impacts of climate change in different social, political and cultural contexts; and of mitigation (e.g. REDD+), adaptation and biofuel development on households; adaptation options; and access to resources and distribution of benefits. We will, jointly with the FTA Gender Integration team, identify gender-specific research questions (following the FTA gender strategy), to address the gender implications of these and other activities (e.g. corporate zero-deforestation pledges, bioenergy development). We will assess gender-differentiated roles in land-use planning for adaptation, how climate change and coping strategies impact and change gender relations, and the gendered impacts of adaptation policies, projects and interventions. FP5 aims to identify mechanisms to enhance the participation of marginalized groups in the formulation of adaptation and mitigation policies and interventions, through our work on safeguards, benefit-sharing, Free, Informed and Prior Consent (FIPC), and negotiated approaches to resource management. We will address the gender and IPLC aspects of producing, transporting and using wood energy.

Gender considerations will be integrated into target and priority settings, identifying boundary partners, dissemination of knowledge products, performance evaluation and our own staffing. For example, while our FP5 leadership composition is still male-biased (something FP5 will work to change), our REDD+ research team has a F:M relation of 2:1 (in terms of number of staff and person-month allocation). We will use the Gender Equality in Research Scale (GEIRS) for monitoring. FP5 will contribute to the sub-IDO (B1) Gender-equitable control of productive assets and resources.

We will apply in our overall design of FP5 research the concept of inter-sectionality and use methods, which will be gender, race and age sensitive and take power relations into account as well. For example, we will analyze in focus group discussions differentiated perceptions, impacts and (preferred) responses to diverse drivers of change of women, men and youth, as outlined for example in Djoudi et al. (2012[26]); Brockhaus et al. (2013[27]). This will allow us to provide much more nuanced policy recommendations for the needs and ambitions of different societal groups and classes. In addition, we will work with youth groups, e.g. forestry students concerned with climate change that came up with innovative solutions at the Global Landscape Forum.

2.5.1.10 Capacity development

We will develop capacity by: (i) working with national partners on mitigation and adaptation; employing the co-production of science model that enables country partners to develop research capacity 'on the job'; (ii) investing considerable resources into academic training of our future developing country leaders; and (iii) producing quality training materials (e.g. online tools). The long-term impact of our research program in capacity development in developing countries is one of the major outcomes of CGIAR research – developing national ownership and problem-solving capacity by empowering national institutions and individuals addressing development and climate change problems. Our capacity development efforts predominantly address ***D.1.2 Enhanced individual capacity in partner research organizations***, but indirectly contribute to developing the capacities of research/delivery institutions where those individuals work, in poor, vulnerable countries. This is reflected in 10% of our budget going to capacity development explicitly (see Table 2). We expect direct involvement in 30–40 new PhD studies and 20–30 MSc and BSc studies in the course of this phase.

2.5.1.11 Intellectual asset and open access management

Intellectual assets (IA) produced under FTA are in compliance with the CGIAR Principles on the Management of Intellectual Assets (CGIAR IA Principles) and CIFOR IA management policy for effective dissemination of research outputs and maximizing global impact. The following CGIAR IA principles shall be adopted as guidance on IA management of FTA:

- FTA research results and development activities are regarded as international public goods for maximum possible access
- Partnerships are critical to ensuring access to the best knowledge and innovation to achieve maximum impact
- Sound management of IA and intellectual property rights (IPR) with integrity, fairness, equity, responsibility and accountability
- All IAs produced under FTA are managed in ways that maximize global accessibility.

In line with the CGIAR Open Access and Data Management policy and CIFOR OA policy, FTA outputs will be made available under the least restrictive licensing to describe the legal rights to information products and encourage their use and adaptation. It will be published in a format that can be downloaded, indexed and searched by commonly used web applications. The outputs will be disseminated through open access repositories to ensure it is archived and shared systematically with other centers and made accessible as international public goods.

A section on FTA IA management and open access implementation is available in Sections 1.0.12 and 1.0.13 of the full FTA Proposal, including a detailed strategy for IA management in Annex 3.10 and OA/OD implementation in Annex 3.9.

2.5.1.12 FP management

FP5 will rely on a collaborative management model in which the three lead partners will distribute responsibilities and manage the flagship program collaboratively, building on the last 6 years of a successful partnership (Table 5). The overall coordination of FP5 will be led by Christopher Martius, a Principal Scientist at CIFOR and each CoA will have a small management team (the rows) consisting of the institutions and the named people in the table. Teams will meet annually and consult frequently by email and VoIP. The coordinating team (column 2) will meet biannually if possible and consult frequently by email and VoIP. This

arrangement will be revised every 2 years – or earlier in specific cases, e.g. if one of the leaders should leave the team.

Table 5. FP5 leadership and CoA management groups

Cluster of activity	Lead/coordinating	CGIAR partner	Non-CGIAR major partner
CoA 5.1	CIFOR: Christopher Martius	ICRAF: Peter Minang CIAT: (20x20 Initiative): Louis Verchot	Norwegian University of Life Sciences (NMUB): Arild Angelsen
CoA 5.2	Cirad (EbA): Bruno Locatelli	CIFOR (vulnerability): Houria Djoudi ICRAF: Lalisa Duguma	Helsinki University (adaptation policies): Markku Kanninen CATIE (smallholders, capacity development): Eduardo Somarriba
CoA 5.3	ICRAF (bioenergy for smallholders): Navin Sharma	CIFOR (bioenergy policies): Himlal Baral	Will be determined later
CoA 5.4	CIFOR (policies): Maria Brockhaus	CIAT (Terra-i): Glenn Hyman	Wageningen University (remote sensing): Martin Herold