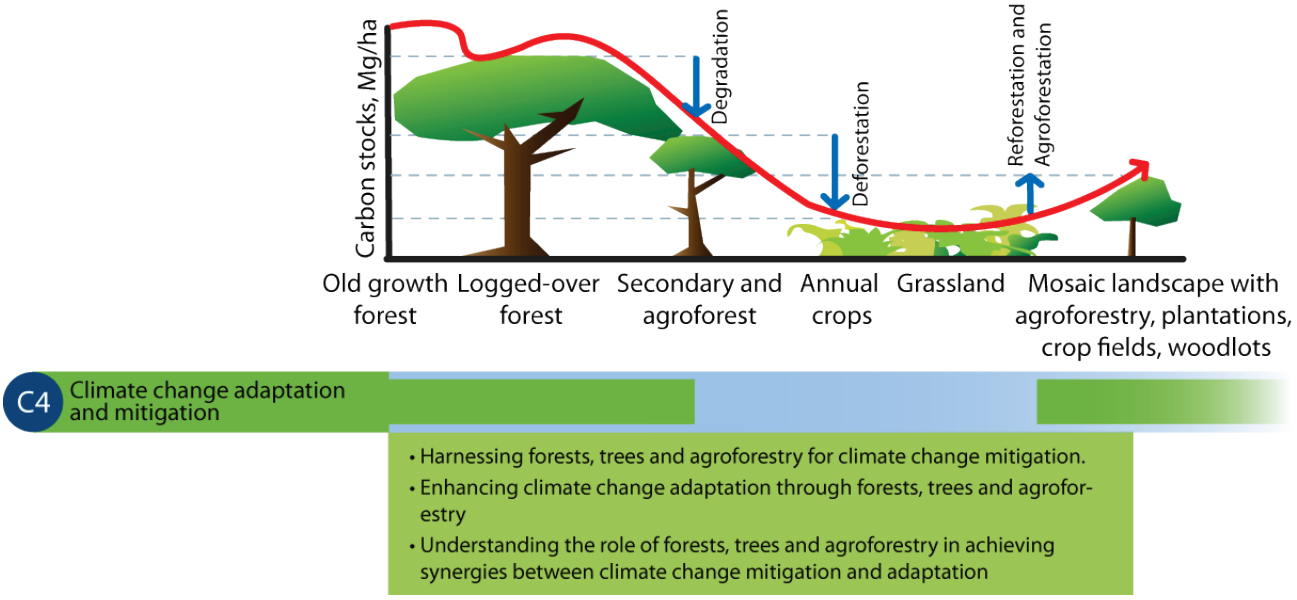
2.4 Component 4: Climate change adaptation and mitigation



2.4.1 Introduction

Better management of forests, tree resources and their genetic diversity is an effective response to many of the challenges of climate change.[103] The contribution of forests and trees to carbon sequestration and mitigation of emissions is recognized in the international negotiations on reducing emissions from deforestation and degradation (REDD+), related national strategy initiatives and the many landscape-scale pilot projects underway around the world. Land use change, including tropical deforestation, is a significant source of carbon emissions and an active contributor to global warming. Deforestation is estimated to have contributed on average 1.6 gigatons of carbon per year in the 1990s—about one-fifth of current global carbon emissions.[104] Other studies have estimated emissions from deforestation and forest degradation to be about 12% of the current total anthropogenic emissions (15% if peatlands are included).[105]

Deforestation has various causes, most of which originate outside the forestry sector. Understanding these causes is crucial to identifying appropriate incentives to curb deforestation, while at the same time benefiting people whose livelihoods depend on forests. Finding ways to maintain terrestrial carbon pools and to reduce carbon emissions from land use change will be key elements in future negotiations and climate agreements. This could have large-scale implications for the forestry sector, land use and rural livelihoods, including

[103] Turner, W.R. et al. 2009. A force to fight global warming. Nature 462: 278–279; World Bank. 2009. Convenient solutions to an inconvenient truth: ecosystem-based approaches to climate change. Environmental Department, World Bank, Washington, DC.
[104] Denman, K.L. et al. 2007. Couplings between changes in the climate system and biogeochemistry. In: Solomon, S. et al. (eds.) Climate change 2007: the physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 541–584. Cambridge University Press, Cambridge, UK and New York.
[105] Van der Werf, G.R. et al. 2009. CO2 emissions from forest loss. Nature Geoscience 2: 737–738.

for women and disadvantaged groups, in developing countries. The Stern Review, an analysis of the economics of climate change published by the UK government, emphasizes avoided deforestation as one of four "key elements" of future international climate frameworks.[106]

As the concept of REDD+ is relatively new and rapidly evolving, and models for its implementation are still under discussion, reliable baseline data are not yet available.[107] There is growing recognition of the need to address critical non-carbon dimensions of REDD+ implementation[108] encompassing forest governance, rights of indigenous peoples and forest-dependent communities (including women) and tenure (see Box 2.7). These factors are compounded by the complexities of tracking and measuring changes in tropical tree and forest cover,[109] socioeconomic conditions of forest- and tree-dependent communities[110] and governance and institutions.[111] Remarkably few empirical studies are sufficiently rigorous to allow causal linkages to be drawn between policy and project interventions and, for example, conservation or livelihoods impacts.[112]

Box 2.7 Tenure in Component 4

Conflicting claims over rights of resource access and tenure between state, local communities and the private sector have been recognized as a major contributor to forest degradation and use of fire, which lead to carbon emissions. Consequently, negotiated agreements on forest access are seen as a precondition for effective REDD+ efforts and at least some positive steps have been taken in key countries. Further negotiation support is needed, and the REDD-related expectations of financial gains for claimants of forest rights have complicated the process. Similarly, unclear and contested rights to land and trees, as well as unexplored rights to carbon, all impinge on the level of investment in agroforestry and its potential for carbon sequestration.[1] With regard to adaptation, several studies have shown that land tenure influences people's vulnerability to climate change and, thus, plays an important role in adaptation.[2] Comparative studies of the way forest institutions and state claims over forestlands have developed and how pluralistic rights systems have evolved can support policy reforms, and timely evaluations of ongoing policy reforms can reduce the time lags in further learning.

References:
[1] Akiefnawati, R. et al. 2010. Stewardship agreement to reduce emissions from deforestation and degradation (REDD): case study from Lubuk Beringin's Hutan Desa, Jambi Province, Sumatra, Indonesia. International Forestry Review 12: 349–360.
[2] Toni, F. and Holanda, E. 2008. The effects of land tenure on vulnerability to droughts in Northeastern Brazil. Global Environmental Change 18(4): 575–582.

[106] Stern, N. 2006. Stern review: the economics of climate change. Cambridge University Press, Cambridge, UK.
[107] Angelsen, A. (ed.) 2008. Moving ahead with REDD: issues, options and implications. CIFOR, Bogor, Indonesia; Angelsen, A. (ed.) 2009. Realising REDD+: national strategy and policy options. CIFOR, Bogor, Indonesia.
[108] Phelps, J. et al. 2010. What makes a "REDD" country? Global Environmental Change 20: 322–332.
[109] Grainger, A., 2008. Difficulties in tracking the long-term global trend in tropical forest area. Proceedings of the National Academy of Sciences USA 105(2): 818–823.
[110] Andam, K.S. et al. 2010. Protected areas reduced poverty in Costa Rica and Thailand. Proceedings of the National Academy of Sciences USA 107(22): 9996–10001 doi:10.1073/pnas.0914177107; Orozco-Quintero, A. and Davidson-Hunt, I. 2010. Community-based enterprises and the commons: the case of San Juan Nuevo Parangaricutiro, Mexico. International Journal of the Commons 4(1): 8–35.
[111] Wardell, D.A. and Lund, C. 2006. Governing access to forests in northern Ghana. Micro-politics and the rents of non-enforcement. World Development 34(11): 1887–1906; Agrawal, A. et al. 2008. Changing governance of the world's forests. Science 320: 1460–1462; Sikor, T. et al. 2010. REDD-plus, forest people's rights and nested climate governance. Global Environmental Change 20(3) doi:10.1016/j.gloenvcha.2010.04.007; Larson, A. et al. 2010. New rights for forest-based communities? Understanding processes of forest tenure reform. International Forestry Review 12(1): 78–96.
[112] Jagger, P. et al. 2009. Learning while doing. Evaluating impacts of REDD+ projects. In: Angelsen, A. (ed.) Realising REDD+: national strategy and policy options, 282–292. CIFOR, Bogor, Indonesia; Andam, K.S. et al. 2010. Protected areas reduced poverty in Costa Rica and Thailand. Proceedings of the National Academy of Sciences USA 107(22): 9996–10001 doi: 10.1073/pnas.0914177107.

In addition to their contribution to climate change mitigation, forests, trees and their genetic diversity are also relevant to adaptation, i.e., the reduction of the impacts of climate change on ecosystems and societies. Global climate change will adversely affect forests, natural resources and people's livelihoods in myriad ways. Gradual changes in precipitation and temperature patterns are expected and the amplitude and frequency of weather-related disturbances, such as hurricanes, droughts and accompanying fires, as well as pests and diseases, are likely to increase.[113] Weak institutional, political and economic conditions limit the adaptive capacity of developing countries, making their populations more vulnerable to climate change, which threatens livelihoods, especially those of women and vulnerable groups. A major challenge is to reduce the vulnerability of people and climate-sensitive sectors, including forestry, agriculture, energy and water resources, to today's climate variability and then to ensure that future development activities are appropriate to future climate contexts.

The identification and implementation of adaptation measures (including the maintenance of adequate levels of diversity, within and between forest tree species) will play a crucial role in preserving options for adapting to climate change.[114] Moreover, forests, trees and their genetic diversity provide ecosystem services that facilitate the adaptation of local people to climate change and adaptation of wider sectors of the economy and society and, as such, are a key component of ecosystem-based adaptation (EBA).[115] In short, EBA can be defined as measures using ecosystem services for societal adaptation. EBA is an approach that considers both humans and ecosystems in a context of vulnerability to climate change. EBA can be integrated to community-based adaptation and associated to measures that are not based on ecosystems (such as infrastructure).

Forests and trees have not been considered in most adaptation policies to date, as the sectors that are prioritized in adaptation tend to define strategies in the absence of linkages to other sectors. Implementing EBA will require both mainstreaming adaptation into forest and tree management (so that managers consider climate change threats to forests and trees) and mainstreaming forests and trees into wider adaptation strategies (so that non-forest stakeholders dealing with adaptation consider forests and trees as part of adaptation measures).

Policymakers and practitioners at national and subnational levels face many challenges in the development and implementation of mitigation and adaptation (M&A) policies and measures, including REDD+, the Clean Development Mechanism (CDM), Nationally Appropriate Mitigation Actions (NAMAs), National Adaptation Programmes of Action (NAPAs) and other adaptation policies. This CRP6 component will focus on providing the knowledge and tools needed to enhance the role of forests, trees and their genetic diversity in mitigating and adapting to climate change. Research will address (1) technical, livelihood and governance challenges, including the modeling and monitoring of carbon stocks; (2) the impacts of climate change; (3) the equitable, effective and efficient implementation of REDD+ and adaptation initiatives (including their differentiated impacts on gender groups); (4) agricultural intensification as a strategy for achieving REDD+ and enhancing other

[113] IPCC. 2007. Climate change 2007. Impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry et al. (eds.). Cambridge University Press, Cambridge, UK.
[114] Guariguata, M.R. et al. 2007. Mitigation needs adaptation: tropical forestry and climate change. Mitigation and Adaptation Strategies for Global Change 13(8): 793–808.
[115] IUCN. 2009. Position paper: Ecosystem-based adaptation (EbA). UNFCCC Climate Change Talks. 28 September – 9 October, Bangkok, Thailand.

ecosystem services; and (5) the inclusion of forests and trees in strategies to reduce social vulnerability.

In addition to its outputs and impact pathways specific to either mitigation or adaptation, this component will address the linkages between mitigation and adaptation. Even though mitigation and adaptation have two fundamentally different objectives,[116] it is necessary to explore the relationships between them, especially the potential synergies or conflicts, and interactions with development plans and institutions in order to maximize their efficiency.[117] Some scientists state that mitigation and adaptation should be pursued simultaneously because they are complementary and because "win–win" policy options may be possible.[118] Others have suggested that implementing mitigation and adaptation in synergy is not straightforward.[119] As stated above, forests and tree landscapes produce ecosystem services relevant to both mitigation (carbon) and adaptation (e.g., hydrological services). Agroforestry, which already harnesses the benefits of trees for agriculture, provides a good example of a strategy for M&A as trees sequester carbon and can increase the resilience of agricultural systems by providing both income and production security.

Mitigation projects can facilitate or hinder the adaptation of local people to climate change, whereas adaptation projects can affect ecosystems and their potential to sequester carbon. Even though adaptation is needed to ensure the permanence of mitigation projects in a context of a changing climate, this has not been considered so far.[120] Climate and forest policies have the potential to enhance the synergies between adaptation and mitigation and to contribute to sustainable development.[121]

[116] Swart, R. and Raes, F. 2007. Making integration of adaptation and mitigation work: mainstreaming into sustainable development policies? Climate Policy 7: 288–303.
[117] Kok, M.T.J. and de Coninck, H.C. 2007. Widening the scope of policies to address climate change: directions for mainstreaming. Environmental Science and Policy 10(7–8): 587–599; Ayers, J.M. and Huq, S. 2009. The value of linking mitigation and adaptation: a case study of Bangladesh. Environmental Management 43(5): 753–764.
[118] Klein, R.J.T. et al. 2005. Integrating mitigation and adaptation into climate and development policy: three research questions. Environmental and Science Policy 8: 579–588.
[119] Dang, H.H. et al. 2003. Synergy of adaptation and mitigation strategies in the context of sustainable development: the case of Vietnam. Climate Policy 3S1: S81–S96.
[120] Ravindranath, N.H. 2007. Mitigation and adaptation synergy in the forest sector. Mitigation and Adaptation Strategies for Global Change 12:843–853; Reyer, C. et al. 2009. Climate change mitigation via afforestation, reforestation and deforestation avoidance: and what about adaptation to environmental change? New Forests 38: 15–34.
[121] Klein, R.J.T. et al. 2005. op. cit.

The need and opportunities for mitigation and adaptation differ spatially, as mitigation opportunities depend on the carbon content in ecosystems and deforestation or degradation trends (see Figure 2.6) and adaptation needs depend on vulnerabilities (see Figure 2.7). However, synergies and trade-offs between mitigation and adaptation should be explored in all contexts.

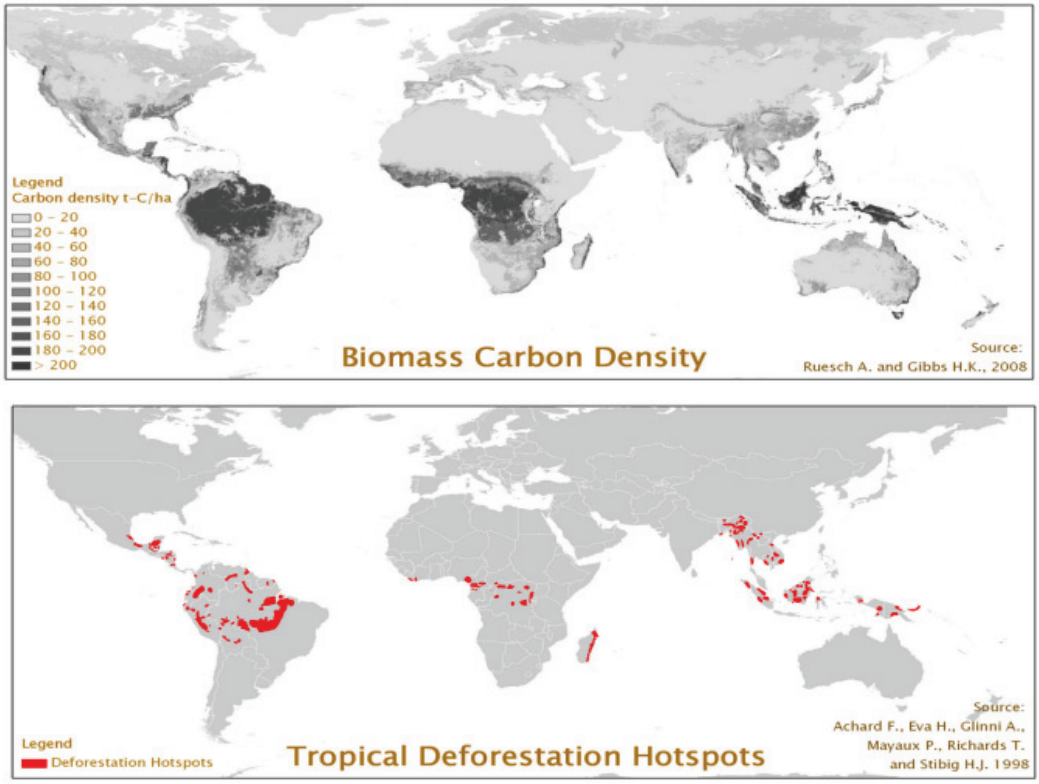


Figure 2.6. Ecosystem-based mitigation opportunities in terms of Carbon Biomass density and deforestation

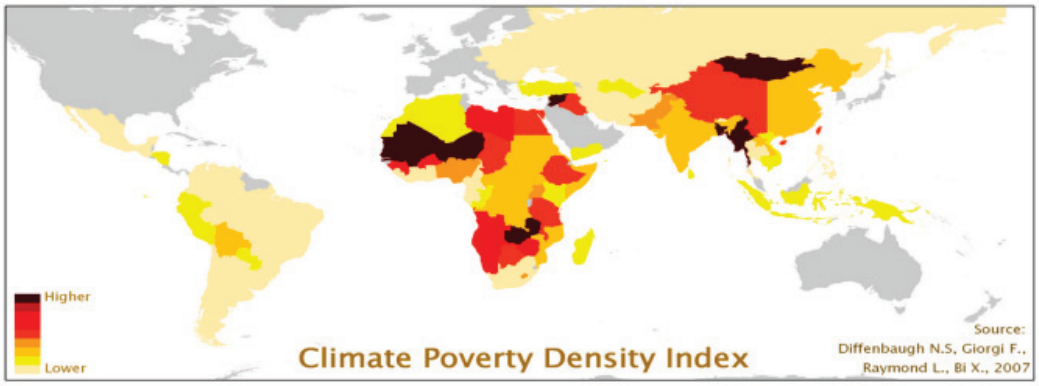


Figure 2.7 Adaptation needs: The climate poverty density index[122]

[122] The climate poverty density index aggregates the national climate change index with the percentage of each nation's population living on less than two international dollars per day (from Diffenbaugh, N.S. et al. 2007. Indicators of 21st century socioclimatic exposure. Proceedings of the National Academy of Sciences USA 104(51): 20195–20198).

Box 2.8 Broad hypotheses underpinning Component 4 research

Mitigation:

Tree-based carbon sequestration and reduced deforestation and forest degradation in rural landscapes (e.g., agroforestry, improving forest management, forest conservation, etc) offer significant opportunities for developing countries to reduce their national greenhouse gas emissions.

Appropriate incentives can be developed for the economic sectors that are responsible for deforestation, which simultaneously alter land use decisions, conserve forests and promote sustainable development.

Adaptation:

Ecosystem services contribute to reducing the vulnerability of forest- and tree-dependent people and the broader society to climate change.

Improved forest and tree management reduces significantly the impacts of climate change on ecosystems.

Ecosystem-based adaptation is a cost-effective approach to adaptation and increases the sustainability of adaptation initiatives and policies.

Synergies between adaptation and mitigation:

Developing international and national policies and subnational initiatives aimed at both adaptation and mitigation is an effective way to tackle climate change and can provide significant benefits to local development and biodiversity conservation.

Considering adaptation and mitigation jointly can promote efficient investment, e.g., increased financial resources from REDD+ can be used to support the shift from unsustainable land management practices to sustainable practices and promote adaptation to climate change among poor rural communities.

2.4.2 Thematic focus

The three research themes of Component 4 of CRP6 will address the main challenges related to enhancing the contribution of forests, trees and agroforestry to climate change, mitigation, adaptation and synergies between mitigation and adaptation.

- Research Theme 1: Harnessing forests, trees and agroforestry for climate change mitigation
- Research Theme 2: Enhancing climate change adaptation through forests, trees and agroforestry
- Research Theme 3: Understanding the role of forests, trees and agroforestry in achieving synergies between climate change mitigation and adaptation

Within each theme, the research will be carried out in three foci (see Figure 2.8): international- and national-level policies, subnational and local initiatives, and best-practice methods.

- Focus 1: Informing international- and national-level[123] policies and processes related to climate change, forests, trees and agroforestry
- Focus 2: Improving subnational and local initiatives for climate change mitigation and adaptation

[123] In some countries, policy and regulatory frameworks may be partially determined at the subnational level, e.g., Brazilian Amazonas and Central Kalimantan, Indonesia, which now has its own Provincial Council for Climate Change.

- Focus 3: Best-practice methods for improved mitigation and adaptation initiatives and policies

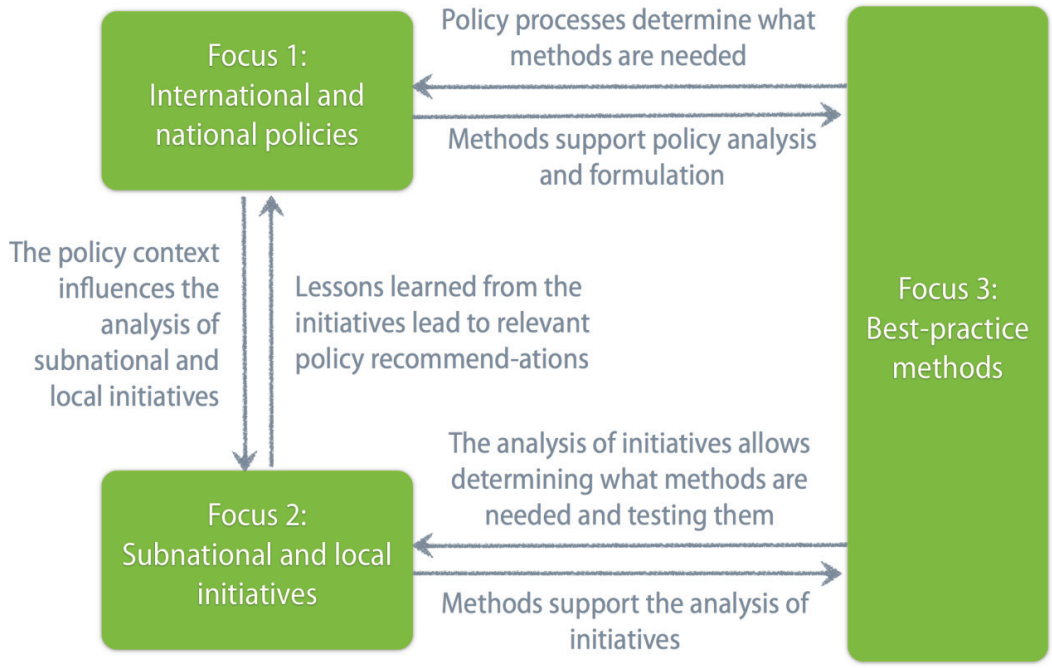


Figure 2.8 Articulation of the three foci in Component 4

2.4.3 Objective and expected outcomes (10 years)

It is our aspiration that research conducted under this component will contribute to the development of new forest-and-climate regimes (currently being negotiated at global and national levels) and subnational initiatives related to climate change, forests and trees in ways that ensure that they are effective, efficient and equitable. Within five years, research results will have shaped key features of the global regulatory systems as well as governance and financing priorities for forest-related M&A measures. Within 10 years, research will have resulted in demonstrable improvements in policies and practices, and effective governance as "second-generation" initiatives incorporate lessons from those now getting underway or being negotiated, including those aimed at increasing synergies between M&A policies and measures. Although not fully attributable to CRP6, associated impacts will be estimated in terms of tons of CO_2e emissions avoided or carbon sequestered in forests and trees, forest areas under improved management, and people benefiting from M&A initiatives.

2.4.4 Geographic priorities

The work on mitigation (Theme 1) will focus on hotspots of tropical deforestation and areas with high potential for C sequestration (see Figure 2.6). Priority countries are selected according to this criterion and some additional criteria (for example, the strong tradition in community-based forest management in Nepal and the reported increase in total forest area in Vietnam), as well as the existence of strong partnerships. Priority countries, which represent more than half of the tropical forest carbon stock, are: Brazil, Peru, Bolivia, Ghana,

Cameroon, DRC, Tanzania, Kenya, Indonesia, India, Nepal, Vietnam and Papua New Guinea.

The work on adaptation (Theme 2) will focus on climate change and vulnerability hotspots. Central America is the major tropical climate change hotspot and will experience a decrease in precipitation and an increase in precipitation variability.[124] Priority countries in this region are Costa Rica, Honduras and Nicaragua. Western, eastern and southern Africa are hotspots of climate vulnerability (Figure 2.7) and are severely affected by droughts (Figure 2.9). Our priorities in Africa are Burkina Faso, Mali, Uganda and Tanzania. Many countries in Southeast Asia are vulnerable to climate variability and disasters, especially in coastal areas, which are particularly vulnerable to storms, waves and sea level rise (Figure 2.9). Our priority countries in this region are Indonesia, the Philippines and Vietnam.

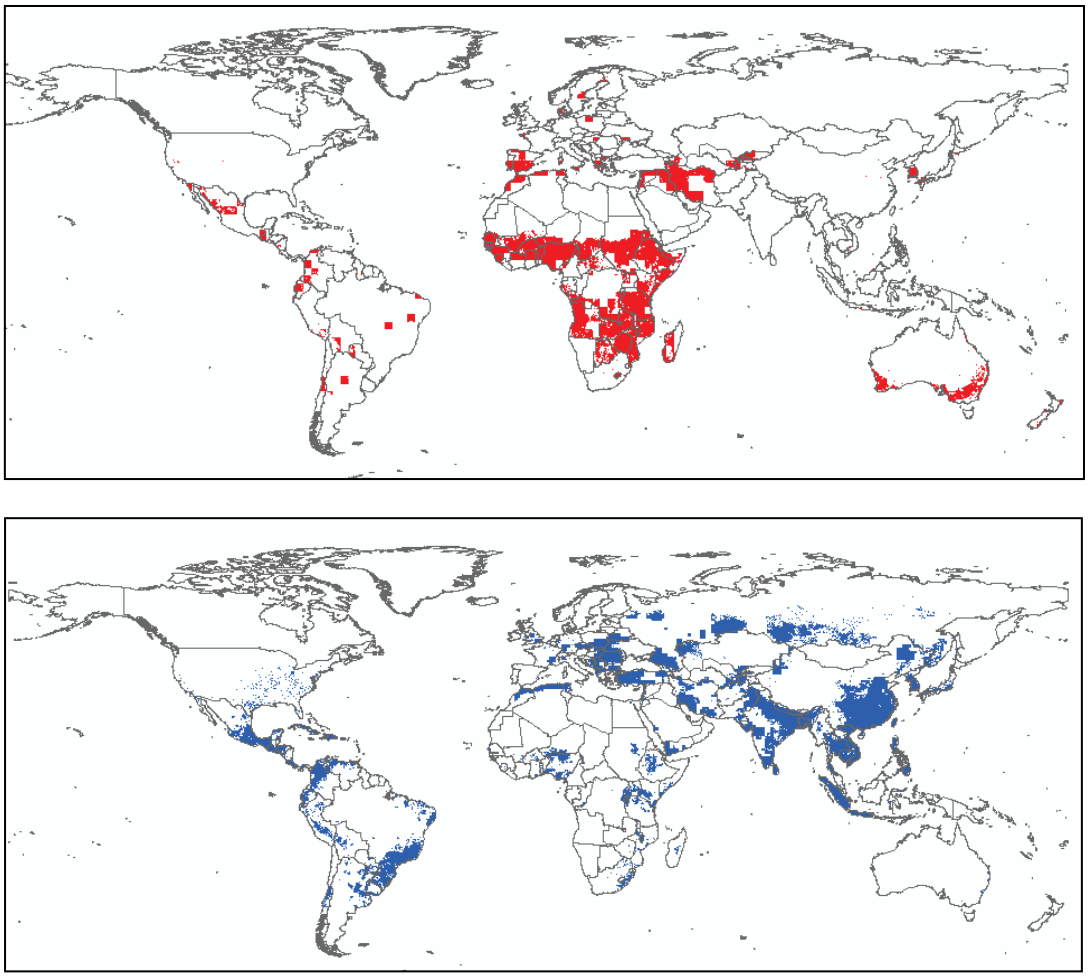


Figure 2.9 The areas most affected by drought (top) and flood (bottom), in terms of mortality or economic losses

Source: Natural disaster hotspots — A global risk analysis (raster data set downloaded from http://www.ldeo.columbia.edu/chrr/research/hotspots/coredata.html)

[124] Giorgi, F. 2006. Climate change hot-spots. Geophysical Research Letters 33(8), L08707, doi:10.1029/2006GL025734

Theme 3 on the synergies between adaptation and mitigation will work in a subset of the countries mentioned in Themes 1 and 2. Synergies will be explored in the sites where sufficient data on mitigation or adaptation are available. Selected sites will allow us to study the trade-offs and synergies between mitigation and adaptation along the forest transition curve and in dry and humid areas (i.e., with different relevance for adaptation and mitigation). The research will be forward looking and will consider factors that are not currently being considered in policy circles, such as REDD+ opportunities in dry forests, particularly in West and East Africa.

2.4.5 Research Theme 1: Harnessing forests, trees and agroforestry for climate change mitigation

Rationale

The international community recognizes that land use, land use change and forestry are critical components of national and international strategies for mitigating climate change through reduced emissions and increased carbon stocks. The 15th Conference of the Parties (COP15) to the UN Framework Convention on Climate Change (UNFCCC) in Copenhagen agreed in the Copenhagen Accord to include reduced emissions for deforestation and forest degradation in developing countries (REDD+) as part of a climate mitigation portfolio. The nature of the international framework for REDD+ was decided at COP16 in Cancún.

The aim of this research theme is to ensure that policymakers and practitioner communities have the knowledge, information, analysis and tools they need to ensure effective and cost-efficient reduction of carbon emissions and enhancement of carbon stocks with equitable impacts and co-benefits, including poverty reduction, enhancement of non-carbon ecosystem services and protection of local livelihoods, rights and tenure.

REDD+ offers new opportunities to promote sustainable forest management as an integral component of sustainable development. Whatever forms international REDD+ mechanisms will take, significant financial resources could flow to developing countries. These resources have the potential to alter the economic landscape in many developing countries—a landscape that currently promotes the continued clearance of forest assets, often at the expense of local rights and livelihoods. However, REDD+ proponents must overcome several challenges for this new instrument to fulfill its promise.

The research will generate knowledge about what processes will lead to REDD+ and other mitigation strategies that ensure effective, efficient and equitable outcomes. Over time, as experience accumulates, research will be able to answer questions about the conditions under which needed reforms—such as ways to secure rights of access to, and use of, land and forest resources—can be accelerated, as well as the comparative efficacy of alternative institutional arrangements for channeling REDD+ funds and for facilitating the necessary intersectoral and cross-scale collaboration.

Attention to governance is needed if national governments are to develop policies to address the underlying causes of deforestation and degradation and attract investments as viable alternatives to competing land use demands for food and biofuels. The effectiveness of forest governance is increasingly independent of formal ownership patterns. The research will explore the dynamic relationships between established bureaucracies and new and emerging institutions associated with governing the global commons, anti-corruption efforts and the growing role of communities and market actors associated with increasing commoditization

of forests. We will develop tools and guidelines for improving the design of REDD+ policies and initiatives at national and subnational levels, based on the lessons learned during first-generation experiences in several countries.

Methods and research approach

In Theme 1, we will employ a wide range of methods to assess first-generation REDD+ processes to formulate national REDD+ strategies and polices. An initial country assessment will be carried out to understand the context of deforestation in the country—who the actors are, what agencies are involved in forest policy and where the real power lies. An assessment of the country REDD+ strategy will be conducted through a desk review of key planning documents (R-PINs, R-Plans, national forest legislation and national planning documents). Public participation in national strategy development will be assessed through an analysis of national electronic and print media. Policy network analysis will be conducted to understand the political economy around forest resources through surveys and interviews.

In subsequent phases of the work, these elements will be combined into a comparative analysis that will link the essential elements of the policy process with the eventual outcome of the national program. For the subnational focus of the research, a rigorous design called before–after, control–impact (BACI), using before and after comparisons of both control and project areas, will be applied. We will assess project effectiveness (actual emissions reductions), efficiency (cost/benefit) and equity (social and financial). Methods will involve independent field measurements, household surveys and targeted interviews. Interviews with local people will focus on their perspectives of, and their participation in, the development of REDD+ initiatives.

The focus area on methods and tools will take advantage of many of the study areas used in the subnational focus work to make biophysical measurements of C stocks and greenhouse gas (GHG) fluxes in different land uses. We will develop tools for setting reference emissions based on historical deforestation and specific national circumstances including development plans. We will also develop tools for improved carbon and GHG accounting. We will assess the cost effectiveness and accuracy of community-based monitoring through independent measurement and in-depth interviews. Methods will include application of new and experimental technologies (e.g., LIDAR) as well as established approaches (e.g., remote sensing linked with ground surveys). Experimental work will also be conducted using gas chromatography and infrared technologies for measurement of trace gas emissions from soils associated with land use change.

Box 2.9 Example of methods: Emissions associated with peatland conversion in Jambi, Indonesia

Peatlands in Indonesia are likely to be of global significance; their conversion contributes up to several percent of total global C emissions, although uncertainty surrounding their magnitude remains high. The overall hypothesis is that deforestation of peatlands and/or conversion to oil palm and industrial timber plantations leads to significant GHG emissions both from the peat and from the vegetation, while drainage affects neighboring forest areas. However, forms of forest modification that involve drainage and fertilization have minor consequences.

In two sets of sites representing land use change in peatlands on deep peat (>8 m) and on shallow peat soils (<1.5 m), we are quantifying aboveground carbon stocks using standard inventory techniques (measuring tree diameters at breast height and tree heights, and applying allometric equations). For belowground biomass, we are excavating sample pits and individual root systems. We will develop fractal branch models of root systems using measurement of root diameters and branching distances.[1]

To measure changes in soil carbon in these peat systems, we are measuring inputs and outputs from the system.[2] Measurement of peat stocks is challenging (presence of wood fragments, voids and fibrous organic matter; highly variable bulk density; difficulty of sampling with an auger and properly maintaining the vertical alignment of the sampling hole at depths below about 5 meters; uncertainty due to conversion factors used in standard lab procedures). Thus, we are also measuring total soil respiration with an infrared gas analyzer and standard chamber techniques. We are separating plant-based and peat-based soil respiration using both novel isotopic techniques and standard trenched plot approaches. We are measuring inputs from litterfall using standard traps in the understory of forests. For oil palm plantations, we are recording frond harvests and using mean frond weights to estimate inputs to the soil. Over the short term, we are using literature estimates for root inputs but we expect to begin minirhizotron studies. A third approach that is used in a form of triangulation of methods makes use of the ash content as an "internal tracer" of C losses. Results from a pilot study in Aceh, Indonesia, suggested that the confidence intervals of the three methods overlap.

We are measuring N_2O and CH_4 fluxes using chamber techniques and analyzing samples with gas chromatography.[3] In partnership with CIRAD, we are using fertilizer trials in an industrial oil palm plantation to measure the N_2O fluxes associated with different levels of fertilization. We are also looking at the effects of fertilization on peat-based respiration (peat decomposition) using *in situ* manipulations of root density and laboratory incubations.

We will be working with several models and will extend models of temperate peatlands to tropical peats (initially with the Ecosse model and possibly with others: NASA-CASA, DNDC, etc.). Data quality control is practiced at all levels of data collection. For example, supervisors spend significant time in the field with students at the beginning of the work and make frequent visits to the sites. For gas analysis, the chromatographic results are evaluated against standards. Within-day and within-week variances of the standards are examined regularly.

References:

[1] van Noordwijk, M. and Mulia, R. 2002. Functional branch analysis as tool for fractal scaling above and belowground trees for their additive and non-additive properties. Ecological Modelling 149: 41–51.
[2] Murdiyarso, D. et al. 2010. Land-use dynamics of tropical peatlands: opportunities for reducing GHG emissions and maintaining productivity. Proceedings of the National Academy of Sciences USA 107: 19655–19660. doi/10.1073/pnas.0911966107.
[3] Verchot, L.V. et al. 2006. Nitrogen availability and soil N_2O emissions following conversion of forests to coffee in southern Sumatra. Global Biogeochemical Cycles 20, GB4008. doi:10.1029/2005GB002469

Research questions

Broad research questions (Component 4, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
Focus 1 (Policies) What design elements of international agreements, finance and capacity-building efforts are necessary for efficient, effective and equitable REDD+ policies and initiatives?	Do mitigation modalities have gender-specific aspects that have to be taken into account? What factors condition the use and implementation of gender-specific elements of mitigation modalities? How could international REDD+ agreements affect women and disadvantaged groups?	Global analysis of agreements and options for a global climate regime and their likely outcomes for REDD+, including analysis of convergence and divergence of opinions Analysis of comparative advantages/disadvantages of the various financing arrangements to shape the political economy in recipient countries Recommendations on international agreements, based on a comparative analysis of their effects on the formulation and implementation of efficient, effective and equitable REDD+ policy and initiatives
Focus 1 (Policies) How do national policies and institutions influence the formulation and implementation of efficient, effective and equitable REDD+ policies?	How can the interests of women and disadvantaged groups be addressed in national REDD+ strategies? What kinds of measures and obligations can be incorporated into national policy and planning processes to increase the likelihood that the interests, knowledge and needs of disadvantaged groups (including women) are effectively articulated?	Analysis of the political economy of REDD+ at the national scale, including the role of non-state actors in shaping the national debate on REDD+ and the value judgments about the achievable efficiency, effectiveness and equitability of REDD+ Assessment of the effects of REDD+ policies on national economies and national or international markets, especially timber and fuelwood (linked with Component 5). Recommendations on institutional frameworks at the national level within which REDD+ can be effectively implemented and ensure service delivery, deal making, identification of trade-offs, and mediation, in the current context of proliferating pilot projects and fragmented policy arena Guidelines to improve the transparency, inclusiveness and efficiency of REDD+ policymaking processes and associated reforms (e.g., tenure reform and intersectoral planning), based on comparative analysis
Focus 2 (Subnational) How does the local context determine the design of a REDD+ initiative?	How should gender inequalities be addressed in the design and implementation of REDD+ initiatives? What kinds of measures and obligations can be incorporated into planning processes to increase the likelihood that the interests, knowledge and needs of disadvantaged groups (including women) are effectively accounted for in the design and implementation of REDD+ initiatives?	Comparative analysis of how *de jure* and *de facto* tenure rules and forest tenure reform affect the security of local populations and REDD+ initiatives Analysis of the political economy of REDD+ initiatives (how different local actors exercise authority in interaction with national actors, how multilevel forest governance processes influence land use) Recommendations on institutional designs or mechanisms promoting inclusive decision making, accountability and legitimacy in subnational initiatives, particularly with regard to community and market actors Recommendations on the design of REDD+ initiatives (e.g., in terms of payments and benefit sharing, involvement of local institutions), depending on the type of forests and forest management (e.g., conservation vs. production forests), institutions (e.g., tenure, decentralization, community institutions) and social context

Broad research questions (Component 4, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
Focus 2 (Subnational) How can a REDD+ initiative contribute to livelihood improvement, equitable benefit sharing (including across gender), tenure clarification and leakage prevention?	What are the differentiated impacts of REDD+ initiatives on women's rights and livelihoods? How do gender relationships explain these differentiated impacts? How might gendered relationships intensify these impacts?	Comparative analysis of how REDD+ initiatives affect local governance arrangements and livelihoods, including women and disadvantaged groups, including their access to forest products, markets and diversified economic activities Analysis of how REDD+ initiatives affect non-carbon ecosystem services (e.g., hydrological services affected by reforestation) and local economies (e.g., small-scale traders, merchants, artisans) Guidelines for designing pro-poor REDD+ initiatives (e.g., in terms of benefit sharing, tenure clarification and leakage prevention)
Focus 3 (Methods and tools) What are the best practices and decision support tools related to carbon and baseline estimation?	None	Best practice and decision support tools for measuring and estimating carbon balance in mitigation initiatives and baseline scenarios (carbon stocks and greenhouse gas emissions in biomass, soils, forest products and forest or agricultural activities) Best practice and decision support tools for managing trees and forests in REDD+ projects (e.g., selection of adequate species for tree planting depending on ecological and socioeconomic context)
Focus 3 (Methods and tools) What are the most appropriate approaches for involving forest-dependent communities and indigenous peoples in mitigation initiatives?	What are the best methods for understanding the differentiated roles of women and disadvantaged groups in tree- and forest-based mitigation initiatives? What kinds of practices can foster inclusiveness while minimizing distributional conflict among beneficiaries including women and other disadvantaged groups?	Improved and validated approaches for participatory design and planning of tree- and forest-based mitigation initiatives, including negotiation tools for addressing trade-offs and defining achievable targets in terms of efficiency, effectiveness and equitability Approaches to participative monitoring and management of carbon stocks

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Analysis of international agreements and financing arrangements. Analysis of the political economy of REDD+ at national level and in subnational initiatives. Assessment of the effects of REDD+ policies on national economies. Recommendations on institutional frameworks at the national level. Guidelines to improve the transparency, inclusiveness and efficiency of REDD+ policymaking processes. Comparative analysis of how *de jure* and *de facto* tenure rules and forest tenure reform in REDD+. Recommendations on the design of REDD+ initiatives. Comparative analysis of how REDD+ initiatives affect local governance arrangements and local livelihoods. Analysis of how REDD+ initiatives affect the delivery of non-carbon ecosystem services. Guidelines for designing pro-poor REDD+ initiatives. Best practice and decision support tools for measuring and estimating carbon balance in mitigation initiatives and

Type of research partner	Organization	Research partner contributions
		baseline scenarios.
		Improved and validated approaches for participatory design and planning of tree- and forest-based mitigation initiatives.
		Approaches to participative monitoring and management of carbon stocks.
	World Agroforestry Centre	Analysis of tree cover change and its consequences for terrestrial C stocks, in relation to drivers of change; relationships between REDD+ and NAMA, based on the concept of "reducing emissions from all land uses".
		Analysis of opportunity costs of REDD and AFOLU; contributing to IPCC chapters on mitigation.
		Research on carbon-based RES schemes in AF systems.
		Measurement and modeling of GHG fluxes from agroforestry systems.
		Development of decision support tools for AFOLU projects and stakeholders at local to national levels.
	CIAT	Use of remote sensing and geographic information science and technology to develop methods, tools and assessments for monitoring deforestation and land use, including baseline conditions in REDD initiatives
		Land use modeling to assess past changes and future scenarios in the context of climate change mitigation.
International level	ASB	Research on drivers of deforestation, REDD+ and opportunity costs at the tropical forest margins
	CRP7	See Section 2.4.13 on the links between Component 4 and CRP7
	Norwegian University of Life Sciences	Use of GIS technology to develop tools and analysis of appropriate approaches to setting Reference Emissions Levels, Business as usual (BAU) emissions scenarios and crediting levels for REDD+.
	Wageningen University	Application of novel remote sensing technologies to project-level accounting and analysis of institutional capacity of countries for MRV.
Regional level	The Nature Conservancy	Developing inter-institutional arrangements for monitoring and assessment of deforestation and land use change.
	US Forest Service	Assessment of carbon stocks in tropical wetlands and diffusion of MRV-related material to REDD initiatives in Latin America and Asia.
Country or site level	Bogor Agricultural University (Indonesia), Embrapa (Brazil), IBIF (Bolivia)	Assessment of national capacity and data sources for carbon accounting.
	Corpoica (Colombia), INIA (Peru), Embrapa (Brazil), INIAP (Ecuador)	Local verification and validation of land use change and deforestation for monitoring and assessments.

2.4.6 Research Theme 2: Enhancing climate change adaptation through forests, trees and agroforestry

Rationale

Forests and trees are exposed to different factors of climate change and variability, as well as to other drivers such as land use change or pollution that exacerbate the impacts of climate change. It remains unclear how forest and tree ecosystems will adapt in terms of composition, density and provision of ecosystem services. A major challenge is to better understand the sensitivity and adaptive capacity of forests and trees to climate change and other drivers of change. Despite the expected impacts of climate change on forests and trees, few measures have been implemented for their adaptation. For example, most countries do not have genetic diversity conservation strategies in place for forests and trees.

Rural communities depending directly on forests and trees are among the world's poorest and most vulnerable people and stand to bear the brunt of climate change. Facilitating community-based adaptation is crucial for reducing the negative impacts of climate change on these communities and their livelihoods. As forests and trees provide services that reduce the vulnerability of local people to climate change (e.g., by providing non-timber forest products that serve as safety nets when agriculture is affected by climate events, by conserving water quality, by regulating microclimates, by protecting settlements from storms and waves in coastal areas), adaptation policies and projects should consider enhancing forest and tree management as part of adaptation. There is a need to analyze the past and current strategies developed by local communities for adapting to climate variability and other drivers of change (e.g., markets and policies) and to understand how institutional and political factors shape local adaptation and resilience in the face of accelerated change.

At the same time, many economic sectors are vulnerable to climate change (e.g., agriculture, forestry, energy, housing and transport) and benefit from the diverse ecosystem services provided by forests and trees. The major challenge is to reduce the vulnerability of these climate-sensitive sectors in all future development activities. This will require developing and implementing "best practice" guidelines for developing appropriate EBA strategies, i.e., strategies for conserving or managing ecosystem services with the objective of reducing the vulnerability of society to climate change. These strategies can complement other adaptation strategies, be cost effective and sustainable, and generate environmental, social, economic and cultural co-benefits.[125] According to TEEB,[126] cost–benefit analyses indicate that public investment should support ecological infrastructure (forests, mangroves, wetlands, etc.) because of its contribution to adaptation to climate change.

The aim of this research theme is to improve the design of adaptation policies and initiatives in landscapes with forests and trees. These policies and initiatives represent an opportunity for achieving the dual purpose of better managing forests (including restoring forest landscapes, reforesting and conserving) and facilitating sustainable processes of societal adaptation. In practice, EBA requires new modes of local and national governance that include multisectoral processes, stakeholder participation and flexible institutions, such as policy networks.

[125] Convention on Biological Diversity. 2009.
[126] TEEB. 2009. Climate issues update: September 2009. The economics of ecosystems and biodiversity (TEEB), UNEP. www.teebweb.org/.

The theme will develop research both on ecosystems (e.g., the impacts of climate change on forests and trees) and on social systems (e.g., the vulnerability of local communities to climate change and political or economic changes). Emphasis will be placed on the interactions between ecological and social systems, in order to understand how changes in ecosystems (e.g., due to climate change, land use change or degradation) may affect people's vulnerability and how the consequences of climate change on people may in turn affect ecosystems (e.g., through unsustainable use of forest products for coping with climate-related stress). Analyzing the dynamics of socio-ecological systems is crucial to the development of adequate adaptation strategies that increase the resilience of both ecosystems and social systems.

The research will also explore who governs and how, and will seek to understand how institutions shape social vulnerability. It will also explore the resilience and vulnerability of local communities, including women and disadvantaged groups, and the impacts of subnational and local adaptation initiatives on local livelihoods. The research will enable the proponents of initiatives to integrate existing and new knowledge to ensure effective, efficient and equitable outcomes. Although experience in the implementation of adaptation demonstration activities is limited, there is considerable experience from related activities (e.g., adaptive collaborative management[127]) to inform the design of new initiatives.

Methods and research approach

To analyze the effects of international decisions, funding modalities and national policies on adaptation processes, we will apply methods and tools from the political sciences, such as policy network analysis, discourse analysis and coalition analysis. Policy networks will enable understanding of how subnational adaptation processes are influenced by higher-level decisions. Discourse analysis and coalition analysis will capture information on the political economy of REDD+ and the diversity of interests and perceptions around REDD+.

To assess the impacts of climate change on ecosystems and ecosystem services, we will use climate scenarios and ecosystem models, such as SVAT (Soil Vegetation Atmosphere Transfer) models for hydrological services. Attention will be given to assessing the uncertainties of impacts, using different models and climate scenarios. We will use similar methods for assessing the effectiveness of adaptation measures for ecosystems (e.g., assessing the effect of biological corridors in facilitating the migration of species or the enhancement of genetic diversity for increasing resilience).

To analyze the vulnerability of forest- and tree-dependent people to climate change in association with other drivers of change, we will use bottom-up approaches for vulnerability assessments and livelihood analysis (e.g., surveys, interviews and participatory action research methods). Historical methods will be applied to gain understanding of past adaptive strategies. Methods relevant to gender analysis will be applied in the participatory vulnerability assessments.

To analyze the role of local ecosystem services in the adaptation of local people and the broader society, we will combine biophysical-economic modeling and participatory assessment. Understanding the challenges of EBA will require a combination of top-down and bottom-up approaches (respectively for studying climate change impacts and assessing social vulnerability).

[127] http://www.cifor.cgiar.org/acm/

Research questions

Broad research questions (Component 4, Theme 2)	Gender-specific aspects of the research question	Examples of science outputs
Focus 1 (Policies) How can international and national policies and funds improve the design and implementation of adaptation initiatives that reduce the vulnerability of people and ecosystems?	How can national adaptation strategies and policies integrate the interests of women and disadvantaged groups? How should negotiation and planning processes be structured, sequenced and timed to allow for the effective representation and/or participation of disadvantaged groups?	Analysis of the effects of international decisions on adaptation and funding modalities and their effectiveness, equity and efficiency Comparative analysis of the effects of national policies and processes (e.g., decentralization, tenure reform, agriculture policy, trade and investment) on people's adaptive capacity. Guidelines to improve national policies for strengthening local adaptive capacity under different contexts Guidelines on how to incorporate adaptation into forest policies and forests and trees into adaptation policies
Focus 2 (Subnational) How will climate change affect forests and trees? What measures can be designed for reducing ecosystem vulnerability?	None	Regional assessments of climate change impacts on forests and trees (e.g., fires, storm, pests, dieback, suitable tree crops) Assessment of the resilience of forest and tree ecosystems (including tree crop systems under different management) to climate change Guidelines for identifying and implementing adaptation options for forests and trees, including landscape-scale measures (e.g., biological corridors), forest management measures (e.g., improved planting or harvesting) and tree diversity management (e.g., appropriate tree planting materials and germplasm delivered to farmers)
Focus 2 (Subnational) How resilient are forest- and tree-dependent people in the face of climate change and an array of other drivers of profound change? What institutional and technical measures (e.g., institutional reforms, technical measures and ecosystem management) can be designed for reducing the vulnerability of forest- and tree-dependent people and economic sectors?	What are the gender-differentiated vulnerabilities of local people to climate change? How do local social and political institutions (e.g., property rights, patronage) shape gendered vulnerabilities? Do men and women perceive adaptation needs and strategies differently? What is the differentiated role of women in local adaptive strategies? How do gender inequalities explain differentiated vulnerabilities? How can the adaptive capacity of women and disadvantaged groups be enhanced?	Analysis of the vulnerability of local communities to climate variability and climate change, in interaction with other socioeconomic and political changes Documentation and comparative assessment of past and current local adaptive strategies and coping responses of local communities Comparative analysis of how local and national institutions affect the adaptive capacity of local communities Analysis of the role of ecosystems in reducing the vulnerability of local communities and society to climate change (e.g., through water regulation, diversification of livelihoods ensured by tree crops, products for energy and health, regulation of microclimate) Analysis of the trade-offs between different adaptation options (ecosystem-based measures and other measures) and between different land uses Recommendations on how to design societal adaptation with ecosystem-based measures and other measures Recommendations on governance reforms and local institution strengthening for adaptation

Broad research questions (Component 4, Theme 2)	Gender-specific aspects of the research question	Examples of science outputs
Focus 3 (Methods and tools) What are cost-effective methods and tools for assessing the impacts of climate change on forests, agroforestry and biodiversity (including genetic resources) and for determining adaptation options for ecosystems?	None	Methods and tools for assessing the potential impacts of climate change on forests, agroforests and their genetic diversity, taking into account non-climatic drivers of change Modeling approaches for assessing the impacts of climate change on ecosystem services Methods for assessing the effectiveness of adaptation measures for ecosystems (e.g., biological corridors, enhancement of genetic diversity for resilience) Methods for understanding adaptive genetic variation in tree species (e.g., climate change genomic studies) and guiding germplasm exchanges of suitably adapted or plastic material
Focus 3 (Methods and tools) What are the best practices and decision support tools for managing ecosystem services in ecosystem-based adaptation?	How to study the role of ecosystem services in the livelihoods and the adaptation of women and disadvantaged groups?	Best practices (combining biophysical-economic modeling and participatory assessment) for analyzing the role of local ecosystem services in the adaptation of local people and the broader society
Focus 3 (Methods and tools) What are the most appropriate methods for involving forest-dependent communities in adaptation initiatives?	How to encourage the meaningful participation of women and disadvantaged groups in adaptation initiatives and planning processes? What suite of tools and methods can best draw out gender-differentiated knowledge and experiences?	Improved and validated action research methods for assessing vulnerability and planning adaptation with local communities Approaches to participatory monitoring of climate change impacts

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Analyzing international and national policies and funding for adaptation.
		Modeling impacts of climate change on forests and analyzing adaptation measures for forests.
		Assessing vulnerability of forest-dependent communities and proposing institutional and technical measures for community adaptation.
		Developing methods for assessing the impacts of climate change of forests.
		Developing decision support tools for managing ecosystem services in ecosystem-based adaptation.
		Developing best practices for involving communities in adaptation.
	World Agroforestry Centre	Quantifying the climate effects of trees in the landscape.
		Exploring agroforestry as part of EBA.
		Quantifying the responses of trees to past climate variability.
		Exploring the effects of ES on landscape resilience to climate impacts.
		Contributing to IPCC chapters on adaptation.
		Assessing the limits of adaptation through tree-based management systems and developing instruments to manage climate related risks.
		Analyzing international and national policies and funding for adaptation.
		Assessing vulnerability of forest-dependent communities and proposing institutional and technical measures for community adaptation.
		Developing decision support tools for managing ecosystem services in EBA.
		Developing best practices for involving communities in adaptation.
		Developing climate analogues and adaptation pathways and strategies.
	Bioversity	Examining role of tree genetic diversity in ecosystem resilience to climate change.
		Developing guidelines for identifying valuable diversity and implementing genetic resource management that increase the resilience of forests and trees (e.g., appropriate tree planting materials and germplasm delivered to farmers).
		Developing methods for understanding adaptive genetic variation in tree species (e.g., climate change genomic studies) and guiding germplasm exchanges of suitably adapted or plastic material
	CIAT	Linking adaptation work in the forest and trees sector to the broader adaptation research carried out under CRP7.
		Linking adaptation work to ongoing development of negotiation and decision-support systems.
International level	CIRAD	Conducting research on impacts of climate change on forests and adaptation measures for forests.
		Carrying out vulnerability assessment and community adaptation planning.
	SEI (Stockholm	Conducting research on policies, vulnerability

Type of research partner	Organization	Research partner contributions
	Environmental Institute), UEA (University of East Anglia)	assessment, EBA and community adaptation planning.
	CRP7	See Section 2.4.13 on the links between Component 4 and CRP7
	Humboldt and Marburg Universities	Conducting research on adaptation and institutions.
	IRD	Conducting research on local knowledge and adaptation.
	WorldFish	Conducting research on EBA in coastal areas.
	Conservation International	Analyzing the needs for decision support tools and developing tools for EBA.
Regional level	CATIE	Conducting research on the different topics of Theme 2 in Latin America.
	TNC	Conducting research on impacts of climate change on ecosystems in Central America.
	WWF, IUCN, CI	Conducting research on community-based adaptation and EBA.
Country or site level	National universities and national research institutes (e.g., University of Kisangani (DRC), IRAD (Cameroon), IRET/CENAREST (Gabon), IER (Mali), LIPI (Indonesia))	Conducting research on impacts of climate change on forests, adaptation policies, vulnerability assessment and community adaptation planning.

2.4.7 Research Theme 3: Understanding the role of forests, trees and agroforestry in achieving synergies between climate change mitigation and adaptation

Rationale

There is growing consensus within the climate community on the need to explore the trade-offs and synergies between climate change mitigation and adaptation, and to promote synergies. Current international negotiations have treated mitigation and adaptation as two separate streams, with a cascading effect on national-level policy. While adaptation processes emphasize the development of NAPAs, mitigation processes at international levels call for the development of NAMA planning and Readiness Preparation Plans (RPPs). These are completely separate policy processes with very little communication between them. As a result, mitigation and adaptation have had different negotiators, actors and funds. Development funds (including agriculture) have started to embrace adaptation, while mitigation funds have yet to do so. Competition for funds has potential impacts on effectiveness and efficiency in the delivery of both mitigation and adaptation benefits, and limits the potential for enhancing potential win–win options through the current dual-financing mechanisms.

At the landscape and project levels, current practices include, on the one hand, mitigation projects considering adaptation as a co-benefit. On the other hand, adaptation projects such as mangrove protection for reducing social vulnerability in coastal areas often incorporate carbon sequestration as a co-benefit. Synergies in design and implementation are needed to maximize the benefits for both mitigation and adaptation. This could mean prioritizing either mitigation actions that help reduce vulnerability to climate change or vice versa. It also means promoting actions that can simultaneously contribute to mitigation and adaptation.

Agroforestry represents an example of a set of actions that could help increase carbon sequestration, increase overall productivity and help systems cope with the adverse effects of climate change (e.g., by moderating local temperatures, conserving water availability or providing socioeconomic safety nets) particularly for women and vulnerable groups. Issues related to biofuel are important to both mitigation (because they influence deforestation and GHG balance) and adaptation (because of their role in livelihood strategies and their impacts on income or health) (see Box 2.10).

Box 2.10 The role of biofuels in adaptation and mitigation

Biofuels contribute to the energy needs of countries to different degrees, often strongly biased by the country's natural assets. For instance, in Indonesia and Malaysia, biofuels expansion has led to oil palm plantations replacing natural forests. Although such biofuels contribute to these countries' income, the mitigation effect that can be achieved by substituting tree plantations for primary forests is generally negative because of the loss of carbon during forest conversion. However, although unsustainable oil palm production can have large negative environmental externalities, there are options for producing the oil more sustainably by focusing on previously degraded areas, avoiding peatlands and considering aspects of fairness next to economic criteria.

In many parts of sub-Saharan Africa, biofuels, in particular wood fuel and charcoal, comprise 70–90% of the population's energy demands. Nearly all rural households use wood for cooking and more than 90% of urban households use charcoal. Consumption of charcoal in sub-Saharan Africa is projected to double with projected urbanization and firewood usage to increase by 24% from 2000 to 2030. Excessive dependence on traditional biomass energy has caused deforestation and environmental degradation in both private and public lands through unsustainable harvest, collection and end-use technologies. Rapid population growth and urbanization can further accelerate deforestation and increase the vulnerability of smallholders to other challenges to their livelihoods, such as the risks resulting from anthropogenic climate change.

The absence of efficient and affordable energy services also results in negative socioeconomic and health impacts associated with the carrying of fuelwood, indoor pollution and other hazards from which vulnerable people, including women and children, suffer most. Possibilities for increasing the efficiency of stoves and of kilns for charcoal production exist but are underutilized because of high costs, lack of incentives to invest in better technology and huge bureaucratic hurdles. Biofuel production also requires better legislation and enforcement of existing laws to reduce illegal logging and widespread forest and landscape degradation to meet the demands of an ever-growing urban and rural population.

This theme recognizes the current need to understand trade-offs and develop synergies between mitigation and adaptation at multiple levels. Although some options and pathways for synergies at the landscape level are known, [128] they have not been quantified, and literature on optimal mixes (or "good enough" mixes) of various options is currently lacking. At the policy level, conditions for mainstreaming and effective mixing of single adaptation and mitigation win–win policies are yet to receive sufficient attention. This theme intends to contribute to addressing these challenges.

Methods and research approach

For the governance and livelihoods aspects of this theme, we will use similar approaches to those for Themes 1 and 2. We will also combine biophysical-economic modeling and participatory assessment for mapping different ecosystem services and analyzing their trade-offs or synergies, for example between carbon and local ecosystem services that are relevant for adaptation. Biophysical-economic modeling and participatory assessment will be also used for defining and analyzing future scenarios and pathways for M&A (i.e., defining possible future scenarios of socio-ecological systems under different climate, policy and socioeconomic conditions and identifying the measures necessary to avoid undesirable outcomes or enable desirable ones). To assess ecosystem-based M&A measures, we will

[128] van Noordwijk, M. et al. Forthcoming. Promoting REDD+ and resilient livelihoods of riverine communities bordering the Lamandau River Wildlife Reserve, Central Kalimantan, Indonesia.

apply participatory multi-criteria analysis and economic valuation for comparing costs and benefits of different adaptation options based on ecosystems or not. We will also apply modeling approaches for studying the coupled dynamics of social and ecological systems and integrating knowledge from different disciplines and stakeholders (e.g., knowledge-based modeling, linking advanced simulation models with cognitive maps, agent-based modeling).

Research questions

Broad research questions (Component 4, Theme 3)	Gender-specific aspects of the research question	Examples of science outputs
Focus 1 (Policies) What are the opportunities and modalities for linking M&A in international and national policies?	How can linked M&A policies increase attention to gender issues?	Comparative analysis of the trade-offs and synergies between M&A in international and national policies and identification of opportunities for linking adaptation and mitigation Assessment of the political economy of M&A trade-offs (e.g., mitigation as a global issue driven by developed countries vs. adaptation driven by local and national needs in developing countries) Recommendations for enhancing synergies between M&A in international policies and funding
Focus 1 (Policies) What governance mechanisms are most effective in fostering the synergies between M&A?	How can cross-sectoral and cross-scale coordination for M&A include gender issues? What institutional arrangements, incentives and stakeholder interactions are required to ensure that M&A work synergistically to minimize gendered inequalities produced by climate change?	Analysis of how the performance of forestry- or climate-related institutions is affected by being embedded in larger architectures and addressing objective of both M&A Guidelines for governance reforms to foster cross-sectoral planning for M&A Recommendations of institutional and financial mechanisms for fostering the synergies between M&A (e.g., pro-poor payments for multiple ecosystem services)
Focus 2 (Subnational) How to increase the synergies between M&A in subnational and local initiatives? Do smallholder resource use patterns exist that promote both M&A?	How can M&A subnational initiatives include gender-specific aspects?	Analysis of the impacts of climate change on the success of REDD+ initiatives (through impacts on forests and carbon, or impacts on local population) Recommendations on how to include adaptation in REDD+ initiatives for increasing social and ecological resilience Guidelines for assessing the contribution of EBA initiatives to mitigation and facilitating their access to mitigation funding Global synthesis on the trade-offs and synergies between M&A in forest-, tree- and agroforestry-related subnational and local initiatives Guidelines to improve the design of M&A initiatives, in terms of institutions (e.g., funding and local governance) and techniques (e.g., resilient tree crop systems or multistrata silvopastoral systems, rehabilitation of ecosystems) Analyses of which existing smallholder resource use patterns promote M&A and how these may be built upon, scaled up, enhanced and included in M&A initiatives

Broad research questions (Component 4, Theme 3)	Gender-specific aspects of the research question	Examples of science outputs
Focus 3 (Methods and tools) What are the best practices and decision support tools for developing M&A initiatives?	What are the best methods for incorporating gender issues n M&A initiatives? How to address gender issues in the analysis of socio-ecological systems and the development of future scenarios?	Methods and tools for mapping ecosystem services and analyzing their trade-offs or synergies (carbon vs. services relevant for adaptation) Approaches for analyzing the trade-offs and synergies between M&A in terms of livelihoods and governance Modeling approaches for studying the coupled dynamics of social and ecological systems and integrating knowledge from different disciplines and stakeholders Best practices (e.g., combining scientific modeling and participatory assessment) for defining and analyzing future scenarios and pathways for M&A Methods and tools for assessing ecosystem-based M&A measures, current and future costs and benefits

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Research on linkages between M&A in policies, synergies and trade-offs between M&A in subnational initiatives, methods and tools for analyzing trade-offs and future scenarios.
	World Agroforestry Centre	Assessment of synergies and trade-offs between mitigation and adaptation of agroforestry systems. Research on linkages between M&A in policies. Testing and improvement of the toolbox for integrated assessment methods.
	Bioversity	Methods for mapping ecosystem services and their relation with biodiversity. Recommendations on how to include tree genetic diversity management in M&A initiatives.
	CIAT	Research on linkages between M&A work in the forest and trees sector and that carried out in the agricultural sector.
International level	CIRAD	Synergies and trade-offs between M&A in subnational initiatives. Methods and tools for analyzing trade-offs and future scenarios.
	SEI (Stockholm Environmental Institute), UEA (University of East Anglia)	Development of methods and tools for analyzing trade-offs and future scenarios.
	ASB	Landscape approaches to REDD+ within ASB Benchmark sites contributing to synergies between adaptation and mitigation (research in synergy with CRP7).
	CRP7	See Section 2.4.13 on the links between Component 4 and CRP7
Regional level	CATIE	Research on the linkages between M&A in policies and subnational initiatives in Latin America
Country or site level	National universities and national research institutes	Research on the linkages between M&A in policies and subnational initiatives

2.4.8 Sentinel landscapes

In this component, sentinel landscapes will be used for research on both mitigation and adaptation, for understanding the trade-offs and synergies between M&A along the forest transition curve, in dry and humid areas (thus with different relevance for mitigation and adaptation). In these sites, we will proceed as follows.

1. Study the history of change in both social and ecological systems to understand the drivers of previous change and establish the historical context behind our research. This research is particularly relevant for understanding how people have coped with or adapted to climate events and changes, and the role ecosystem services played in their adaptive strategies. It is also relevant for understanding the dynamics of land use change and carbon.
2. Monitor the dynamics of socio-ecological systems, develop modeling approaches for studying the coupled dynamics of social and ecological subsystems, and integrate knowledge from different disciplines and stakeholders for a more holistic approach to M&A (e.g., knowledge-based modeling, linking advanced simulation models with cognitive maps, agent-based modeling). The work will focus on the feedback and feed-forward mechanisms between the social and ecological components of these complex systems in a context of climate change.
3. Define and analyze future scenarios and pathways for M&A (defining possible future scenarios of socio-ecological systems under different climate, policy and socioeconomic conditions and identifying the measures necessary to avoid undesirable outcomes or enable desirable ones).

2.4.9 Impact pathways

Global environmental change challenges research to go beyond traditional disciplinary scientific research to generate knowledge that can influence decision makers and societies and guide them toward low-carbon and resilient development pathways. The strategy of this component is to generate and disseminate credible and useful scientific knowledge and information for use by a broad array of partner organizations related to forest or climate change (government, nongovernmental, university/research, civil society and private sector). These will include new and emerging institutions charged with improving governance and investment in the forestry sector or other sectors. Research output will induce action and changes in policy and practice on the ground. The research outputs will facilitate the processes of change through *inter alia* a clearer articulation of goals, improved understanding of the trade-offs in policy choices, and more efficient and equitable processes of negotiation.

This component will work with several impact pathways at different scales: global, national and subnational, including local (see Figure 2.10. and Section 3.1 for examples of gender-specific impact pathways). Specific research products will be generated that target the different impact pathways and groups. In terms of ultimate impacts, the component will contribute to reducing deforestation and forest degradation, reducing carbon emissions or increasing carbon sequestration, improving livelihood benefits from forests and their ecosystem services, and increasing the resilience of social and ecological systems to climate change. These impacts will have ultimate beneficiaries at different scales: predominantly poor rural forest-dependent communities will benefit from improved and resilient livelihoods, the broader national societies will benefit from ecosystem services and improved governance, and the global population will benefit from climate stabilization and increased resilience of both human and forest systems.

The overall approach to impacts will be oriented to the needs of local and national stakeholders. To identify the key windows of opportunity where policy processes can be influenced, institutions, policy networks and stakeholders' interests and needs will be analyzed. Key stakeholders and institutions at different levels will be identified and engaged early on in order to gain both interest and ownership. Impacts will be achieved through different activities, such as capacity building, the dissemination of timely and relevant information (e.g., publication of peer-reviewed papers, syntheses, toolkits, guidelines, data and policy briefs, organization of special events and side events in international forums, direct contribution to specific policy formulation and development of guidelines for specific issues) and the development of platforms for facilitating exchanges of information between scientists, policymakers and local stakeholders. Most of these activities will be conducted with relevant partners, such as capacity-building partners, development NGOs, donors, advocacy NGOs and media.

The main assumption underlying the success of the impact pathways is that relevant international, national and subnational stakeholders are willing and able to address issues related to climate change mitigation and adaptation. Due to the increasing international and national attention given to climate change, this component is highly likely to find opportunities to influence national and subnational policies and initiatives. The identification of key stakeholders in key policy processes and their involvement in a dialogue between policymakers and practitioners will contribute to achieving the expected impacts.

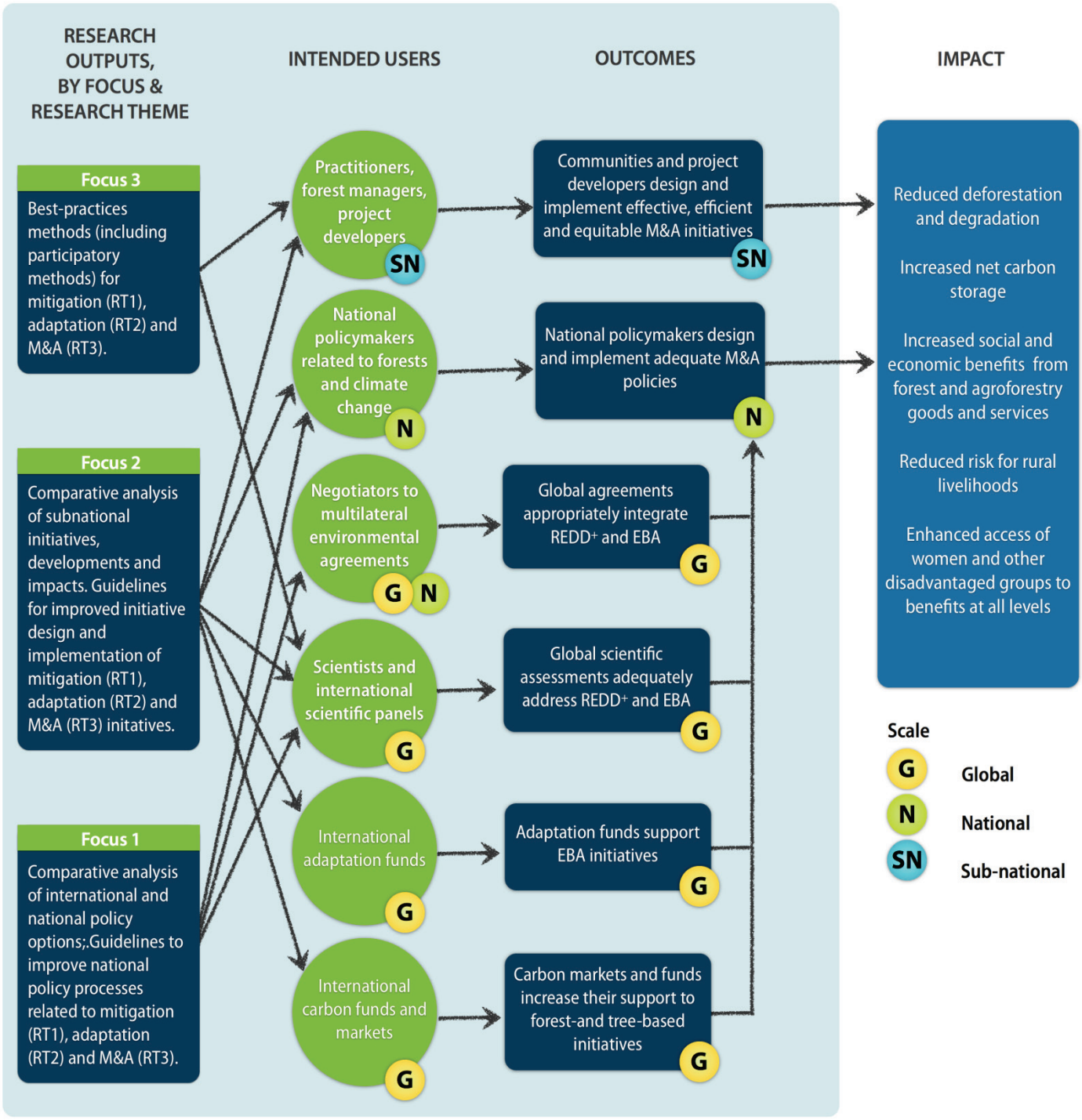


Figure 2.10 Impact pathways for Component 4

Impact pathway 1: Practitioners, forest managers, project developers

The intended users of the research outputs are the stakeholders involved in subnational initiatives, e.g., managing forests or developing adaptation or mitigation projects. These encompass a broad array of public sector, private sector, nongovernmental and civil society organizations including community-based enterprises. It is expected that these stakeholders will use the research results to design REDD+ and adaptation projects that are effective, efficient and equitable (see Box 2.11 for examples).

Box 2.11 Climate change mitigation: A quantified impact example

Countries' entrance into the REDD+ market depends on their capacity and willingness to supply REDD+ credits, rather than just on the technical potential of forests to reduce emissions. Coren and Streck (2010) estimated the difference between the potential amount of carbon credits from REDD+ in the five largest suppliers of REDD+ credits and the constrained amount resulting from governance failures and an inability to adopt policies and prepare institutions to support REDD+ (see table below). Political and technical constraints—rather than biophysical potential—cause the difference.

Estimated potential and constrained supply of REDD+ credits in the five largest suppliers of REDD+ credits (based on Coren and Streck, 2010)

Country	Potential Mt CO_2/yr	Constrained Mt CO_2/yr	Gap (potential – constrained) Mt CO_2/yr	Value of the gap Million USD/yr (US$10 per t$CO_2$)
Brazil	1596	798	798	7980
Indonesia	849	593	256	256
Zambia	84	84	0	0
Cameroon	60	46	14	140
Bolivia	58	48	10	100
Total	**2647**	**1569**	**1078**	**10780**

Quantified impacts of CRP6

Assumptions:

- Baseline: We assume that the "gap" between potential and "constrained" emission reductions from deforestation and degradation (REDD+ credits) is in total 1078 Mt CO_2 yr^{-1}.
- Impacts: We assume that research outcomes (through scientific outputs, communication, capacity building and advocacy) will increase the effectiveness of REDD+ efforts and thus decrease the "gap" by 1–25%.
- There are several ways of achieving the impacts, e.g., through research that leads to accelerated clarification of tenure and access rights, to improved financial management capacity, and to improved and cost-efficient monitoring methods with community involvement.

Calculations: Reduced emissions from deforestation and forest degradation as an impact of CRP6 ("decrease in the gap") can be presented as "impact scenarios". They range from 11 to 270 Mt CO_2/yr. Increased funding allocated to REDD+ project range from 110 million to 2700 million USD/yr (with a price of 10 USD/tCO_2).

Reference:

Coren, M. and Streck, C. 2010. Estimated REDD credit supply into international carbon markets by 2035. Climate Focus. http://www.theredddesk.org/ resources/reports/ estimated_redd_credit_supply _into_international_carbon_markets_by_2035.

Impact pathway 2: National policymakers related to forests, climate change and good governance

The intended users of the research outputs are national policymakers directly or indirectly related to forests or climate change mitigation or adaptation (e.g., ministries of forestry, agriculture, environment, finance, planning, or energy, the climate change offices or

Designated National Authorities (DNAs) to the UNFCCC) and good governance (e.g., anti-corruption agencies, ombudsman, national audit authorities, banks and other financial institutions and law enforcement agencies). The relevant policymakers will differ across countries depending on the drivers of deforestation and forest degradation, and the interactions between a given sector and forests. It is expected that the research will enhance the engagement of national policymakers in an integrated and transparent process of formulation, implementation and evaluation of mitigation and adaptation policies.

Impact pathway 3: Negotiators to multilateral environmental agreements

The intended users include the negotiators and national policymakers involved in defining their countries' position in negotiations of multilateral environmental agreements related to forests and/or climate change (e.g., the UNFCCC, the Convention on Biological Diversity (CBD), the UN Convention to Combat Desertification (UNCCD) and the UN Forum on Forests (UNFF)). Special attention will be given to negotiators from countries shaping the negotiations (e.g., Indonesia, Brazil, US, EC, China) and countries that are very active in supporting REDD+ (e.g., Norway). These negotiators need the right information on how to include REDD+ and EBA in future global environmental agreements. A continuous policy–science dialogue and options assessments with these stakeholders will enable CRP6 to analyze the challenges of the forthcoming negotiations and provide them with key and timely information.

Impact pathway 4: Scientists and international scientific panels

The intended users of "classic" research outputs, i.e., peer-reviewed articles, are scientists globally and international panels (e.g., the Intergovernmental Panel on Climate Change (IPCC) and the future Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)). It is expected that global scientific production and the assessment and synthesis reports produced by the panels (including regional assessments related to our geographic priorities) will reflect the research findings of CRP6 on mitigation and adaptation.

Impact pathway 5: International adaptation funding

Additional intended users include the board members and managers of adaptation funds at international and national levels (e.g., the Least Developed Countries Fund (LDCF), the Special Climate Change Fund (SCCF), the Kyoto Protocol Adaptation Fund (AF), the Climate Resilience Fund), multilateral and bilateral donors (e.g., Global Environmental Facility (GEF)), the World Bank and the regional development banks managing funds for adaptation. It is expected that adaptation funding will be available to support adaptation projects in the forestry sector and, more generally, EBA projects that benefit local people, host countries and the local and global environment (see Box 2.12).

Box 2.12 Contribution of adaptation funding to local livelihoods

Adaptation policies and funding can facilitate the development of adaptation initiatives that benefit people and ecosystems. It is expected that Component 4 will influence international adaptation funds and make more funding available to support adaptation policy reforms and projects in the forestry sector and, more generally, EBA projects that benefit local people, host countries and the local and global environment (Impact Pathway 5). To quantify this impact, we analyze the current share of ecosystem-based projects in adaptation project portfolios and make assumptions about future adaptation funding.

Analysis of adaption project portfolios

In the 44 NAPAs submitted to the UNFCCC as of 1 March 2010, 468 adaptation projects are proposed;[1] of these, 107 (22.9%) consider ecosystem measures for human well-being or societal resilience to climate change. The average cost of an adaptation project in the NAPAs is US$3.6 million and the average cost of an ecosystem project (for human well-being or societal vulnerability) is US$2 million. Very little information is given in the NAPAs regarding the number of final beneficiaries of the projects.

Of the 85 adaptation projects accepted in the Development Marketplace,[2] 12 projects (14.1%) use ecosystem restoration as "soft adaptation". The number of final beneficiaries ranges from less than 1000 to more than 50,000 per project, with an average around 10,000. The budget ceiling per project is US$200,000 for two years, and projects are therefore small and local. The costs per beneficiary ranged between US$20 and $200 (i.e., $10–100/year).

Quantified impacts of CRP6

Assumptions:

- Baseline: Following the analysis of adaptation project portfolio, we assume that the share of ecosystem-based projects in adaptation project portfolios is currently between 14.1% and 22.9%.
- Impacts: We assume that research outcomes (through scientific outputs, communication, capacity building and advocacy) will increase the share of ecosystem-based projects up to 30% to 40%.
- Trends in adaptation funding: The current funds (disbursed, committed or pledged) currently reach around US$1 billion.[3] The annual costs of adaptation in developing countries are estimated to be US$50–170 billion per annum.[4] According to the UNFCCC, adaptation will require additional investment and financial flows in developing countries (US$28–67 billion per annum). Some think tanks recommend public and private investments for adaptation, starting at US$10 billion and growing to US$50 billion per year.[5] We assume that, within 10 years, adaptation funding will represent US$5–20 billion per annum.
- Final beneficiaries of adaptation projects: We assume that people depending on goods and services from ecosystems and trees will benefit from EBA projects. We assume that the number of final beneficiaries will depend on the total funding available for such projects, with a cost per person of around US$20–50 per year.

Calculations: The change in the number of people benefiting from EBA projects (as an impact of CRP6 and increased funding allocated to these projects) is calculated using the following formula:

$$ChangeInNumberOfBeneficiaries = \frac{ChangeInTheShareOfFundingForEBA \quad x \quad GlobalAdaptationFunding}{CostOfAdaptationPerBeneficiary}$$

Using a Monte Carlo simulation with the values of parameters randomly drawn in the assumed intervals, we find a median value of 60 million beneficiaries (20–130 million being the 90% confidence interval).

The need for impact assessment

More research is required to understand the benefits of EBA measures and policies on livelihoods and ecosystems. An example from Vietnam provides an idea of the scale of such benefits. There, mangrove ecosystem rehabilitation cost approximately US$1.1 million and saved US$7.3 million per year in dike maintenance.[6] Several questions need to be addressed, such as who benefits from EBA measures and policies, how these benefits are distributed, and how the integration of ecosystems in adaptation projects increase their effectiveness, efficiency and sustainability.

References:

[1] Pramova, E. et al. 2010. To what extent are ecosystem services considered in the National Adaptation Programmes of Action? Paper in preparation. CIFOR, Bogor, Indonesia.
[2] Heltberg, R. et al. 2010. Community-based adaptation: lessons from the development marketplace 2009 on adaptation to climate change. Fondazione Eni Enrico Mattei, Milan, Italy.
[3] Mohan, S. and Morton, B. 2009. The future of development cooperation in a changing climate. In: Rethinking development in a carbon-constrained world. Palouso, E. (ed.), Ministry for Foreign Affairs of Finland, Helsinki.
[4] UNFCCC. 2008. Investment and financial flows to address climate change: an update. UNFCCC, Bonn, FCCC/TP/2008/7.
[5] Global Leadership for Climate Action. 2009. Facilitating an international agreement on climate change: adaptation to climate change. June 2009. www.globalclimateaction.org
[6] Girot, P.O. 2008. Biodiversity and environment (and livelihood) security. In: Global environmental outlook: environment for development (GEO-4). UNEP.

Impact pathway 6: International REDD+ funding and carbon markets

The intended users include the managers of REDD+ funding schemes under the UNFCCC, other carbon funds (e.g., World Bank, regional development banks), funding agencies for forestry and agriculture (e.g., FAO, World Bank, UNDP, UNEP), carbon market regulators (e.g., decision makers of the European Union Emission Trading System (EU ETS)), the associations involved in the development of international standards for carbon projects (e.g., the Climate, Community and Biodiversity Alliance (CCBA) and Voluntary Carbon Standards Association (VCSA)), as well as buyers of carbon credits in the private sector. Other important users are the intermediary organizations in the carbon markets (e.g., International Emissions Trading Association (IETA), the Carbon Markets Investment Association (CMIA), the Designated Operational Entities (DOEs) that validate and verify project emission reductions or the brokers of carbon credits). It is expected that the research outputs will help these stakeholders understand the challenges and opportunities of forest-based emission reductions and will facilitate the implementation of carbon markets and funds for forestry and agroforestry.

2.4.10 Milestones

Milestones for the activities, outputs, outcomes and impacts of Component 4 are presented in the following table.

	Years									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Inception: Research and implementation partnerships established. Role and responsibilities agreed. Data-sharing agreements developed. Capacity-building and communications strategies defined. Baseline established.	**X**	**X**								
Focus 1. Comparative analysis of international and national policy options		**X**	**X**	**X**	**X**	**X**				
Focus 1. Guidelines to improve national policy processes related to M&A				**X**	**X**	**X**	**X**			
Focus 1. Communications and capacity-building related to the outputs of Focus 1			**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Focus 2. Comparative analysis of subnational initiatives		**X**	**X**	**X**	**X**	**X**				
Focus 2. Guidelines to improve subnational initiatives and project-level activities related to M&A				**X**	**X**	**X**	**X**			
Focus 2. Communications and capacity building related to the outputs of Focus 2			**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Focus 3. Best-practice methods developed and tested		**X**	**X**	**X**						
Focus 3. Best-practice methods improved			**X**	**X**	**X**	**X**	**X**			
Focus 3. Communications and capacity building related to the outputs of Focus 3			**X**	**X**	**X**	**X**	**X**	**X**	**X**	
Outcome 1 (Communities and project developers design and implement effective, efficient and equitable M&A initiatives)					**X**	**X**	**X**	**X**	**X**	**X**
Outcome 2 (National policymakers design and implement adequate M&A policies)					**X**	**X**	**X**	**X**	**X**	**X**
Outcome 3 (Global agreements integrate REDD+ and EBA)					**X**	**X**	**X**	**X**	**X**	**X**
Outcome 4 (Global scientific assessments adequately address REDD+ and EBA)					**X**	**X**	**X**	**X**	**X**	**X**
Outcome 5 (Adaptation funds support EBA initiatives)					**X**	**X**	**X**	**X**	**X**	**X**
Outcome 6 (Carbon markets and funds increase their support to forest- and tree-based initiatives)					**X**	**X**	**X**	**X**	**X**	**X**
Impacts observed as a result of designed and implemented policies and subnational initiatives (reduced deforestation and degradation, increased net carbon storage, increased social and economic benefits from forests and agroforestry, reduced risk for rural livelihoods, enhancement access of women and other disadvantaged groups to benefits at all levels)									**X**	**X**

2.4.11 Role of partners

Our work will be carried out with three kinds of partnerships: research, policy and practitioner, and knowledge sharing (research partners are described under each theme). A non-exhaustive list of key policy/practitioners and knowledge sharing partners at various levels is provided in Table 2.4 and an example of how partnerships might work in Component 4 is provided in Box 2.13.

Policy and practitioner partners are the immediate and intermediate clients for research results in impact pathways. At the international level, all components will work with organizations aiming at synthesizing and disseminating information on adaptation and mitigation to policy makers and practitioners, such the FAO or the Nairobi Work Program of the UNFCCC. Policy partners include ministries of forestry and the environment and regional bodies (e.g., CEEAC, COMESA, COMIFAC and CILSS). Other policy and practitioner partners are international and national NGOs involved in advocacy activities and making the case for intervention directly to decision makers. Other partners are involved in practical management and the implementation of M&A initiatives, directly (e.g., local NGOs, private sector) or indirectly (e.g., international NGOs developing standards for carbon projects or developing methodologies).

Our knowledge-sharing partners will help translate research results into accessible knowledge and extend it to larger-scale target audiences. We will work with international organizations (e.g., CBD, UNFCCC NWP, UN-REDD+, FCPF), international NGOs (e.g., WWF, CI, IUCN and TNC) and media organizations (e.g., BBC, Panos, RFN, national media). We will also partner with capacity-building and education organizations (e.g., CATIE, RECOFTC, WOCAN, national universities).

Table 2.4 Illustrative list of policy and knowledge-sharing partners for Component 4

Levels/types	Policy and practitioner partners*	Roles/contributions	Knowledge-sharing partners	Roles/contributions
International level	FAO, UNFCCC NWP (Nairobi Work Programme on Adaptation)	Synthesizing information and disseminating it	CBD, WWF, CI, IUCN, TNC	Communicating on ecosystems and climate change, distributing research findings, developing guidelines and policy guidance documents
	IUCN, WWF, Conservation International (CI), RFN, WOCAN (Women Organizing for Change in Agriculture and Natural Resource Management)	Making the case for intervention/change directly to decision-makers	weAdapt	Sharing knowledge and building networks on climate change adaptation
	WWF, CI, FSC (Forest Stewardship Council), CCBA, VCS	Designing, validating, financing and managing M&A projects, demonstrating new models and developing new methodologies	UNFCCC Nairobi Work Programme (NWP), UN-REDD+, Forest Carbon Partnership Facility (FCPF), World Bank	Policymaker capacity building, organizing training sessions or side events during climate change negotiations, publishing policy briefs, developing capacity-building toolkits, or contributing to specific policy formulation
			BBC World Service Trust, Panos, RFN	Public/media outreach, raising awareness and recruiting public support
Regional level	Regional bodies (CEEAC, COMESA, COMIFAC, CILSS,…)	Using research findings to raise awareness on climate change issues and inform policies	CATIE	Developing graduate curricula, capacity building
	Green Belt Movement, WOCAN, WWF, CI	Making the case for intervention/change directly to decision-makers	Oxfam, RECOFTC, WOCAN	Community capacity building, supporting and mobilizing forest communities through the dissemination of information and the creation of platforms for exchanges between communities and scientists or policymakers
Country or site level	Ministries of forestry and the environment	Making informed decisions on climate change and forests	Outreach and continuing education institutions	Training of practitioners
	National and local NGOs	Implementing subnational initiatives for M&A	National and local media	Public/media outreach, raising awareness and recruiting public support
	Private sector	Implementing subnational initiatives for M&A.		
		Supporting EBA (e.g., from water or energy sector).		

Note that research partners are also presented under each theme.

Box 2.13 Example of partnerships (and the role of partners in impact pathways): The CCB standards

Even though synergies between climate change mitigation, communities and biodiversity have been documented widely, some concerns have also been raised about the possible negative impacts that badly designed mitigation projects may have on communities and biodiversity. In this context, methods are needed for helping project developers, host-country policymakers and carbon market actors assess the contribution of mitigation projects on communities and biodiversity.

CRP6 members and partners contributed to elaborating the Climate, Community and Biodiversity (CCB) standards, which were developed by the Climate, Community and Biodiversity Alliance (CCBA), a partnership between leading companies, NGOs (e.g., Conservation International and The Nature Conservancy) and research institutes (CIFOR, CATIE, World Agroforestry Centre). The voluntary CCB Standards aim at identifying land-based climate change mitigation projects that generate climate, biodiversity and sustainable development benefits.

The development of the CCB Standards involved NGO members of the CCBA and research institutes. The standards were opened for public comments and field-tested in several countries. A first edition of the standards was released in May 2005 and translated into four languages (English, French, Spanish and Chinese) for increased impact. The standards were revised in 2008 and the second edition was launched on 6 December 2008 at Forest Day 2, organized by CIFOR and CPF members in Poznań, Poland. The second version clarifies or strengthens some evaluation criteria, such as the legal ownership of the carbon or the rights of local communities. Projects are also evaluated in terms of their contribution to adaptation to climate change.

The CCB Standards are beneficial to project developers or other stakeholders involved in a project, as the standards can guide the design of the project and help attract investors interested in projects with multiple benefits. The standards can also be useful to project investors and carbon buyers for screening low-risk projects, as forestry projects with positive impacts on biodiversity and communities are more likely to be successful. Governments can also use the standards for checking the contribution of carbon projects to sustainable development of their countries.

As of December 2008, more than 100 projects around the world were using the CCB Standards to improve project design, 15 were in the process of certification and six had been officially CCB-certified. In the tropics, reviewed or certified projects are located in Brazil, China, El Salvador, India, Indonesia, Nicaragua, Panama, Peru, Tanzania and Uganda.

For more information, see http://www.climate-standards.org.

2.4.12 Prioritization

If the required resources for this component are not fully available, the work on mitigation will start in Latin America and Asia, where most REDD+ subnational initiatives and national policy processes are taking place. The work on adaptation will start in Africa where adaptation needs are the highest. Additional "phasing" (i.e., what could start later) and "scaling" (i.e., what could be done in fewer places) will be applied to the work on the synergies between M&A. If resources are limited, synergies and trade-offs between M&A will not be explored fully. In the sites for mitigation research, we will explore the opportunities of integrating adaptation in REDD+ and, in the sites for adaptation research, we will explore the opportunities of REDD+ and carbon markets for funding EBA.

2.4.13 Relevance of addressing climate change in CRP6 and links with CRP7[129]

The importance of linking the component on forests and climate change with the other components on forests

To achieve the outcomes and impacts expected from Component 4 on climate change and forests, there is a clear need to link this component with the other components under CRP6. Mitigating and adapting to climate change in forests will be possible only if issues related to production systems and markets (Component 1), management and conservation of forest and tree resources (Component 2), environmental services and landscape management (Component 3) and trade and investment (Component 5) are considered. For this reason, the results of the other components will be integrated into the work undertaken in Component 4.

Similarly, the results of Component 4 will be relevant to the other components (Figure 2.11). For example, mitigation mechanisms (such as carbon payments) can contribute to improving production systems based on forests, trees and agroforestry (Component 1) or supporting the conservation of other environmental services (Component 3). With regard to adaptation, climate change risks and adaptation opportunities have to be taken into account when improving production systems (Component 1) or managing forest resources (Component 2). Funds earmarked for climate mitigation and adaptation are likely to be among the most significant source of finance for implementation activities related to the other components, so it is critically important that integrated research addresses such questions as how to optimize trade-offs among multiple forest and tree management goals (e.g., climate protection, biodiversity protection, livelihood security).

[129] Links between Component 4 and CRPs 1–5 are discussed in Annex 3.

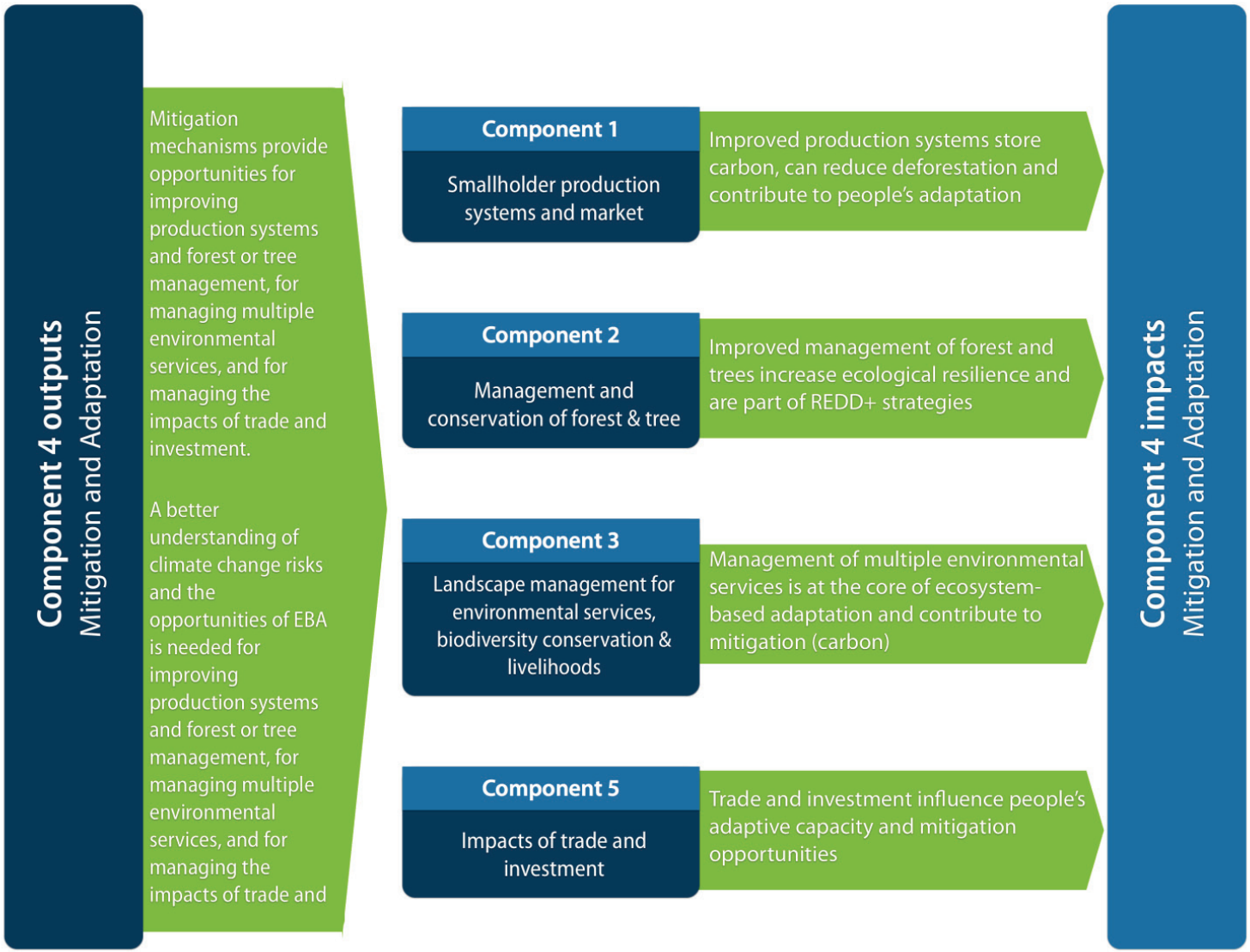


Figure 2.11 Links between Component 4 and the other components of CRP6

Component 4 and CRP7: Different impact pathways

Forests and agriculture are separated in the international policy processes on climate change and their inclusion is advancing at different paces. Some scientists and policymakers, especially those from the agricultural sector, argue that forests and agriculture have to be dealt with together. There is some truth in the stated need to bring forestry and agriculture together (e.g., because agriculture is a driver of deforestation) but this integration will take time. The developers of Component 4 and CRP7 recognize the need to work together but, given the currently separated impact pathways, the integration has to be progressive.

Forests are already high on the global climate change agenda, whereas agriculture still needs to make it onto the agenda. As a result, national policy processes and subnational initiatives also are different for forests and agriculture. For this reason, Component 4 and CRP7 will have to follow different impact pathways.

Since 2001 and the inclusion of Afforestation and Reforestation activities in the Clean Development Mechanism, forestry sectors in tropical countries have started to develop projects for climate change mitigation. More recently, the inclusion of REDD+ in the international negotiations on climate change has fostered the interest of the forestry sector in mitigation. National policymakers have started to consider forests and mitigation, for example through the creation of national task forces on REDD+. In parallel, the scientific community has invested considerable effort in developing methodologies, collecting data and delivering analyses on forest and climate change mitigation, including GHG flux measurement and modeling, as well as issues related to livelihoods and policy.

The tropical agricultural sector is not well represented in the international negotiations on climate change and the related policy instruments. The CDM includes agricultural projects but only for GHG mitigation from improved animal waste management systems and energy generation from biogas recovery. The Agriculture and Rural Development Days organized during the climate change negotiations at Copenhagen (December 2009) and Cancún (December 2010) highlighted the need for increased attention on agriculture in the climate change negotiations.

The specific partnerships (spanning the types of partner—research, policy and practitioner, and, to a degree, knowledge-sharing) will differ for the forest-and-climate and agriculture-and-climate impact pathways. The different components of CRP6 will work with the same partners and will be deeply engaged with forestry ministries, forestry research organizations, forest industry and forest-related advocacy groups. There are significant synergies to grouping forest-related climate work with CRP6, and significant inefficiencies—or even dissynergies—that would result from moving this work to CRP7.

Although there may be some points at which impact pathways converge (e.g., outreach opportunities at UNFCCC COPs), current mechanisms of coordination (e.g., linkages between Agriculture and Rural Development Day and Forest Day) can be strengthened for this purpose.

Linking Component 4 and CRP7

Strong links will be developed between Component 4 and CRP7 (see Figure 2.12).

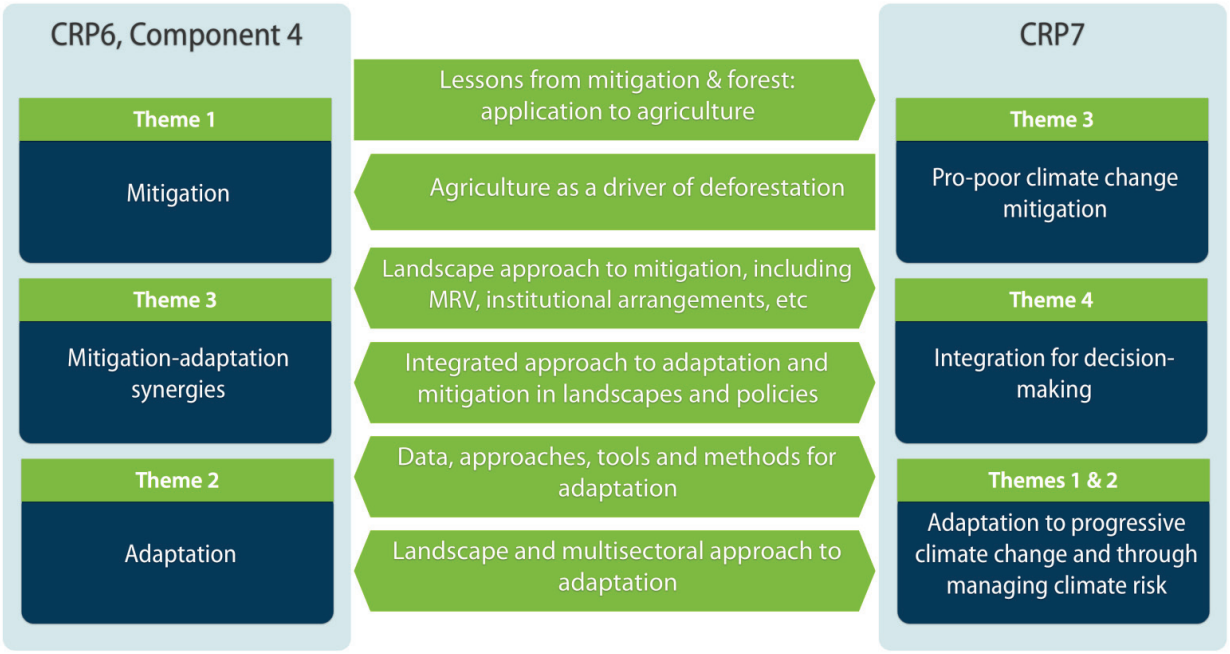


Figure 2.12 Links between Component 4 and CRP7

Our Theme 1 (Mitigation) will interact with CRP7.3 (Pro-Poor Climate Change Mitigation). As policies and projects related to climate change mitigation have started earlier in forests than in agriculture, lessons learned from the forestry sector may facilitate the development of such policies and projects in the agricultural sector. Interactions are also needed because agriculture is a driver of deforestation and because smallholder systems and landscapes typically include agriculture and forests (Table 2.5).

Our Theme 2 (Adaptation) will interact closely with CRP7.1 (Adaptation to Progressive Climate Change) and CRP7.2 (Adaptation through Managing Climate Risk) regarding data, approaches, tools and methods for adaptation. This interaction will enable the development of an integrated approach to adaptation, considering different sectors (forests, agroforestry, agriculture, livestock, fisheries, etc.). Some outputs of CRP7 (e.g., climate change scenarios) will be highly relevant to Component 4.

Our Theme 3 (Synergies between Adaptation and Mitigation) will interact with CRP7.4 (Integration for Decision Making). The integrative approach to adaptation and mitigation, as well as the integration of agriculture and forestry, will allow the exploration of common impact pathways for Component 4 and CRP7 and hence will increase impacts.

Table 2.5 Links between Component 4 and CRP7

Work to be undertaken in Component 4 that is relevant to CRP7	Work to be undertaken in CRP7 that is relevant to Component 4	Work to be undertaken jointly
Mitigation		
Evaluating global and national policies for REDD+ and subnational institutional arrangements	Analyzing agricultural drivers of deforestation Developing institutional arrangements and incentives that enable smallholder farmers and common-pool resource users to participate effectively in carbon markets and reduce GHGs	Evaluating pro-poor mitigation payment schemes for both agriculture and forests Assessing policies at national and international levels and institutional arrangements in subnational initiatives for a landscape approach to mitigation
Improving methods for MRV	Identifying agricultural options for reducing GHG emissions	Developing MRV for landscape approaches to mitigation
Adaptation		
Analyzing international and national policies and funds for adaptation	Refining frameworks for policy analysis	Analyzing the interactions between different sectoral policies in a context of adaptation
Assessing the vulnerability of forest- and tree-dependent people and analyzing adaptation options	Enabling rural communities to manage risk and build resilient livelihoods Adapting farming systems to changing conditions through the integration of tested technologies, practice and policies	Developing integrated approaches for vulnerability assessment and adaptation planning taking into account the diversity of livelihood activities
Assessing the impacts of climate change on forests, agroforests and biodiversity and determining adaptation options for ecosystems	Enhancing the prediction of climate impacts	Developing integrated approaches for assessing the impacts of climate change on agriculture, forests and trees at the landscape scale
Developing best practices and decision support tools for managing ecosystem services in ecosystem-based adaptation	Linking knowledge with action Assembling data and tools for analysis and planning	Assembling data and tools for a landscape and multisectoral approach to adaptation
Synergies between Adaptation and Mitigation		
Developing approaches for analyzing the trade-offs and synergies between M&A in terms of livelihoods and governance	Developing a framework and set of modeling tools and databases to analyze the implications, both positive and negative, of human responses to the climate challenge in terms of regional food security and the preservation of important ecosystem services	Approaches and tools for analyzing the trade-offs and synergies between M&A for development, food security and the environment at different scales (local, regional, global)
Defining and analyzing future scenarios and pathways for M&A	Developing plausible future food security scenarios under climate change	Developing scenarios at different scales for food security, ecosystem conservation, adaptation and mitigation

Common activities have already been planned between Component 4 and CRP7. These activities aim at extending the research on MRV (Measurement, Reporting and Verification) developed in forests to the agricultural parts of the landscape. The focus will be on assessing GHG emissions from soils in target land use systems, assessing changes in C stocks with associated with land use change and evaluating agronomic practices for their potential to reduce emissions.

The relationships between Component 4 and CRP7 will include the following activities.

- Once a year, CRP6 and CRP7 planning teams will convene a joint meeting to plan for joint activities and to ensure complementarities.
- At least one joint multi-stakeholder meeting will be conducted each year to foster impacts that cut across the forestry and agricultural sectors; the content of such meetings will be determined in the planning meetings.
- It is expected that a joint dissemination activity will be conducted at least once a year.
- Within the first three years, at least two major joint research outputs will be produced.