CGIAR Research Program 6

Forests, Trees and Agroforestry:
Livelihoods, Landscapes and Governance

Proposal

February 2011

CIFOR World Agroforestry Centre TRANSFORMING LIVES AND LANDSCAPES CGIAR Bioversity International CIAT

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Abbreviations

ADB	Asian Development Bank
AERC	African Economic Research Consortium
AF	Kyoto Protocol Adaptation Fund
AFAWI	Alliance for African Women Initiative
AfDB	African Development Bank
AFF	African Forest Forum
AFOLU	Agriculture, forestry and land use
AFORNET	African Forest Research Network
AFP	Asia Forest Partnership
AFTP	Agroforestry tree product
AfSIS	African Soil Information Service
AGRA	Alliance for a Green Revolution in Africa
AGTER	Améliorer la gouvernance de la terre, de l'eau et des ressources naturelles
AIT	Asian Institute of Technology
ANAFE	African Network for Agriculture, Agroforestry and Natural Resources Education
ANAFOR	National Forestry Development Agency (Cameroon)
APAFRI	Asia Pacific Association of Forestry Research Institutions
APFORGEN	Asia Pacific Forest Genetic Resources Programme
ARI	Advanced research institute
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa
AU	African Union
AU-NEPAD	African Union, New Partnership for Africa's Development
BACI	Before–after, control–impact
BAU	Business as usual
BFW	Austrian Federal Research and Training Centre for Forests, Natural Hazards and Landscape
BIC	Bank Information Center
BNDES	Brazilian Development Bank
BOKU	University of Natural Resources and Life Sciences
BRIC	Brazil, Russia, India, China
C	Carbon

CAAS	Chinese Academy of Agricultural Sciences
CAF	Chinese Academy of Forestry
CAMCORE	Central American and Mexico Coniferous Resources Cooperative
CAN	Andean Community of Nations
CANGIS	CacaoNet Germplasm Information System
CARPE	Central African Regional Program for the Environment
CATIE	Tropical Agriculture Research and Higher Education Center
CBD	Convention on Biological Diversity
CBFE	Community-based forest enterprise
CBFP	Congo Basin Forest Partnership
CBO	Community-based organization
CCBA	Climate, Community and Carbon Alliance
CCI	Cocoa Coconut Institute (PNG)
CDM	Clean Development Mechanism
CEB	Council of Europe Development Bank
CEDLA	Center for Latin American Research and Documentation
CEEAC	Economic Community of Central African States
CEESP	IUCN Commission on Environmental, Economic and Social Policy
CENAREST	National Center for Scientific and Technologic Research (Gabon)
CEPLAC	Comissão Executiva de Planejamento da Lavoura Cacaueira (Brazil)
CGIAR	Consultative Group on International Agricultural Research
CI	Conservation International
CIAT	International Center for Tropical Agriculture
CICY	Centro de Investigación Científica de Yucatán
CIFOR	Center for International Forestry Research
CILSS	Comité Permanent Inter-etats pour la Lutte Contre la Sécheresse au Sahel (Permanent Inter-State Committee for Drought Control in the Sahel)
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement (Centre for International Cooperation on Agricultural Research for Development)
CIT	Component implementation team
CMIA	Carbon Markets Investment Association
CNRA	Centre National de Recherche Agronomique, Ivory Coast
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent

COMESA	Common Market for Eastern and Southern Africa
COMIFAC	Central African Forest Commission
COMTRADE	UN Commodity Trade Statistics Database
COP	Conference of the Parties
CORAF	Conférence de responsables de recherche agronomique africains
CORPOICA	Corporación Colombiana de Investigación Agropecuaria
COSA	Committee on Sustainability Assessment (UNCTAD)
CPF	Collaborative Partnership on Forests
CRC	Collaborating research center
CRES	Compensation and rewards for environmental services
CRI	Coconut Research Institute
CRIG	Cocoa Research Institute of Ghana
CRP	CGIAR Research Program
CRP6	CGIAR Research Program 6, Forests and Trees and Agroforestry: Livelihoods, Landscapes and Governance
CRP7	CGIAR Research Program 7, Agriculture and Climate Change
CRREA	Centre Regional de Recherches Environnementales et Agricoles (Burkina Faso)
CSF Borneo	Center for Social Forestry (Indonesia)
CSF	Conservation Strategy Fund (Latin America)
CSIR	Council for Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSO	Civil society organization
CTFS	Center for Tropical Forest Science
DFID	Department for International Development (United Kingdom)
DNA	Designated national authority
DNDC	DeNitrification-DeComposition
DOE	Designated operational entity
EAC	Environmental Audit Committee
EBA	Ecosystem-based adaptation
EC	European Commission
ECA	Ecosystems Climate Alliance
ECOWAS	Economic Community of West African States
EFI	European Forest Institute
EIB	European Investment Bank

Embrapa	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Enterprise for Agricultural Research
EPIA	*Ex post* impact assessment
ERAIFT	Ecole régionale post-universitaire d'aménagement et de gestion intégrés des forêts et territoires tropicaux
ES	Environmental services
EU ETS	European Union Emission Trading System
EU	European Union
EUFORGEN	European Forest Genetic Resources Programme
EU-RED	European Union-Reducing Emissions from Deforestation
FAO	Food and Agriculture Organization of the United Nations
FAO's COFOs	Committee on Forestry of the FAO
FARA	Forum for Agricultural Research in Africa
FAWE	Forum for African Women Educationalists
FBD	Forestry and Beekeeping Division (Tanzania)
FCPF	Forest Carbon Partnership Facility
FDI	Foreign direct investment
FEM	Food, energy and medicine
FFI	Fauna and Flora International
FLACSO	Facultad Latinoamericana de Ciencias Sociales (Latin American School of Social Sciences)
FLEGT	Forest Law Enforcement, Governance and Trade
FLR	Forest landscape restoration
FMU	Forest management unit
FORDA	Forestry Research and Development Agency (Indonesia)
FORI	Forestry Research Institute
FORIG	Forestry Research Institute of Ghana
FORNESSA	Forestry Research Network for Sub-Saharan Africa
FPP	Forest Peoples Programme
FRI	Forestry Research Institute
FRIM	Forestry Research Institute of Malawi/ Forestry Research Institute Malaysia
FSC	Forest Stewardship Council
GCARD	Global Conference on Agricultural Research for Development
GCBS	Global Strategic Base Collection
GCS	Global Comparative Study on REDD+

GEF	Global Environmental Facility
GEOSS	Global Earth Observation System of Systems
GFAR	Global Forum on Agricultural Research
GHG	Greenhouse gas
GIAHS	Globally Important Agricultural Heritage Systems
GIS	Geographic Information System
GOFC-GOLD	Global Observation of Forest and Land Cover Dynamics
GRPR	Gender responsive participatory research
GSAC	Global Strategic Active Collection
IAASTD	International Assessment of Agricultural Science and Technology for Development
IADB	Inter-American Development Bank
IBIF	Bolivian Institute of Forestry Research
ICAR	Indian Council of Agricultural Research
ICCRI	Indonesian Coffee Cocoa Research Institute
ICECRD	Indonesian Center for Estate Crops Research and Development
ICHORD	Indonesian Center for Horticulture Research and Development
ICIMOD	International Centre for Integrated Mountain Development
ICRW	International Center for Research on Women
IDRC	International Development Research Center
IER	Institut d'Economie Rurale du Mali
IETA	International Emissions Trading Association
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IFRI	International Forestry Resources and Institutions
IGBP	International Geosphere-Biosphere Program
IHDP	International Human Dimensions Program
IHSA	Natural Resources Law Institute (Institut Hukum Sumberdaya Alam, Indonesia)
IIAM	National Institute for Agriculture Research (Mozambique)
IIAP	Instituto de Investigaciones de la Amazonia Peruana (Peruvian Amazon Research Institute)
IIED	International Institute for Environment and Development
IITA	International Institute of Tropical Agriculture
ILC	International Land Coalition
ILTER	International Long-term Ecological Research

IMFN	International Model Forest Network
IMS	Information management system
INBAR	International Network for Bamboo and Rattan
INERA	L’Institut de l’Environnement et de Recherches Agricoles (Burkina Faso)
INESEFOR	Instituto de Investigaciones y Servicios Forestales (Costa Rica)
INIA	Institute of Agricultural Research (Spain)
INIA	National Institute of Agrarian Innovation (Peru)
INIAP	Instituto Nacional de Investigacao Agraria e das Pescas (Ecuador)
INTA	El Instituto Nacional de Tecnología Agropecuaria (Argentina)
IPB	Bogor Agricultural University I(ndonesia)
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPEA	Instituto de Pesquisa Econômica Aplicada (Brazil)
IPG	International public goods
IPOC	Indonesian Palm Oil Commission
IRAD	Institute of Agricultural Research for Development (Cameroon)
IRD	L'Institut de Recherche pour le Développement
IRET	Institut de Recherche en Ecologie Tropicale (CENAREST)
ISPC	Independent Science and Partnership Council
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature
IUFRO	International Union of Forest Research Organizations
IWGFF	Indonesian Working Group on Forest Finance
IYF	UN International Year of Forests (2011)
JRC	Joint Research Center
KARI	Kenya Agricultural Research Institute
KEFRI	Kenya Forestry Research Institute
LAFORGEN	Latin American Forest Genetic Resources Network
LAMIL	Landscape Management for Improved Livelihoods
LDCF	Least Developed Countries Fund
LIPI	Lembaga Ilmu Pengetahuan Indonesia (Indonesian Institute of Sciences)
LLS	Livelihoods and Landscapes Strategy of the IUCN
LSMS	Living standard measurement survey
LTER	Long-term ecological research

LTSER	Long-term socio-ecological research
LUCC	Land use and cover change
M&A	Mitigation and adaptation
M&E	Monitoring and evaluation
MAB	Man and the Biosphere Programme
MARD	Ministry of Agriculture and Rural Development (Vietnam)
MCB	Malaysian Cocoa Board
MDG	Millennium Development Goal
MERCOSUR	Southern Common Market
MRV	Measurement, Reporting and Verification
MSU	Management Support Unit
NAFFORI	National Forestry Resources Research Institute (Uganda)
NAFRI	National Agriculture and Forestry Research Institute (Lao PDR)
NAMA	Nationally Appropriate Mitigation Action
NAPA	National Adaptation Programme Of Action
NARIS	National agricultural research information systems
NARO	National Agricultural Research Organisation (Uganda)
NARS	National agricultural research systems
NEPAD-CAADP	New Partnership for Africa’s Development – Comprehensive African Agricultural Development Programme
NFA	National Forestry Authority (Uganda)
NGO	Non-governmental organization
NHSCP	National Household Survey Capability Program
NICFI	Norway’s International Climate and Forest Initiative
NRM	Natural resources management
NSS	Negotiation Support Systems
NTFP	Non-timber forest product
NWP	UNFCCC Nairobi Work Programme
ODA	Overseas development assistance
ODI	Overseas Development Institute
OECD	Organization for Economic Cooperation and Development
OTCA	Amazon Cooperation Treaty Organization
PA	Protected area
PCA	Philippine Coconut Authority
PEFC	Programme for the Endorsement of Forest Certification

PEN	Poverty Environment Network
PES	Payments for environmental services
PILI	Pusat Informasi Lingkungan Indonesia (Indonesian Environmental Information Center)
PIPA	Participatory impact pathways analysis
PLAAS	Institute for Poverty, Land and Agrarian Studies
PRA	Participatory rural appraisals
PRESA	Pro-poor payments for Environmental Services in Africa
PROFOR	Program on Forests
PSP	Permanent sample plot
REC	Regional Economic Community
RECOFTC	Center for People and Forests
REDD+	Reducing emissions from deforestation and forest degradation and enhancing carbon stocks
RES	Rewards for environmental services
RFN	Rainforest Foundation Norway
RIFFEAC	Réseau des institutions de formation forestière et environnementale d'Afrique centrale (Gabon; Network of Forestry Schools in Central Africa)
RIL	Reduced impact logging
RPI	Integrated Research Plan (FORDA)
RPP	Readiness preparation plan
RRI	Rights and Resources Initiative
RSB	Roundtable for Sustainable Biofuels
RSPO	Roundtable on Sustainable Palm Oil
RTRS	Roundtable on Responsible Soya
RUFORUM	Regional Universities Forum for Capacity Building in Agriculture
RUPES	Rewards for use of and shared investment in pro-poor environmental services
SADC	Southern African Development Community
SAFORGEN	Sub-Saharan African Forest Genetic Resources
SARD	Sustainable Agriculture and Rural Development
SBSTA	Subsidiary Body for Scientific and Technological Advice
SBTTA	Special Body for Scientific, Technical and Technological Advice
SCALE	Sustainable Collective Action for Livelihoods and the Environment
SCCF	Special Climate Change Fund
SCRI	Scottish Crop Research Institute

SEANAFE	Southeast Asia Network for Agroforestry Education
SEARCA	Regional Center for Graduate Study and Research in Agriculture
SEI	Stockholm Environment Institute
SFA	Stephen F. Austin State University
SFM	Sustainable forest management
SIGEO	Smithsonian Institution Global Earth Observatory Network
SLIMF	Small and low intensity forest management
SLU	St Louis University
SMART	Specific, measurable, achievable, relevant and time-bound
SME	Small- and medium-sized enterprise
SNGF	Silo National des Graines Forestières (Madagascar; National Forestry Seed Bank)
SNV	Netherlands Development Organisation
SPC	Secretariat of the Pacific Community
SPDA	Peruvian Society for Environmental Rights
SPIA	Standing Panel on Impact Assessment
SRF	Strategic results framework
SSAC	Scientific and Stakeholder Advisory Committee
STCP	Sustainable Tree Crops Program
STRI	Smithsonian Tropical Research Institute
SVAT	Soil vegetation atmosphere transfer
T&I	Trade and investment
TA	Tanzania Association of Foresters
TAFORI	Tanzania Forestry Research Institute
TAWLAE	Tanzanian Association of Women Leaders in Agriculture and Environment
TBI	Tropenbos Indonesia
TEEB	The Economics of Ecosystems and Biodiversity
TNC	The Nature Conservancy
UEA	University of East Anglia (United Kingdom)
UNAM	Universidad Nacional Autónoma de México
UNAMAZ	Asociación de Universidades Amazónicas
UMB	Norwegian University of Life Sciences
UNCCD	United Nations Convention to Combat Desertification
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme

UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
UN-REDD	United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries
VARTC	Vanuatu Agricultural Research and Training Centre
VCSA	Voluntary Carbon Standards Association
VDS	Association des Volontaires pour le Dévelopement au Sahel (Burkina Faso)
VPA	Voluntary partnership agreement
WAC	Watershed Agricultural Council
WALHI	Wahana Lingkungan Hidup Indonesia (Indonesian Forum for the Environment)
WARSI	Conservation Information Forum (Indonesia)
WB	World Bank
WCS	Wildlife Conservation Society
WEDO	Women’s Environment and Development Organization
WFP	UN World Food Programme
WOCAN	Women Organizing for Change in Agriculture and Natural Resource Management
WRI	World Resources Institute
WWF	World Wide Fund for Nature

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We received endorsement letters, provided in Annex 6, from key partner institutions including: CIRAD, the Forestry Research and Development Agency (*FORDA*) of Indonesia, the Institut de Recherche pour le Développement (IRD), the International Union for Conservation of Nature (IUCN), the International Union of Forestry Research Organizations (IUFRO), the Kenya Forestry Research Institute (KEFRI), the Latin American Forest Genetic Resources Network (LAFORGEN), the Stockholm Environment Institute (SEI), the Sub-Saharan Africa Forest Genetic Resources Network (SAFORGEN) and the Tropical Agricultural Research and Higher Education Centre (CATIE). We express our gratitude to all, particularly for providing advice and perspectives on our evolving ideas and the proposal document itself, often within tight timeframes.

In addition, representatives from more than 50 institutions provided valuable comments and feedback on earlier versions of this proposal. Many of them also participated in one or more of our outreach events (GCARD, IUFRO, COP16, UNFF9) or attended the CRP6 partner consultation workshop in Nairobi (see Annex 2).We thank them all for their time, effort and responsiveness. Members of the CGIAR Consortium Board along with four anonymous reviewers provided invaluable critiques and reviews of various versions of this proposal for which we are grateful. Our investors/donors also provided valuable formal and informal views that have helped us better assess demand for our work. Among other non-CGIAR contributors, we thank Jürgen Hagmann and Picoteam for facilitating planning events and providing fresh perspectives.

Executive Summary

The challenge

Forests are cut, temperatures rise and biodiversity is lost. The poor become poorer and indigenous cultures disappear. With the rise in temperatures, fires increase, droughts lengthen, floods spread, and pests and diseases affecting livestock and plants adapt and multiply. What many are calling a “perfect storm” gathers strength and the impact rolls across the developing world from the forests to the farms to the atmosphere. The first and hardest hit are the poorest people who eke out a living on formerly forested lands, or farm dry cereals on degraded and rain-fed lands where the margins for error are slim to none. Next hit are the irrigated areas where floods and drought combine to silt or empty reservoirs; and farmers who plant highly targeted crop varieties struggle to adapt. The incomes and livelihoods of the world’s poorest people spiral downward.

This scenario stems in large measure from the poor management of our forests, trees and wild genetic resources. Despite decades of research and development efforts to reverse deforestation, forest degradation and biodiversity loss, these trends continue at an alarming rate. During the time it takes to read this case for investment, as much as 3000 hectares of natural forests and tree cover will disappear, along with the biodiversity they embrace, a loss of almost 13 million hectares annually. Deforestation and land use change contribute 12–18% of the world’s total annual carbon emissions accelerating global warming.

Natural forests form a dwindling part of a finite land area where conversion to agriculture poses the greatest threat in the developing tropics. Adjacent or newly cultivated cropland may retain remnant trees or accommodate natural tree regeneration. However, these are insufficient to provide the environmental goods and services formerly coming from intact forests. And while conversion of forest to agriculture can in some cases improve rural incomes, all too often deforestation leads to impoverishment of both ecosystems and communities.

Such outcomes are overwhelmingly the result of governance failures at landscape, national and global scales. Such governance failures are typically manifested through such factors as unclear land tenure or insecure access rights to resources; poorly regulated extraction, trade and investment regimes; nonexistent or inchoate land use planning; a growing propensity for land grabbing; perverse incentives; exclusion of poor, often indigenous, people from decision-making processes; and weak law enforcement. Individually or collectively, these factors contribute to the loss of forest and tree cover, the progressive depletion of tree genetic resources and biodiversity, and the unequal distribution of economic and social benefits from forests, trees and agroforestry systems.

Deforestation and degradation cause the loss of more than just the biodiversity, products and environmental services that forests and trees provide—carbon sequestration, stabilization of soils, adaptation to the destructive effects of rising temperatures or a simple, peaceful retreat. Failure to optimize land use means we are squandering an opportunity to improve the livelihoods of more than a billion of the world’s poorest people, as well as the national balance sheets of developing countries. More than US$3 billion a year is lost in illegal logging in Indonesia alone. Forests and trees conservatively provide US$250 billion in the various types of income—timber, fuelwood, food, medicines and non-forest tree products—

from these resources. However, this amount could be much higher and could also be sustainable for generations to come.

Studies show that people living in or near forests earn on average about 25% of their income from forest resources; this amount could be much higher with multiple-use management approaches that target all the potential sources of income from forests, trees and environmental services, instead of the prevailing narrow focus on the extraction of a few valuable tree species. The potential of payments for environmental services (PES)—and specifically reducing emissions from deforestation and degradation (REDD+)—as sources of revenue for rural forest stewards remains barely tapped. Trees on farms offer tremendous potential to increase rural incomes. Roughly 10% of the world's tree cover is found on farms—and the rate is increasing—making an important contribution to climate mitigation and adaptation. In developing countries, agroforestry systems provide essential fodder and non-timber forest products, and contribute significantly to the revenues of women-led households. Wild tree species have the potential to play a critical role in improving livelihoods on small farms. Nevertheless, most extension agents do not receive training in agroforestry techniques and most wild tree species are not yet adequately conserved. If extension agents were so trained, if wild tree species were classified and cultivated to preserve and improve their sustainable productivity, and if access to markets for tree products were enhanced, then income from trees on farms could be vastly increased.

The world requires a well-planned, well-resourced and long-term effort to improve the management and governance of our remaining forests, to reduce conflicts over disputed lands, to increase the input of women and marginalized communities and to derive more value from trees deliberately cultivated in agricultural and forest-adjacent lands. In the absence of that effort, those people who depend on forests and trees for their livelihoods will be left to become even further impoverished, and climate change will continue to warm the world.

What is needed now to answer this challenge is a new approach to research—more strategic, more targeted and more collaborative. It must be ambitious and far reaching. It must be driven by innovation, by new methods, by new partnerships and by more capacity. The time it takes to move from science to impact must be slashed. Time is not a friend of forests and trees.

A new research approach

In response to the urgency of the challenge described above, four centers within the Consultative Group on International Agricultural Research propose the *CGIAR Research Program No. 6: Forests, Trees and Agroforestry: Livelihoods, Landscapes and Governance* (CRP6). This initiative brings together four of the world's leading research centers in their respective subjects—the World Agroforestry Centre, CIFOR, CIAT and Bioversity—together with their partners, data, resources and experience and channels them toward a clear objective: enhancing the management and use of forests, agroforestry and tree genetic resources across the landscape from forests to farms.

CRP6 is designed to make a significant contribution toward the vision and strategic objectives articulated in the CGIAR's Strategic Results Framework (see the box below) by:

1. enhancing the contribution of forests, agroforestry and trees to production and incomes of forest-dependent communities and smallholders;
2. conserving biodiversity, including tree genetic diversity, through sustainable management and conservation of forests and trees;
3. maintaining or enhancing environmental services from forests, agroforestry and trees in multifunctional and dynamic landscapes;
4. reducing emissions of greenhouse gases and augmenting carbon stocks through better management of forest- and tree-based sources while increasing local and societal resilience through forest-, agroforestry- and tree-based adaptation measures; and
5. promoting the positive impacts and reducing the negative impacts of global trade and investment as drivers of landscape change affecting forestlands, agroforestry areas, trees and the well-being of local people.

A New Vision and Strategic Objectives

Vision

To reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership and leadership.

Strategic Objectives

- **Food for People:** Create and accelerate sustainable increases in the productivity and production of healthy food by and for the poor.
- **Environment for People:** Conserve, enhance and sustainably use natural resources and biodiversity to improve the livelihoods of the poor in response to climate change and other factors.
- **Policies for People:** Promote policy and institutional change that will stimulate agricultural growth and equity to benefit the poor, especially rural women and other disadvantaged groups.

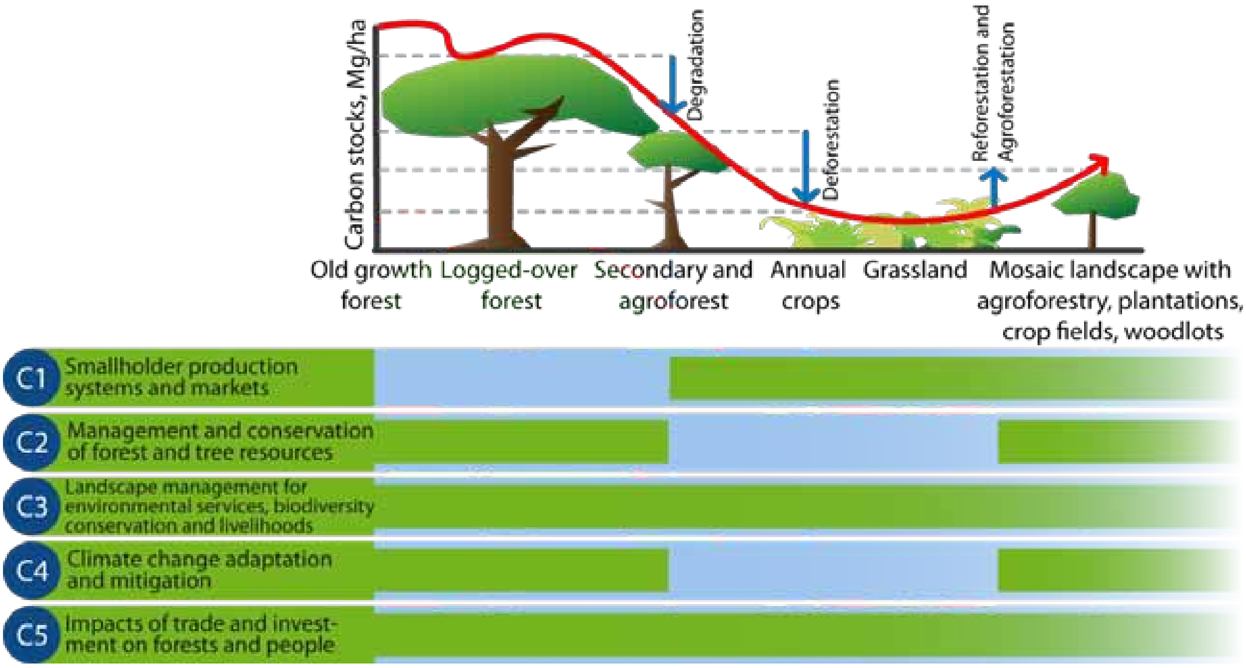
Source: CGIAR. 2010. A strategy and results framework for the CGIAR. http://www.cgiar.org/changemanagement /pdf/cgiar_srf_june7_2010.pdf (5 September 2010).

Innovation is central to CRP6, from design to execution, from the way we choose our partners to the way we communicate. CRP6 represents cutting-edge approaches that incorporate global comparative research with an extended time horizon (both backward and forward to better understand trends), across scales, ecological systems, landscapes, institutions, sectors of society and disciplines. We will develop sophisticated tools, approaches and frameworks to support our research, to test interventions and to assess and define policy options and scenarios. We will further share our knowledge and data to achieve high impact. Implementation of CRP6's innovative approaches to impacts will move the collaborating CGIAR centers and their key partners beyond "business as usual", opening up new opportunities for integration and synergy among themselves and with other partners, within the larger geographic, environmental and social domain relevant to forests and trees.

The framework

Forests occur under varying geographic, edaphic and climate regimes ranging from the boreal regions to the tropics; estimates suggest almost 560 (68%) of the terrestrial ecoregions around the world can be identified as forests and woodlands. Trees, however, are not limited to such habitats; they are an important element in many other systems including agricultural landscapes, grasslands, steppes and deserts. This ecological diversity, along with the considerable cultural and socioeconomic variation in the people that live in and around forests and otherwise depend on forests and agroforestry, makes their management and use complex, requiring a broad diversity of research strategies.

At the same time, we know that historically, forested countries have experienced phases of decreasing and then increasing forest area, with changes in both type and amount of tree cover in landscapes, as illustrated in the below. The progress of a country or region along this **forest and land use transition curve** has tended to track demographic change and economic development. However, this curve is also useful for describing spatial variation across contemporary landscapes. As illustrated in the figure below, the research components of CRP6 together address land use management challenges across the range of variation. CRP6 is thus framed to carry out research along the continuum from relatively undisturbed forest to intensively farmed agricultural land. The continuum provides a useful integrative and analytical concept given that strategies and approaches may vary in a consistent way across the landscape.



CRP6 components within the forest and land use transition curve

CRP6 research will focus on areas where local people depend on resources from forests and agroforestry for their livelihoods, where forests that are important for carbon sequestration or other environmental services are under severe pressure from timber extraction or conversion to other land uses and/or where forests are projected to be severely affected by climate change.

A range of drivers impact the pace of change along the curve, and the extent to which these affect environmental services and livelihood benefits or deficits depends primarily on how they are governed.

Another innovation will be the focus of much CRP6 research on “sentinel landscapes”. Such research will support the collection of the long-term data sets necessary to understand the drivers and impacts of land use change. Sentinel landscapes will also provide excellent locations to foster dialogue among various stakeholders and to test models, thus facilitating consensus on contentious issues such as the sustainable exploitation of a disputed natural resource. They will also offer opportunities to implement experimental design to measure the uptake of research results and for overall impact assessment. Finally, sentinel landscapes will provide global focal points for multidisciplinary research; they will also provide spaces for engagement with the broader suite of researchers, development efforts and stakeholders working in rural areas, including other long-term site-specific research efforts being undertaken within the broader CGIAR network.

The research portfolio

After extensive consultation with partners and stakeholders, we have identified **five components** that will form the core of the CRP6 research and impact strategies. The five CRP6 components are designed to deliver distinct but interlinked outcomes across the forest and land use transition curve, which together will generate a common set of impacts. Through carefully articulated impact pathways, our research will be oriented to produce measurable and significant outcomes and impacts—globally, regionally and locally. A summary of each component is presented below.

1. Smallholder production systems and markets. Key research themes:
    - Enhancing productivity and sustainability of smallholder forestry and agroforestry practices, including food security and nutritional benefits, through better management of production systems
    - Increasing income generation and market integration for smallholders through utilization of forest and agroforestry options
    - Improving policies and institutions to enhance social assets and to secure rights to forests, trees and land
2. Management and conservation of forest and tree resources. Key research themes:
    - Understanding the threats to populations of important tree species and formulating effective, efficient and equitable genetic conservation strategies
    - Conserving and characterizing high-quality germplasm of high-value tree species along the forest-to-farm gradient
    - Developing improved silvicultural and monitoring practices for the multiple-use management of forest ecosystems

- Developing tools and methods to resolve conflicts about distribution of benefits and resource rights in the use of forests and tree resources

3. Landscape management for environmental services, biodiversity conservation and livelihoods. Key research themes:
   - Understanding drivers of forest transition as a prerequisite for their management
   - Understanding the consequences of the forest transition for environmental goods and services and livelihoods
   - Enhancing response and policy options to sustain and maximize environmental and social benefits from multifunctional landscapes
4. Climate change adaptation and mitigation. Key research themes:
   - Harnessing forests, trees and agroforestry for climate change mitigation
   - Enhancing climate change adaptation through forests, trees and agroforestry
   - Understanding the role of forests, trees and agroforestry in achieving synergies between climate change mitigation and adaptation
5. Impacts of trade and investment on forests and people. Key research themes:
   - Understanding the processes and impacts of forest-related trade and investment
   - Enhancing responses and policy options to mitigate negative impacts and enhance positive impacts of trade and investment

Pathways to impact

CRP6 will embed its core research activities in specific **impact pathways** for each component, explaining how research outputs will lead to outcomes and ultimate impacts. Research will result in increased awareness and understanding among key stakeholders, practitioners and policymakers of the problems and opportunities for improving technical practices and developing more appropriate and effective policies and governance mechanisms that deliver real-world impacts.

The five components are tightly interwoven and interlinked, and will synergistically work together to deliver impacts, as detailed in the following figure.

Overall impact pathways

Cross-cutting commitments

The design of CRP6 also includes a number of commitments to undertake research for development in ways that will produce more effective and equitable results.

Gender sensitivity

For decades, gender analysis has been given lip service in agricultural and forestry research. Moreover, foresters and extension agents, project managers, policymakers and scientists have routinely overlooked gender in their work. This occurs despite repeated studies showing that increasing the involvement of women results in improvements in the management of resources, whether at the community, household or farm level, as well as enhancements to livelihoods. Gender is integrated into all CRP6 components and activities. Gender analysis methods will generate understanding of key institutional, cultural and attitudinal contexts that entrench inequity and squander opportunities to improve women's lives. Our approach will include collection of sex-disaggregated data, development of gender-focused partnerships and alliances, knowledge sharing and adaptive learning. CRP6 research will also identify policies, technologies and practices that will enhance gender equity in the access, use and management of forests and trees and the distribution of associated benefits.

While we highlight gender, CRP6 will also prioritize other disadvantaged groups such as indigenous peoples, the youth and the elderly.

Capacity strengthening

Most of the developing countries in which CRP6 will operate have major capacity gaps. There are too few trained foresters and agroforestry specialists, and even less multidisciplinary expertise spanning the biophysical, social, economic and political sciences. Moreover, the problem is worsening, with a marked reduction in training and education in forestry. Enrolments are declining and there is a worrying pattern of universities closing forestry colleges.

Capacity strengthening is not optional for CRP6; rather, it is a crucial ingredient of the project's impact orientation. Research will document and increase understanding of the global capacity needs required for the management and conservation of forests, agroforestry and tree genetic resources. Increasing current awareness of the global importance of forest issues presents a rare opportunity to develop a new generation of professionals able to address the breadth of challenges and opportunities that forests, trees and agroforestry provide. We recognize the need for more sophisticated multi- and trans-disciplinary expertise, increased numbers of trained people within disciplines and more capable institutions. Although capacity building on the scale needed goes beyond the scope of CRP6, we will strengthen and mobilize capacity through joint learning and implementation with new and existing partners.

Partnerships

A third commitment, alongside our approaches to gender and capacity building, is the way we approach partnerships—as *the* most important path to impact.

We will convene as research partners the world's leading expertise through new and existing partnerships with advanced and national research institutes, and other specialized research organizations necessary to complement the core competencies of the CGIAR. We will also engage "policy and practitioner partners" as the immediate clients for our research results. Policy and practitioner partners will span the range from global negotiating forums to local community organizations. Further, we will establish working relationships with "knowledge-sharing partners" to serve as intermediaries in reaching the media, students and the general public. Consistent with our approach to impact pathways, we will work closely with national- and local-level partners to assess and build capacity—both to undertake and to act on research—to ensure that measurable and significant outcomes and impacts result, globally, regionally and locally.

Knowledge sharing

At least part of the reason forestry and agroforestry science has not translated more broadly and rapidly into changes in policy and practice has been a failure of communication. The knowledge-sharing model introduced in this CRP combines traditional research outputs and media outreach with a viral and multidirectional delivery and feedback communications system. It will leverage available and emerging social media tools, "member communities", new concepts, trends and monitoring techniques. It is designed to ensure that all research outputs, including research data, are delivered to the people who need them—scientists, practitioners, donors, development agencies, policymakers, media and NGOs—today rather than five years from now. CRP6 will lead the way in developing knowledge sharing as an integral part of agricultural research.

Management

CIFOR, the World Agroforestry Centre, CIAT and Bioversity will lead the implementation of CRP6. The management structures, intended to be light, will include a Lead Center charged with the fiduciary and legal responsibility for CRP6. A Steering Committee comprised of the core participating CGIAR centers, plus additional CGIAR and external partner institutions as appropriate for the effective implementation of this ambitious program, will provide direction and oversight. A Scientific and Stakeholder Advisory Committee will provide guidance to ensure relevance, and a Management Support Unit based at the Lead Center will provide day-to-day management and coordination. Component Implementation Teams with scientists based across participating centers and partner organizations will be charged with undertaking the research and other activities necessary to deliver CRP6's outputs and outcomes, leading ultimately to impacts.

CRP6 will put in place mechanisms to ensure the quality, relevance and impact of our research, and will develop procedures for monitoring and evaluation of activities, projects and processes. CRP6's management will focus on promoting scientific excellence and adaptive management characterized by transparency, fairness and inclusiveness.

Resources required

To achieve these ambitious objectives through this program, CRP6 will require an initial start up budget of US$232.9 million over the next three years for what will be a minimum 10-year program. In the first year a budget of US$67.8 million is envisaged; of which US$ 23 million is expected from unrestricted funding, US$ 33.5 million from confirmed restricted grant projects and the remaining US$ 11.3 million from unconfirmed proposals. Restricted grants include current ongoing grant activity.This represents only a modest increase on “business as usual” as participating centers align their research programs with CRP6 and build Consortium-level management and communications capacity. In the second and third years, we project increased levels of funding, to enable us to implement the more innovative aspects of the proposal, such as a network of sentinel landscapes. We anticipate that this level of funding will leverage substantial additional investment in research by the CRP6 partners as well as by external partners over the coming years. In addition, substantial complementary funding will be needed for forest-related capacity-building and implementation agendas, beyond the scope of this research-for-development initiative; these agendas will be required for impact pathways to deliver results on the scale envisaged.

1. Introduction

1.1. Setting the scene

The CGIAR's Strategic Results Framework[1] (SRF) captures the harsh reality that poverty, food insecurity and poor nutrition remain entrenched within the global population. The rural dimension of poverty remains paramount among the world's poorest countries, where the poor depend on agriculture and natural resources for their livelihood—indeed, for many, their survival. However, this increasingly meager natural capital from which production and income are derived is drawn down each day by growing populations and rising expectations, and the commercial interests that serve them.

The result has been the conversion of forests, woodlands and other natural land covers and the accompanying degradation of all land, including agricultural land. This has led to the loss of critical ecosystem services that sustain the livelihoods of rural and urban households. Evidence abounds of deterioration in water regulation and provision, vegetative protection and nutrient cycling of soils, and sources of natural pest predators and crop pollinators. Now, climate change is creating new stresses on natural resources, increasing the urgency for their more effective management. Against this backdrop, forests, woodlands and agroforestry systems—the pillars of the natural resource base and providers of ecosystem services—are the first frontier for increasing and sustaining food production and reducing poverty.

The CGIAR, as part of its ongoing reform process, has explicitly recognized these challenges, and launched the design of this major new research initiative (*CGIAR Research Program 6: Forests, Trees and Agroforestry: Livelihoods, Landscapes and Governance* (CRP6)) involving partner centers CIFOR, World Agroforestry Centre, Bioversity and CIAT (see Annex 1 for background information). The call for this urgent work was echoed by a broad range of stakeholders during the Global Conference on Agricultural Research for Development (GCARD) held in Montpellier, France, in March 2010, and subsequent consultations (see Annex 2). This initiative is a timely response to global concerns, as reflected in the UN designation of 2011 as the International Year of Forests, and more recently evident in the evolving new strategy (2010–2014)[2] of the International Union of Forest Research Organizations (IUFRO).

1.1.1. Sounding the alarm for forests and trees

Humans have been poor stewards of the world's forests and the biodiversity they contain. Similarly, we have been inadequate managers of trees, overlooking the range of genetic diversity they embrace and their enormous potential for use in sustainable farming. Decades of efforts to address deforestation and forest degradation have failed to reverse global trends

[1] CGIAR. 2010. A Strategy and Results Framework for the CGIAR. http://www.cgiar.org/changemanagement/pdf/cgiar_srf_june7_2010.pdf (5 September 2010; currently being revised).
[2] IUFRO. 2010. Draft IUFRO strategy 2010–2014. http://www.iufro.org/discover/strategy/#c10578 (5 September 2010).

of forest loss. At present, around 16 million hectares of natural forests and tree cover, an area the size of England, are lost annually[3] (Figure 1.1). As the forests disappear, millions of the world's poorest suffer through the loss of all or portions of their livelihoods, ecosystem services that underpin agricultural productivity are lost and governments lose an important source of revenue that could otherwise be invested in poverty reduction. Moreover, the potential of forests to mitigate and adapt to climate change continues to decline each day.

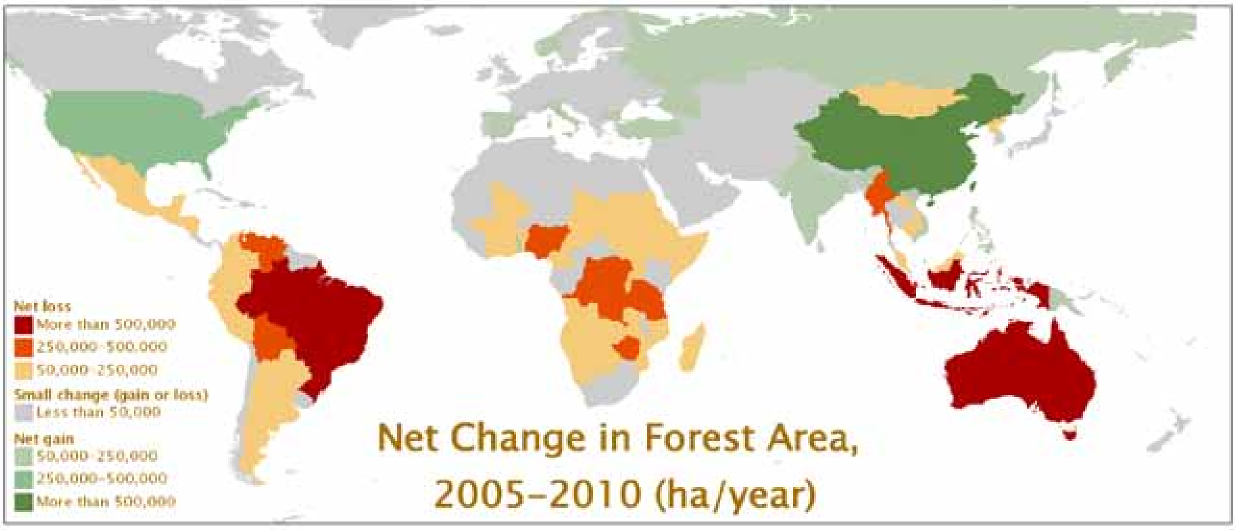


Figure 1.1 Net change of forest area 2005–2010. Forest cover gains are due in large part to plantations, which are of lower value for biodiversity protection and environmental services than "natural" forest types.

Source: FAO. 2010. Global forest resources assessment 2010: key findings. FAO, Rome

None of this takes into account the extraordinary value inherent in these resources if sustainably managed. The international timber trade generates up to US$150 billion yearly,[4] and the real value of local and national timber trade—sawnwood, panels, roundwood, fuelwood—is likely as large. Income derived from the sale of non-timber forest and farm products, such as bamboo, nuts, fruits, honey and bushmeat, adds another US$50 billion.[5] These industries provide income for approximately 1.4 billion people, according to the World Bank.[6] For many disadvantaged rural communities, forest and agroforestry resources contribute to subsistence and household income, and are the lifeline they need to cope with and overcome poverty. Results emerging from a survey of more than 9000 such households suggest that forest products contribute on average 20–25% of annual income.[7]

Further, the environmental services provided by trees and forests—including protecting and revitalizing soils, regulating water regimes for rural producers and urban consumers, providing habitat for pollinators and seed dispersers, and absorbing and storing carbon—are valued in the tens of billions of dollars annually.[8] Beyond their direct economic worth, forests

[3] FAO. 2010. Global forest resources assessment 2010: key findings. FAO, Rome www.fao.org/forestry/fra/fra2010/en (1 September 2010).
[4] World Bank. 2004. Sustaining forests: a development strategy. World Bank, Washington, DC.
[5] World Bank. 2004. Sustaining forests.
[6] World Bank. 2004. Sustaining forests.
[7] http://www.cifor.cgiar.org/pen/_ref/home/index.htm.
[8] Costanza, R. et al. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253–260.

and trees provide a range of other, perhaps less tangible but no less important, values to human society.[9]

Forests underpin cultures across the world as the ecological milieu in which so many societies have evolved. They provide a place and source for spiritual comfort and relief for many people, and their biodiversity and recreational worth are widely recognized. Growing numbers of people from across the world, both rich and poor, visit forests each year, so much so that some natural reserves suffer from severe overuse. It is not surprising then that 97 of the 180 Natural World Heritage Sites listed by UNESCO are in forested areas.[10]

There is hope if we act fast. In some areas, such as China, afforestation has finally begun to increase[11] and reverse local historical trends. Despite continuing deforestation, forests and trees still cover more than 30% of the global land area and contain 80% of terrestrial biodiversity—much of which is outside protected area systems.[12] There are more than 60,000 tree species, many still undescribed, thousands of which are of critical importance to the diets, medicines, shelter, fuel and incomes of the world's poor. Furthermore, the newly appreciated role of forests in climate change adaptation and mitigation strategies promises new sources of funding and political will to maintain and enhance existing assets.

Nearly half of the world's agricultural lands have at least 10% tree cover (see Figure 1.2). In dry areas, trees provide essential fodder and non-timber forest products, and contribute significantly to revenues of women-led households. They facilitate water infiltration, soil conservation and nutrient cycling. Fuelwood from trees accounts for 10% of total primary energy, equivalent to 1.6 billion m^3 of wood. In Africa, more than 90% of wood removals from forests and woodlands are for fuel. Even at a modest value of US$50 per m^3, this equates to an annual value of more than US$80 billion, much of this accruing to poor people.[13] The relationship between forests, agroforestry, agriculture and poverty are elaborated further in Box 1.1.

[9] Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: A framework for assessment. Island Press, Washington, DC.
[10] UN Educational, Scientific and Cultural Organization World Heritage List. http://whc.unesco.org/en/list (1 September 2010).
[11] FAO. 2010. Global forest resources assessment 2010: key findings. FAO, Rome.
[12] Chape, S. et al. 2005. Measuring the extent and effectiveness of protected areas as an indicator of meeting global biodiversity targets. Philosophical Transactions Royal Society (B) 360: 443–455.
[13] Kanninen, M. et al. 2007. Do trees grow on money? The implications of deforestation research for policies to promote REDD. CIFOR, Bogor, Indonesia.

Figure 1.2 Global forest cover and percentage tree cover on farms

Source: Composite of FAO's 2005 Global Forest Resources Assessment and data from the World Agroforestry Centre. Zomer, R.J. et al. 2009. Trees on farm: analysis of global extent and geographical patterns of agroforestry. ICRAF Working Paper No 89. World Agroforestry Centre, Nairobi

Shifting trends in forests, trees and biodiversity will not be easy, and targeted research and collection and dissemination of existing knowledge will be critical. Research centers (including those taking part in this program), NGOs, development agencies, National Agricultural Research Systems (NARS) and their partners have been targeting the improved management of forest and agroforestry resources for decades. However, despite notable progress on the ground, these efforts have proved insufficient to reverse these seemingly unstoppable trends. What is needed now is a more strategic and collaborative approach to research—to how it is designed and conducted, the partners that are engaged and the speed and methods by which knowledge is shared.

Box 1.1 Agriculture, agroforestry and poverty

The crucial role of agriculture in tackling poverty, food insecurity and environmental degradation was strongly highlighted by three influential reports during the past decade, namely: The World Development Report,[1] International Assessment of Agricultural Science and Technology for Development[2] and The Millennium Ecosystem Assessment.[3] Over the past 50 years, humanity has changed ecosystems more rapidly and more extensively than in any similar period of time in history. The changes were largely deliberate to satisfy growing demands for food, settlements, fresh water, fiber and energy. Essentially, human beings have been living beyond their natural capital means with drastic consequences for forests and trees.

Many no longer consider agriculture and forestry to be mutually exclusive land use activities. Recognition of the role of trees on farms in meeting the tree needs of rural communities, in generating income and in stabilizing land productivity has followed better characterization of conditions encountered by resource-poor farmers. As such, there is no discrete interface between agricultural fields and forests, but rather a blurred edge at which poverty commonly abounds. Poverty, in simplest terms, restricts choice and options for development. This leads to short-term perspectives in the use and management of natural resources, including (agro) forestry genetic resources.

Each of the aforementioned publications recognizes that diversification of agricultural enterprises and practices is needed in the developing world to avoid problems escalating. The prospect of more trees on farms, or agroforestry, being able to provide goods and services to satisfy household and market demands is repeatedly raised. The Second World Congress on Agroforestry[4] further highlighted the opportunities and benefits of rural communities being able to grow their own fruit, timber, medicine, energy, oil, fodder and fertilizer trees on their own farms. The IAASTD refers to this as multifunctional agriculture.

Tree products were at one time all harvested from the wild. However, forest area decline, overextraction and increasing demand have either exhausted this opportunity, put unsustainable pressure on wild stands and threatened their integrity, or prompted a need to balance wild-harvested products with cultivated tree products. Tree products from natural forests and woodlands still comprise an important part of the income and livelihood source for hundreds of millions of resource-poor people, and need not be replaced but rather complemented with cultivated tree products on farms. Currently, these are valued as contributing US$18.5 billion in revenue for gatherers, although this is widely recognized as an underestimate.[5]

References:

[1] World Bank. 2008. World development report 2008. World Bank, Washington DC.
[2] IAASTD. 2008. Agriculture at a crossroads: the synthesis report. International Assessment of Agricultural Knowledge, Science and Technology for Development, Washington, DC. www.agassessment.org/
[3] Millennium Ecosystem Assessment. 2005. Ecosystems and human well-being: synthesis. Island Press, Washington, DC. 155p.
[4] World Agroforestry Centre. 2009. Second World Congress on Agroforestry, August 2009. Congress highlights. World Agroforestry Centre, Nairobi. 38p.
[5] FAO. 2010. Global forest resources assessment 2010: key findings. FAO, Rome. www.fao.org/forestry/fra/fra2010/en (1 September 2010).

1.1.2. Recognizing the drivers

The greatest threats to forests continue to come from agricultural expansion and overexploitation for timber and fuel to meet local consumption and satisfy global demand.[14] Unsustainable logging, typically starting with the removal of the most valuable tree species, is frequently the first stage of the process. This is often followed by fire and/or colonization, ultimately ending in conversion to other uses or the abandonment of cleared lands in a highly degraded state. Other drivers include infrastructure development such as roads, dams, mining and urbanization. From local to global scales, markets have been characterized by a persistent

[14] For a summary of the literature on drivers of deforestation, see Kanninen et al. 2007. Do trees grow on money? The implications of deforestation research for policies to promote REDD. CIFOR, Bogor, Indonesia.

undervaluation of forest and tree resources. Many forest and land use policy issues are now shaped by a patchwork of institutions that differ in character, constituencies, spatial scope and subject matter.

Improvements in multiple levels of forest governance are essential if national governments are to develop policies to address the underlying causes of deforestation and degradation, and attract climate change-related investments as viable alternatives to competing land use demands for food, fiber and biofuels.[15] Information is lacking on the evolving relationships between established bureaucracies and new and emerging institutions associated with decentralization reforms. International initiatives to control trade in illegal timber and national anti-corruption efforts further complicate forest policy and need to be analyzed for their effectiveness. More research is also needed on the growing role of communities and market actors associated with the commoditization of forest products and services (including carbon).

There is a chronic lack of reliable data on status and trends in forest and tree resources, appreciation of traditional knowledge and the role of women, and the effective application of these to improve policy, governance and practice. Forest research and management in many parts of the world have focused on industrial forestry, and training has often concentrated on building associated technical skills. Lessons learned from community forestry with potential benefits for the poor and disadvantaged need to be shared across countries, regions and continents. Successful lessons from some socially and environmentally responsible commercial logging concerns have likewise been overlooked. In addition, forest genetic resources work has concentrated on a narrow range of industrial timber species.

At the same time, most of the people who live in and around forests are farmers, typically the key managers of trees on the scale of multifunctional landscapes. However, rigid historical divisions remain between “forestry” and “agriculture” in developing and availing improved tree germplasm, in supporting improved management practices, and in governing the planting, management and harvesting of trees and forests.

Many factors contribute to these failures. Some research has simply not been appropriately targeted or relevant. Research on the small-scale systems important to the world’s poor has often been overlooked because its potential beneficiaries lack political weight or their systems are considered uninteresting to industry or governments. Finally, to be effective, research needs to address a range of issues simultaneously, and link to development and government institutions for impact.

1.1.3. Call for a new approach

In response to the need for a new research approach to these problems, four CGIAR centers propose *CGIAR Research Program 6: Forests, Trees and Agroforestry: Livelihoods, Landscapes and Governance* (CRP6) as an integrated global research initiative focused on enhancing the management and use of forests, agroforestry and tree genetic resources across the landscape, from forests to farms to plantations. The program will convene expertise across the CGIAR system, and will partner broadly with relevant research and practitioner organizations around the world. CRP6 will fit strategically into a portfolio of CRPs currently being developed by the CGIAR Consortium; Annex 3 describes how CRP6 will optimize coordination with research to be conducted under other relevant CRPs.

[15] Agrawal, A. et al. 2008. Changing governance of the world’s forests. Science 320: 1460–1462.

The overarching challenge for this program will be how to enhance livelihoods through forestry, agroforestry and other uses of forest resources while sustaining environmental services and resource resilience. By addressing issues that cross the boundary between small-scale agriculture and forestry, the program will:

- encourage improved forest and agroforestry management practices by smallholders and increase the synergies between them;
- increase the use of sustainable forest management strategies to better conserve tree genetic resources and biodiversity in forest habitats;
- support the development and adoption of more effective and equitable land use policies for conserving ecosystem services at the landscape scale;
- magnify the contribution of forests, trees and agroforestry to enable society to mitigate and adapt to climate change; and
- promote more equitable and environmentally sound outcomes from forest-related trade and investment.

In addition, by systematically incorporating attention to gender, tenure and broader issues of governance, CRP6 will support more transparent, equitable and accountable approaches to the management of forest and tree resources.

CRP6 proponents aspire to play a leading role in providing the broader development and conservation community with impact-oriented research of relevance to forests and trees and the people who depend on them.

The proponents of CRP6 are confident that the research strategy described below adds significant value beyond the summation of current center programs. In particular, the proposed co-location of selected research efforts at sentinel landscapes, the sharing of research data with partners, the organization of cross-center Component Implementation Teams, and the development of new partnerships all provide opportunities for synergy and the avoidance of duplication.

1.2. Conceptual framework

Forests, woodlands and agroforestry systems around the world are extraordinarily diverse in species composition, structure and ecological functionality. Forests occur under varying geographic, edaphic and climate regimes ranging from the boreal regions to the tropics. Numerous classification schemes have been used over the years to categorize global forest types. For instance, a recent classification scheme by the WWF identified 826 terrestrial ecoregions[16] around the world, of which some 60% (n=495) were identified as forests (see Figure 1.3) and a further 8% (n=64) as woodlands.

Trees, however, are not limited to forests and scrublands; they are an important element in many other systems including agricultural landscapes, grasslands, steppes and deserts. This ecological diversity, along with the considerable cultural and socioeconomic variation among the people that live in and around forests or otherwise depend on forests and agroforestry, makes their management and use complex, requiring a broad diversity of research strategies.

[16] WWF defines ecoregions as relatively large units of land or water containing a distinct assemblage of natural communities sharing a large majority of species, dynamics and environmental conditions. http://www.world-wildlife.org/science/ecoregions/item1847.html

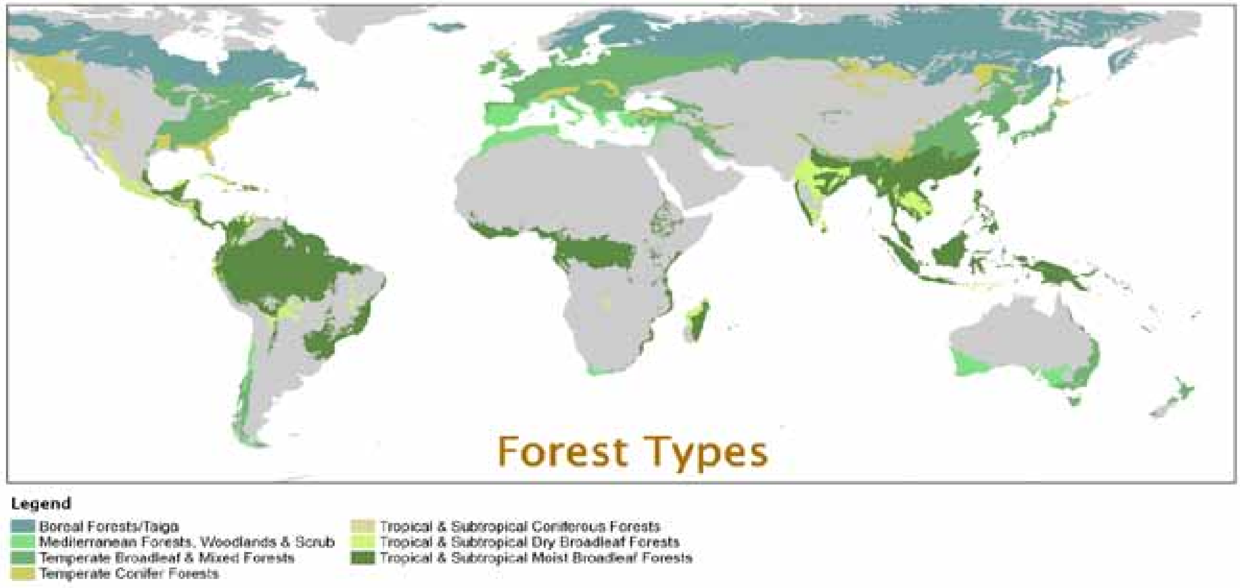


Figure 1.3 Major global forest types. We emphasize that large regions of open woodlands and treed savannas, in which trees are important ecosystem elements, exist outside areas defined as forests.

Source: Simplified and derived from WWF, Terrestrial ecoregions, http://wwf.panda.org/about_our_earth/ecoregions/about/habitat_types/selecting_terrestrial_ecoregions/ (3 February 2011)

Historically, forested countries have experienced phases of decreasing and then increasing forest area, with changes in both type and amount of tree cover in landscapes, as illustrated in Figure 1.4. The progress of a country or region along this **forest and land use transition curve** has tended to track demographic change and economic development.[17] Depending on stakeholder perspectives, changes can imply environmental degradation or improvement. However, various trajectories along the curve can lead to suboptimal outcomes for rural communities and societal resilience with tree cover loss leading to deficits in forest-based livelihoods and the provision of environmental services. The underlying cause of such suboptimal outcomes is, overwhelmingly, a deficit in governance.

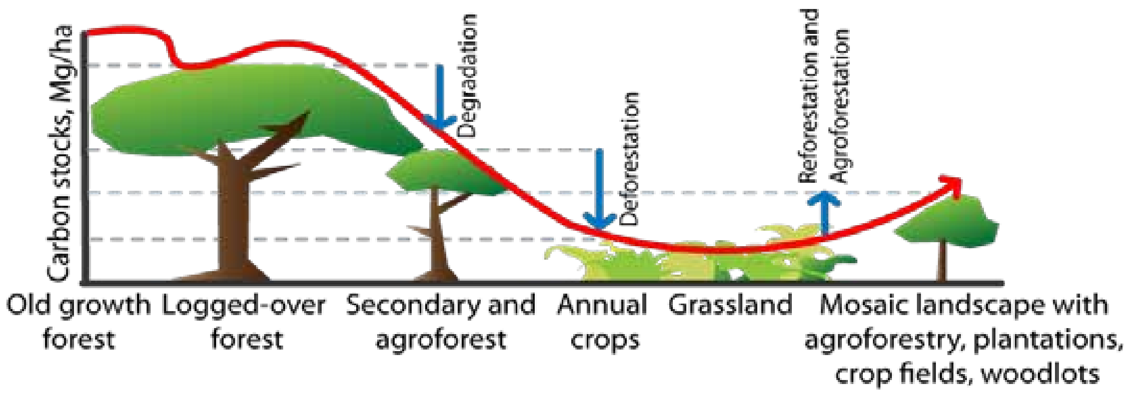


Figure 1.4 Forest and land use transition curve

[17] See Mather, A.S. 1992. The forest transition. Area 24: 367–379; Lambin, E.F. et al. 2001. The causes of land-use and land-cover change: moving beyond the myths. Global Environmental Change 11: 261–269.

The forest cover transition model provides a useful organizing framework for CRP6 because common problems and research needs emerge at similar points along the transition curve. For example, systems in the initial stages of the curve (typically referred to as old growth or climax or pristine forest) are generally in relatively remote areas, with the forest claimed by the state for industrial forestry or for biodiversity conservation, but often contested by other claimants. Local production systems routinely involve harvesting of, and governing access to, multiple products for both subsistence and commercial use.[18] Resource management may be compromised by open-access problems, and local people are often politically and socially marginalized.

Research findings—often disseminated by advocacy-oriented partners—can empower individuals and communities. They can also guide national governments and project donors (such as conservation and development agencies) to modify policies and interventions to encourage better resource management, biodiversity conservation and improved livelihoods. There are also opportunities for innovative institutional arrangements to support comanagement that better engages local stakeholders, creates opportunities for creating and capturing value and conserves biodiversity.[19]

Further along the transition curve, under increasingly intensive agroforestry/agricultural management, farmers may have more secure rights over land, but policies affecting tree tenure, trade, credit, infrastructure and agricultural incentives define the prospects and constraints for improving resource use. These farming systems present opportunities for more intensive planting and use of tree products for food, feed and other commodities. They also provide scope for building small enterprises, backed by associated research and policy, to support improved production, management and postharvest processing and marketing—and ultimately enhance benefits for the poor and disadvantaged. In such landscapes, the conservation and maintenance of environmental services and unique biodiversity present particular challenges. Their protection requires specific policy, governance solutions and incentives.[20]

Although there are distinctive sets of issues at different points along the curve (i.e., in different landscapes), some drivers and challenges cut across all landscapes. Among these are climate change, consequences for adaptation and mitigation and the need for better integration of development and conservation objectives in all types of landscapes where people live. Hence, the conceptual challenge for CRP6 research is to tackle the more pervasive challenges while at the same time developing a meaningful depth of research in critical landscapes to generate outcomes at both global and landscape levels. Thus, there will be a focus on identifying points along the transition curve that lend themselves to coordinated, global comparative research and knowledge sharing.

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[18] Laird, S.A. et al. 2010. Wild product governance: finding policies that work for non-timber forest products. Earthscan, London; Sunderlin, W.D. et al. 2005. Livelihoods, forests and conservation in developing countries: an overview. World Development 33: 1383–1402.

[19] Ancrenaz, M. et al. 2007. The costs of exclusion: recognizing a role for local communities in biodiversity conservation. Public Library of Science Biology (11): e289. doi: 10.1371/journal.pbio.0050289; Barrett, C.B. et al. 2005. Institutional arrangements for rural poverty reduction and resource conservation. World Development 33(2): 193–197.

[20] Barrett, C.B. et al. 2006. The complex links between governance and biodiversity. Conservation Biology 20: 1358–1366. doi: 10.1111/j.1523-1739.2006.00521.x; Colfer, C. and Pfund, J.L. (eds). 2010. Collaborative governance of tropical landscapes. Earthscan, London.

The proponent centers bring experience and partner networks that engage with the range of social, economic and biophysical systems along the curve, which differ from country to country. A key innovation of CRP6 is in combining the experience of the four CGIAR centers (whose research strengths differ along the curve), plus their broad network of partners (e.g., Advanced Research Institutes (ARIs), NARS and others), to provide expertise and coordinate global and landscape-level research to generate outcomes and impacts spanning the entire forest transition curve.

1.3. The challenges

1.3.1. Sustaining livelihoods

An estimated 1.6 billion people depend in part on forests for their livelihoods, and 350 million people live within or adjacent to dense forests, depending on them to a high degree for subsistence and income.[21] A further 2.5 billion people eke out a subsistence living on small farms that were once forests. Many are poor and depend on forests and agroforestry landscapes as a primary source of income. As Figure 1.5 shows, there is broad concordance between areas of forests and poverty, particularly in the tropics. However, the relationship between forest cover and poverty is complex, and conversion of forests to other land uses can be associated with either livelihood improvement or impoverishment, depending on a range of ecological, economic and institutional factors.[22]

Forest-based and agroforestry activities in developing countries provide some 30 million jobs in the informal sector,[23] as well as 13–35% of all rural non-farm employment.[24] Developing countries produce US$30–40 billion worth of timber and processed wood products each year, although only a small portion of this currently benefits poor households.[25] Forests and agroforestry also offer important subsistence contributions to the well-being of the poor and disadvantaged. The World Bank estimates that 90% of the 1.2 billion people living in extreme poverty depend on tree resources for part of their livelihood.[26] The World Health Organization estimates that 2 billion people rely on traditional medicines for their health, most of which come from forests.[27]

[21] World Bank. 2004. Sustaining forests: a development strategy. World Bank, Washington, DC.
[22] Chomitz, K. et al. 2006. At loggerheads? Agricultural expansion and poverty reduction in tropical forests. World Bank Policy Research Report. http://go.worldbank.org/TKGHE4IA30.
[23] Scherr, S. et al. 2004. A new agenda for forest conservation and poverty reduction: making markets work for low-income producers. Forest Trends, Washington, DC.
[24] Phuong, N.T. and Duong, N.H. 2008. The role of non-timber forest products in livelihood strategies and household economics in a remote upland village in the upper Ca river basin, Nghe An, Vietnam. Journal of Science and Development Feb.: 88–98 http://www.hua.edu.vn/tc_khktnn/Upload%5C652008-bai%2011.pdf; World Bank. 2003. World development report 2003. World Bank, Washington, DC.
[25] Sunderlin, W.D. et al. 2005. Livelihoods, forests and conservation in developing countries: an overview. World Development 33: 1383–1402.
[26] World Bank. 2004. Sustaining forests: a development strategy. World Bank, Washington, DC.
[27] World Health Organization http://www.who.int/mediacentre/factsheets/fs134/en/ (1 September 2010).

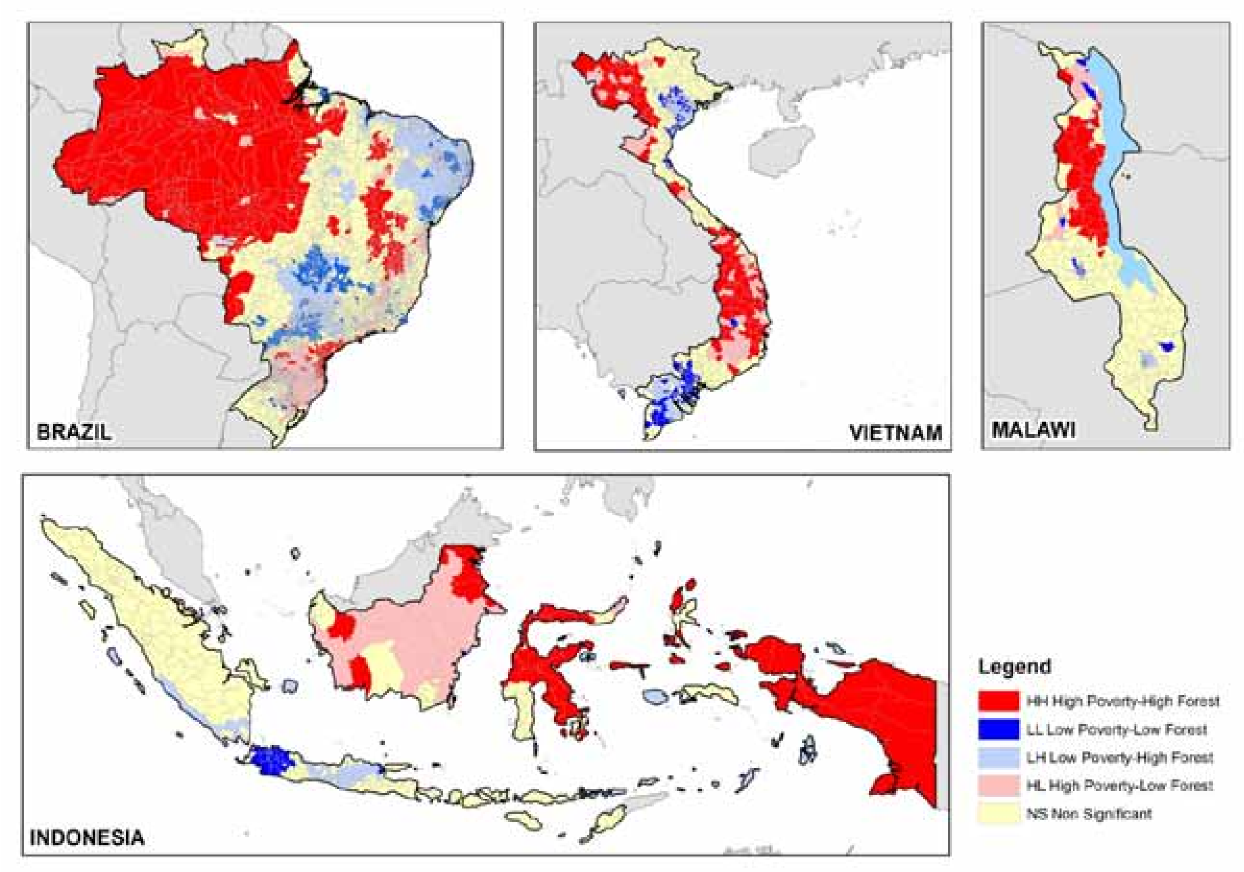

Figure 1.5 Overlap of forests (high and low quality) and poverty (high and low) in four sample countries: Brazil, Indonesia, Malawi and Vietnam

Source: Adapted from Sunderlin, W.D. et al. 2008. Why forests are important for global poverty alleviation: a spatial explanation. Ecology and Society 13(2):24 http://www.ecologyandsociety.org/vol13/iss2/art24/

At the same time, there is rising global demand for the products that smallholder forestry and trees on farms can provide. With rising prices for high-value species, such as teak and mahogany, the potential returns from small-scale forestry are becoming an attractive option for poor farmers—a trend likely to continue as sources of wood from natural forests decline. In addition, there is rapid growth in domestic markets for products such as fuelwood and charcoal, poles, construction timber, low-cost furniture, medicinal plants, fruit and other non-timber forest products. Further, new payments for environmental services (PES) instruments —not least those associated with REDD+—offer the potential of new forest and tree-based revenue streams for rural communities.

A particular challenge is that in many parts of the world, and for many of the systems and species most important to the poor, there is a lack of knowledge on appropriate forest and tree resource management techniques—sometimes made worse by a lack of appreciation for traditional knowledge and experience. Equally problematic has been the widespread failure to implement policies, solutions and innovations based on information that has already been generated by decades of forestry, agroforestry and genetic research.

1.3.2. Improving the governance of forests and trees

Many of the world's poorest and politically marginalized communities are dependent on forests and trees for their livelihoods. Due to opportunities for corruption and lack of transparency, governance of forest resources has often been characterized by repressive government actions to assert control over forests and trees. Forest institutions have traditionally been more oriented toward policing and revenue collection than toward providing support to rural communities. Thus, changes in forest governance pose both risks of harm and opportunities for improvement in the rights and welfare of indigenous and other forest-dependent communities.[28]

Despite the importance of forests and trees to rural communities, their governance has tended to be dominated by the interests of political and economic elites. Access to forest resources and regulations governing their exploitation, transport and marketing are biased against rural producers and in favor of commercial interests;[29] smallholders bringing charcoal, timber or other forest products to market must often carry permits and/or pay bribes not required for the sale of agricultural products. Forest-related law enforcement activities have tended to target small-scale illegal logging rather than large-scale forest crime.[30] Furthermore, the subsidization of inappropriate forest conversion has often been driven by special interests and corrupt practices.[31]

One of the most significant governance failures constraining the sustainable management of forests and trees is the lack of clarity over resource rights. In many tropical countries, unclear forest tenure is a legacy of colonial era management regimes, and state claims are typically contested by indigenous peoples and other communities who live in and around forests. Where tenure is unclear, "open access" leads to overuse of forest resources and uncontrolled forest conversion, and is projected to be a key barrier to the implementation of REDD+.[32] Individually or collectively, these and other factors contribute to declines in forest and tree cover and to the loss of tree genetic resources and biodiversity.

Tenure—access, control and rights over forests, woodlands, trees, and farmland—is of critical importance to communities and households. Forest and tree tenure is, however, often unclear, contested and, in many cases, of insufficient security to induce improved investment and management of trees and forests by communities and households or to improve incomes and enhance livelihoods. Some particular problems include (1) the continued dominance of state ownership of forests, (2) increasing contestation between statutory and customary authorities, (3) conflicts within and between communities over access to trees and forests, (4) weak participation of forest-dependent communities and inferior rights to trees and forests of women and poorer resource users, (5) limited knowledge and understanding of the implications of ongoing tenure reforms and (6) increasing commoditization of the goods and

[28] Seymour, F. 2010. Forest, climate change and human rights: managing risks and trade-offs. In: Humphreys, S. (ed.) Human rights and climate change, 207–237. Cambridge University Press, Cambridge, UK.
[29] Larson, A.M. and Ribot, J.C. 2007. The poverty of forestry policy: double standards on an uneven playing field. Sustainability Science 2(2): 189–204.
[30] Colchester, M. 2006. Forest peoples, customary use and state forests: the case for reform. Paper to 11th Biennial Congress of the International Association for the Study of Common Property. Bali, Indonesia, 19–22 June.
[31] Barr, C. et al. 2010. Financial governance and Indonesia's Reforestation Fund during the Soeharto and post-Soeharto periods, 1989–2009: a political economic analysis of lessons for REDD+. Occasional paper 52. CIFOR, Bogor, Indonesia.
[32] Börner, J. and Wunder, S. 2009. Direct conservation payments in the Brazilian Amazon: scope and equity implications. Ecological Economics 69: 1272–1282.

services of forests and trees. Furthermore, it remains unclear how the aforementioned issues are influenced by, and interact with, governance processes at national, regional and global levels. Choices of property systems and land tenure will be central for new policies and institutional arrangements that are intended to sustain, enhance or regenerate forests, sequester carbon, conserve biodiversity and contribute positively to rural livelihoods.[33] CRP6 will build upon the existing body of diagnostic work and test options that lead to positive institutional and policy reforms in forest and tree tenure at multiple scales.

While most forest areas in the tropics continue to be claimed by governments—regardless of whether they are capable of exercising effective management—private and community-based management of forests is increasing modestly.[34] However, even where rights to forest resources are guaranteed on paper, communities have had difficulty defending those rights and translating them into expected economic benefits.[35] Furthermore, although decentralization is one of three current forest governance trends—the other two being concession-based timber extraction and certification of forest products[36]—governments have proven reluctant to meaningfully devolve forest management authority to local communities.[37] Such devolution, however, is associated with improved forest condition.[38]

1.3.3. Integrating conservation and development in multifunctioning landscapes

Integrated landscape and ecosystem approaches provide the best prospects for reconciling the often-conflicting goals of poverty alleviation and forest conservation. Conservation efforts need to optimize the management of protected areas and recognize the interests of local people. In addition, advances in the management of production forests are needed to better conserve biodiversity and more sustainably harvest timber in ways that also benefit the poor. These efforts need to be supported by further research (a key role for CRP6), improved governance, policy change, capacity building and market incentives.

However, much of the world's biodiversity occurs outside protected areas in fragmented landscape mosaics. In developing countries, the nonmarketable values present in these mosaics are frequently accorded little priority while the sustainable productive potentials of different land areas are often underestimated during land use planning. The result is suboptimal outcomes, including excessive loss of environmental values and biodiversity, and reduced agricultural and forest productivity. Optimizing sustainable use and conservation requires explicit management of the inherent trade-offs between the two through effective land use allocation practices. Other approaches include clarifying access and management rights and responsibilities over land and natural resources, and innovative rewards and incentive mechanisms such as PES.

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[33] Ostrom, E. and Nagendra, H. 2006. Insights on linking forests, trees and people from the air, on the ground, and in the laboratory. Proceedings of the National Academy of Sciences 103(51): 19224–19231.
[34] Sunderlin, W. et al. 2008. From exclusion to ownership? Challenges and opportunities in advancing forest tenure reform. Rights and Resources Initiative, Washington, DC.
[35] Larson, A. et al. 2010. New rights for forest-based communities? Understanding processes of forest tenure reform. International Forestry Review 12(1): 78–96.
[36] Agrawal, A. et al. 2008. Changing governance of the world's forests. Science 320: 1460–1462.
[37] Menzies, N. 2007. Our forest, your ecosystem, their timber. Communities, conservation, and the state in community-based forest management. Columbia University Press, New York.
[38] Wollenberg, E. et al. 2007. Fourteen years of monitoring community-managed forests: learning from IFRI's experience. International Forestry Review 9(2): 670–684.

1.3.4. Mitigating and adapting to climate change

Tropical deforestation is a significant source of carbon emissions and an active contributor to global warming. Deforestation and degradation are estimated to contribute 12–18% of total emissions per year.[39] Actions to reduce these in developing countries (e.g., through REDD+) have the potential to mitigate climate change, with co-benefits including biodiversity conservation, improved livelihoods and incentives for reforestation.

Global climate change is predicted to undermine economic development and efforts to achieve the Millennium Development Goals (MDGs) in many countries.[40] Forests, trees, agriculture, natural resources and people's livelihoods are all adversely affected by climate change.[41] In addition to gradual changes in precipitation and global warming, the scale and frequency of events such as hurricanes, droughts and fires as well as outbreaks of pests and diseases are likely to increase; indeed, they may already be increasing. Weak institutional, political and economic conditions limit the adaptive capacity of developing countries, threatening livelihoods and making their populations vulnerable to climate change.

Unfortunately, forests have not been considered in most adaptation policies to date. The sectors prioritized (e.g., water, energy or health) are developing strategies without adequately considering linkages with forests, trees and agroforestry. Forests should be incorporated for two reasons: (1) their own vulnerability and (2) their potential to help increase society's resilience to climate change.[42] The poor are particularly dependent on forest ecosystem services (e.g., water for drinking, agriculture, hydropower and pollinators) and are accordingly at greater risk from the potential impacts of climate change.[43]

[39] Gullison, R.E. et al. 2007. Tropical forests and climate change. Science 316: 985–986.
[40] Brooks, N. et al. 2009. Development futures in the context of climate change: challenging the present and learning from the past. Development Policy Review 27: 741–765.
[41] 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.
[42] Locatelli, B. et al. 2008. Facing an uncertain future: how forest and people can adapt to climate change. CIFOR, Bogor, Indonesia.
[43] Osman-Elasha, B. et al. 2009. Future socio-economic impacts and vulnerabilities. In: Seppälä, R. et al. (eds) Adaptation of forests and people to climate change – A global assessment report, 101–122. International Union of Forest Research Organizations, Helsinki, Finland.

1.4. Vision of success

We envisage CRP6 to be the leading global comparative research initiative focused on forestry, agroforestry and tree diversity across the developing world as a vehicle for delivering on relevant aspects of the CGIAR’s SRF. Our overall aims are to:

- create and accelerate sustainable increases in the productivity and production of healthy food by and for the poor;
- conserve, enhance and sustainably use natural resources and biodiversity to improve the livelihoods of the poor in response to climate change and other factors; and
- promote policy and institutional change that will stimulate agricultural growth and equity to benefit the poor, especially rural women and other disadvantaged groups.

The vision of the CGIAR is “to reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high-quality international agricultural research, partnership and leadership”. CRP6 scientists will contribute to this vision with the conviction that livelihoods of the poor, ecosystem services and biodiversity conservation in rural landscapes will be enhanced by better management and governance of forests and trees through strong and committed partnership for scientific entrepreneurship, development engagement and advocacy.

CRP6 centers and their partners will conduct research across the forest transition curve and develop key understanding and knowledge through five distinct but closely interlinked components that will:

1. enhance the contribution of forests, trees and agroforestry to production and incomes of forest-dependent communities and smallholders;
2. conserve biodiversity, including tree genetic diversity, through sustainable management and conservation of forests and trees;
3. maintain or enhance environmental goods and services from forests, trees and agroforestry in multifunctional and dynamic landscapes;
4. reduce emissions of greenhouse gases and enhance carbon stocks through better management of forest- and tree-based sources and increased local and societal resilience through forest-, agroforestry- and tree-based adaptation measures; and
5. promote the positive impacts and reduce the negative impacts of global trade and investment as drivers of landscape change affecting forestlands, agroforestry areas, trees and the well-being of local people.

Each of the five components described above is designed to deliver distinct and reinforcing outcomes to generate an integrated strategy for achieving multiple impacts. It is our strongly held belief that each component is essential to the overall strategy for impact. As will become clear in the pages that follow, the removal of any one component would lead to the neglect of an element of the landscape and/or of key impact pathways for change. For example, Component 1’s relative emphasis on trees on farms managed by smallholders provides an essential link between forests and agricultural landscapes and an important vehicle for improving rural livelihoods. Component 5—focused on trade and investment—addresses some of the most powerful forces driving land use change, posing both threats and opportunities for forest-dependent communities. A strategy lacking any one of the five components would thus be incomplete. Accordingly, should sufficient resources not be available to undertake all of the activities described in this proposal, we will scale down the level of ambition across the five components—e.g., work in fewer countries, or phase the initiation of new research themes within each component—rather than choose among them.

Through carefully articulated impact pathways, our research will be oriented to produce measurable and significant outcomes and impacts (see Box 1.2)—globally, regionally and locally. CRP6 will conduct research across landscapes in different climatic, ecological, social and economic contexts to build understanding of how such factors influence opportunities, challenges and approaches for constructive engagement, and identify interventions that will best meet the needs of stakeholders and environmental resilience.

Box 1.2 Impacts after 10 years

After 10 years, research under CRP6 is expected to contribute to the following impacts.

Research under CRP6 will target 46% of global forest cover, 1.3 billion hectares of closed forests and 500 million hectares of open and fragmented forests, and contribute to:

- between 0.5 and 1.7 million hectares of forest being saved annually from deforestation;
- ecologically and socially sustainable production and management practices being adopted in 9.3–27.8 million hectares of managed forests in target regions; and
- carbon emissions being reduced by between 0.16 and 0.68 Gt CO_2 yr^{-1}.

Research under CRP6 will target approximately 500 million people living in or close to forests in Southeast Asia, Africa and Latin America, and will contribute to:

- enhanced production and management options benefiting at least 3 million producers and traders and their families;
- at least 2 million producers benefiting from increased conservation efforts related to tree diversity;
- enhanced production and management technologies raising tree, land and labor productivity of target groups by at least 50%;
- incomes from forest and agroforestry products for target households being at least doubled;
- the accelerated availability of funding for climate adaptation programs benefiting an additional 60 million people.
- increased efficiency of REDD+ resulting in an increased supply of REDD+ credits worth between US$108 million and US$2695 million per year; and
- where women have poor access to benefits provided through forests and trees, significantly improving that access, with our ultimate aim being to ensure equal access to benefits by both genders.

Source: Annex 5

Priority geographic targets for research will include areas where local people depend on forest and agroforestry resources for their livelihoods, forest areas under severe pressure from other land uses, forest areas with high levels of biodiversity and/or areas projected to be severely affected by climate change. We will particularly target regions where forests and multifunctional landscapes overlap with high incidence of poverty.

In CRP6, we will engage with major policy and development processes and initiatives to help identify the types of scientific outputs that can support the achievement of outcomes and impacts. We will convene leading expertise through existing and new partnerships with advanced and national research institutes, and other scientific organizations. We will further work with forest users and tree growers across genders and other forms of social differentiation to capture traditional knowledge and approaches. We will develop and implement new alliances for communication and knowledge sharing, building on our core research strengths, to leverage changes in policy and practice. Further, through working closely with a range of national- and local-level partners, we will prioritize capacity-strengthening needs (individual and institutional) according to potential for contributing to outcomes and impacts.

1.5. Strategy for impact

Impact strategies will guide CRP6 in its partnerships and collaborative actions, its capacity-strengthening efforts, its communications strategy and tools deployed, and its specific attention to gender. These strategies, tailored to each of the five components, will guide the set of approaches and methods used to move from knowledge to action. The strategies are not fixed over time or uniform for different components and contexts. The strategies themselves must be evaluated to determine if more effective methods can be employed to improve the outcome and impact delivery of the CRP. Indeed, certain elements of the strategies, such as the use of different communication tools, may be formally tested as research questions. Our intention is to go well beyond the achievement of outcomes and impacts, to better understand how and why such outcomes are achieved and how they may be more effectively, efficiently or expeditiously attained.

The CRP6 impact strategy follows a four-step process beginning with outputs as follows (see also Figure 1.6).

1. **Research outputs.** These include publications and associated research data targeted for specific audiences (scientists, practitioners, policymakers, donors and local community members), languages, tools and new media. These outputs hinge on collaboration with key research partners (e.g., ARIs and NARS), forging partnerships with development agents (e.g., governments, civil society organizations, local communities) and making the best use of the diffusion capabilities of knowledge-sharing partners. Outputs also include improved tree varieties and management practices.
2. **Outputs to outcomes**. These typically hinge on planning outputs in discussion with potential users and developing and implementing appropriate knowledge-sharing and dissemination strategies, to ensure knowledge generated by CRP6 reaches policymakers and practitioners in accessible and useable formats. This will require sophisticated approaches (detailed in appropriate sections below).
3. **Development outcomes**. The delivery and implementation of outcomes such as improved policies and practices, adoption and use of new tools, and more favorable market conditions hinge on the existence of strong partnerships, strengthened capacity to demand, absorb, understand and act on knowledge generated, and improved empowerment and governance.

4. **Outcomes to impacts**. As improved policies and management practices alone will not necessarily lead to transformative change, a broad set of enabling conditions must be in place for tangible impacts to ensue. These conditions include robust governance systems, legal and regulatory frameworks, strengthened individual and institutional capacities at multiple scales, enhanced public awareness and ultimately increased commitment and financing for investment needed in natural resources and rural development.

Specifically, CRP6 proponents aim to develop research outputs and influence research and development outcomes that ultimately result in the following social and ecological impacts:

- reduced deforestation and degradation;
- increased net carbon storage;
- conservation and increased use of forest and tree genetic resources;
- increased social and economic benefits from forest and agroforestry goods and services;
- reduced risk for rural livelihoods; and
- enhanced access by women and other disadvantaged groups to benefits at all levels.

For each research component detailed in subsequent sections, we provide a diagram to describe the pathways linking outputs, outcomes and impacts, and illustrative milestones to be used to monitor progress toward achieving the impacts of the research now being initiated.

Figure 1.6 Overall impact pathways

1.6. Innovation

Innovation drives CRP6's design. Our goal is to produce new methods and approaches to deliver the societal change required to better protect forests and biodiversity and to catalyze the increased management of trees in agricultural landscapes—to the ultimate benefit of the poor and disadvantaged. In addition to the need for new research, more strategic use needs to be made of existing scientific and traditional knowledge. This program will connect CGIAR centers with external research and development partners in new ways, breaking down institutional and disciplinary barriers. It will deliver an unprecedented degree of synergy and integration among top scientists, development experts and practitioners to address global, regional and local issues of relevance to forests, trees and the people who depend on them.

Key principles guiding our approach and research design follow.

Sentinel landscapes (see Box 1.3 and Annex 4): As documented in the Stripe Review of Social Sciences in the CGIAR[44] and other recent reports, increasing reliance on restricted funding has driven CGIAR research toward ever-shorter time horizons. The assurance of longer-term funding will enable CRP6 to put in place mechanisms for collecting long-term data sets and generating knowledge from global comparative research, including the establishment of "sentinel landscapes" such as those recommended in the review. We envisage employing a number of such benchmark sites to include permanent sample plots, repeated household surveys and stratified baselines. Research at such long-term socio-ecological research sites (LTSERs)[45] would span disciplines and integrate political, socioeconomic, gender and biophysical sciences.

During the first year of CRP6, a major workshop will be held with key partners to assess the prospects and the viability of establishing and orienting selected research around a set of landscapes that capture the full range of geographic, ecological, socioeconomic and political variation across forests and multifunctional landscapes. We emphasize that the recurrent maintenance costs for a network of sites would be high, and we would only adopt this approach if business planning indicated that long-term funding could be secured.

Integrated research across landscapes and scales: By spanning the forest transition and land cover gradient from relatively undisturbed natural forests to trees in agricultural mosaics, CRP6 will develop an integrated vision of forests, trees and agroforestry at the landscape scale, and of the options they provide to improve livelihoods of the poor and protect the environment. By assessing drivers and impacts of tree cover change from local to global scales, CRP6 will illuminate the trade-offs and synergies between local uses and global demands for forest and agroforestry resources. Recognizing that the sustainability of such landscapes requires finding a balance between forest conservation and competing land and resource uses, CRP6 will help achieve more equitable outcomes by providing a basis for negotiation among groups and across scales.

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[44] CGIAR Science Council. 2009. Stripe review of social sciences in the CGIAR. Science Council Secretariat, Rome. http://www.sciencecouncil.cgiar.org/fileadmin/user_upload/sciencecouncil/Systemwide_and_Ecoregional_Programs/SSSR_for_web.pdf.

[45] Haberl, H. et al. 2006. From LTER to LTSER: conceptualizing the socioeconomic dimension of long-term socioecological research. Ecology and Society 11(2): 13. http://www.ecologyandsociety.org/vol11/iss2/art13/; Besseau, P. et al. 2002. The International Model Forest Network (IMFN): elements of success. The Forestry Chronicle 78(5): 648–654.

Box 1.3 Sentinel landscapes

Assuming sufficient funding is available, a significant portion of the research and development activities in CRP6 will be co-located at a set of sentinel landscapes, providing opportunities for synergies between the five components of CRP6.

To achieve the desired results, we will cooperate with other partners to:

- identify a coherent set of sentinel landscapes for longitudinal (long-term) research where existing data sets and partnerships can be used to monitor the impacts of exogenous and endogenous change at the landscape scale;
- develop and apply field-tested and standardized research protocols to allow global comparative studies of forest transition stages, economic and demographic conditions, and climatic/biophysical determinants of environmental services and livelihood options;
- use participatory forms of action research to improve the general well-being and livelihoods of local people, while maintaining environmental services; and
- implement Negotiation Support Systems (NSS)[1] to facilitate change among multiple stakeholders at local scales.

Reference:

[1] van Noordwijk, M. et al. 2001. Negotiation support models for integrated natural resource management in tropical forest margins. Conservation Ecology 5(2):21. [online] http://www.consecol.org/vol5/iss2/art21

Integrated research across institutions, sectors and disciplines: Research has demonstrated that the key drivers of forest loss originate outside the forestry sector, and that solutions must involve institutions and disciplines beyond ministries of forestry. Equally, agroforestry development has often been stymied by lack of coordination between agriculture and forestry policies and programs. CRP6 will mobilize interdisciplinary research teams and partnerships across sectors to match the complexity of the challenges to be overcome (see Section 3.2). We will also draw on expertise from across the CGIAR and explore opportunities to engage with other CRPs (see Annex 3). These links will provide a window into other sectors and institutions (e.g., ministries of agriculture), which may in some cases be working at cross purposes with CRP6 objectives (e.g., crop production work promoting extensive use of agricultural lands, which could reduce tree cover at the landscape scale, or even inadvertently or intentionally encourage encroachment on forests).

Focus on disadvantaged sectors of society: CRP6 proponents aim to enhance the benefits of forests, agroforestry and tree genetic resources for poor communities and will target a number of disadvantaged groups. Our strategy as it relates to women (detailed in Section 3.1) includes a commitment to disaggregating data by gender wherever possible and appropriate. Other groups that will require specific research attention include indigenous peoples and youth. Further, long under-recognized in research are poor urban and periurban sectors; these often consist of recent migrants from forest areas and multifunctional landscapes that depend on and use forest and agroforestry products. Threats and opportunities for these communities will need further research to inform policies and interventions locally and nationally.

New research horizons: In addition to the planned research strategies described under Components 1 through 5, CRP6 proponents will also be alert to new research needs to ensure that the portfolio is constantly refreshed for relevance to the needs of policymakers and practitioners. Particularly fertile areas for scoping new research initiatives will likely be at the boundaries between CRP6 and other CRPs, including topics such as forests and water (link to CRP5) and forests and health (link to CRP4), to examine, for example, the potential of medicinal trees to contribute to rural health and income.

1.7. Comparative advantage of CGIAR centers in leading this effort

The principal CGIAR centers involved in CRP6—CIFOR, World Agroforestry Centre, Bioversity and CIAT—bring a wealth of knowledge on forests, agroforestry, forest and farm landscape mosaics, and on the people that depend on the resources these systems provide. We will engage a broad partnership of targeted institutions to advance a jointly developed research agenda. Our combined strengths in social and policy research, economics, tree domestication, production systems, ecology and knowledge sharing give us the proven ability to deliver world-class analytical products to our target audiences.

Since their inception, the CGIAR centers have focused on leveraging additional research capacity and influence through networks of partner organizations. These include ARIs that can be engaged with to address specific questions (e.g., climate change modeling), as well as NARS and capacity-building organizations and regional networks. Expanding private sector partnerships for forestry and agroforestry also positions the CGIAR centers to attract new resources and extension vehicles for greater impact.

Our comparative advantage derives from the following factors.

- Brand name: Our names are associated with credible, high-quality analysis, independent thinking, a reputation for tackling difficult and controversial issues, and an ability to reach and convene diverse actors and stakeholders.
- Quality of staff: Our staff come from diverse nationalities and cultures and bring expertise from a wide range of disciplines.
- Partnerships: Across our four centers, we have access to skills and networks of diverse partners operating at local, national, regional and global levels.
- Global mandate, local relevance: Our mandate empowers us to address global, regional, national and local issues and gives us the credibility and legitimacy to engage in international and national forums.
- Grounding in local conditions: We have a track record in undertaking and communicating research that meets the needs of forest- and agroforestry-dependent communities across the tropics.
- Communications strategies: Complementary expertise in the various centers strengthens our abilities to harness different media to target different intermediary and end-users of “classic” research outputs such as peer-reviewed journals.
- Responsiveness: We are able to provide robust scientific and policy advice to government and other stakeholders by building on a broad and long-established knowledge base.
- Experience and track record in global comparative research: This enables us to distinguish patterns and trends relevant for practice and policy at scales from local to global.

1.8. Proposal road map

The proposal that follows begins with a presentation of CRP6's portfolio of the five program components summarized above. These include descriptions of thematic focus, expected objectives and outcomes (over 10 years), geographic priorities, research themes, research methods, approaches to sentinel landscapes, impact pathways, component milestones, the role of partners and prioritization. The succeeding section discusses the three cross-cutting themes of gender, partnerships and capacity strengthening. The three program support sections follow: communications and knowledge sharing; monitoring and evaluation for impact; and program management. The document is concluded by a presentation of the budget and eight annexes.

2. Research Portfolio

The following sections describe the CRP6 research portfolio, comprised of five components:

- Component 1: Smallholder production systems and markets
- Component 2: Management and conservation of forest and tree resources
- Component 3: Landscape management for environmental services, biodiversity conservation and livelihoods
- Component 4: Climate change adaptation and mitigation
- Component 5: Impacts of trade and investment on forests and people

Taken together, these components and their constituent research themes are designed to improve the contribution of forest, tree and agroforestry systems to livelihoods as well as to environmental resilience across the continuum from old-growth forest types, through degraded forest and woodlands to agricultural land, and finally to mosaic landscapes with agroforestry and scattered woodlots. The landscape continuum is an umbrella concept to which all of the outputs from the components may be mapped, as depicted in Figure 2.1. It can assist in conceptualizing both spatial and temporal dimensions of land use change, thus providing a useful guide to the identification of research gaps and a means by which to evaluate the comprehensiveness of our research program.

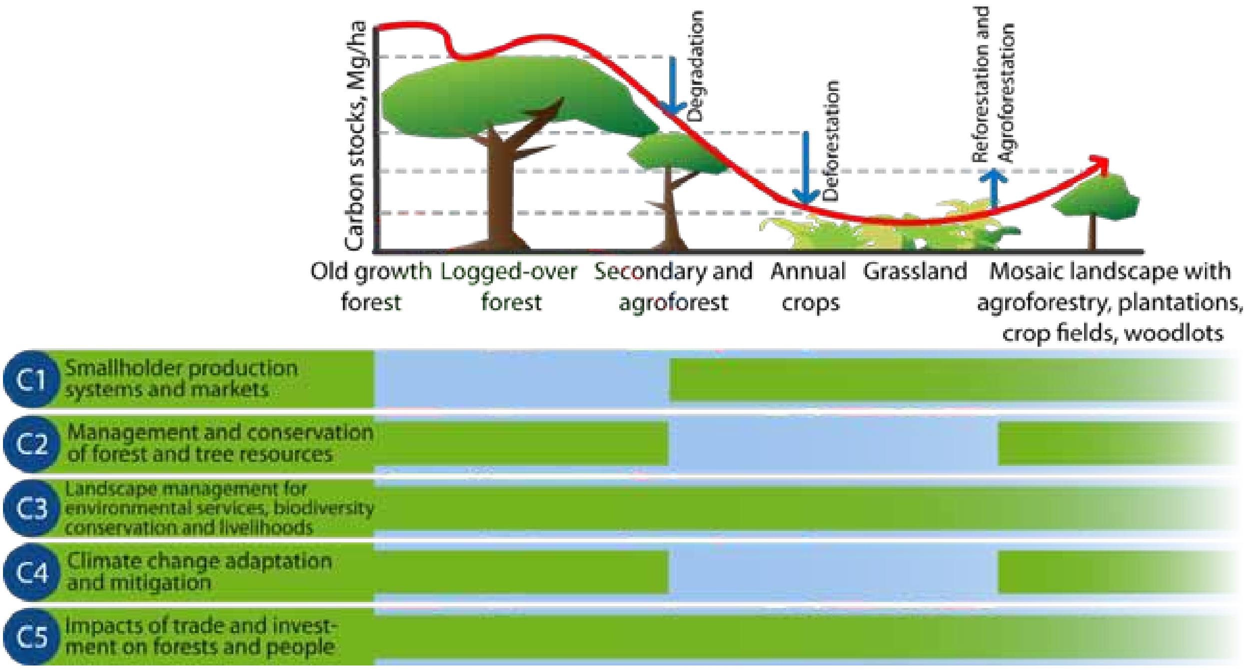


Figure 2.1 CRP6 components along the forest and land use transition curve

The research and associated impact pathways for each component have been constructed so as to most effectively address the needs of particular policy arenas and practitioner communities, with their targets ranging in scale from individual farms to forest ecosystems to global negotiating forums.

- Component 1 focuses on the needs of smallholder producers, with an emphasis on enhancing the productivity of trees on farms (e.g., through domestication of wild species) and improving the access of such smallholders to markets for forest and tree products.
- Component 2 focuses on the needs of forest managers at the level of the forest management unit, with an emphasis on improved technical and governance approaches to conserving forest ecosystems and the genetic resources they contain.
- Component 3 focuses on the needs of landscape-level planners and relevant stakeholders, with an emphasis on mechanisms (such as payments for environmental services or PES) for capturing the value of environmental services and for negotiating trade-offs among competing conservation and development objectives.
- Component 4 focuses on the needs of policymakers and land managers seeking to build forests, trees and agroforestry into climate change adaptation and mitigation strategies.
- Component 5 focuses on needs of policymakers and land managers seeking to ensure that the impacts of globalized trade and investment flows are beneficial to forests and the communities that depend on forests for their livelihoods.

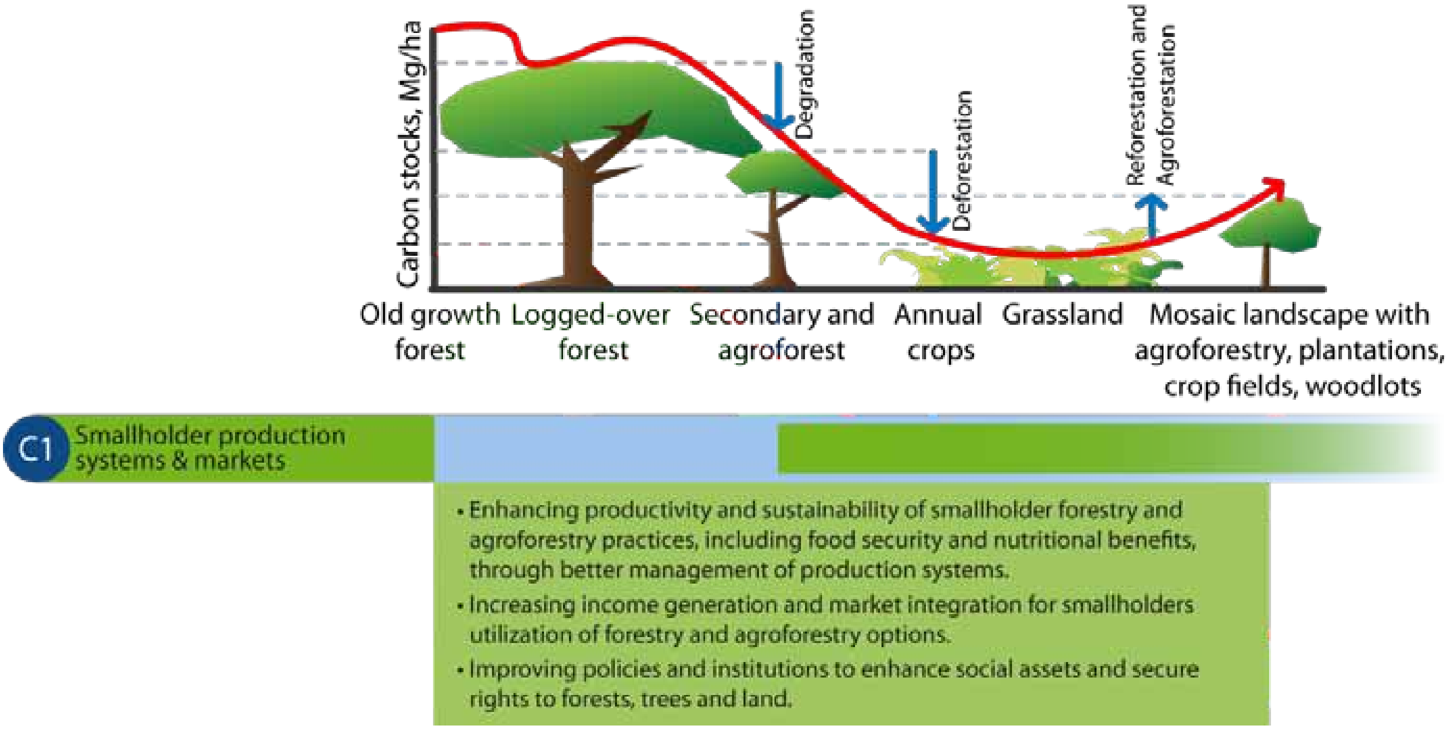
These five components are clearly all interlinked and interdependent. For example, the productivity of smallholder systems addressed in Component 1 and the climate adaptation options addressed in Component 4 both depend on the maintenance of tree genetic diversity addressed in Component 2. Similarly, the global and national policy options for financing forest-related climate activities addressed in Component 4, and the market and regulatory options for conditioning trade and investment flows addressed in Component 5, must articulate with the landscape-level decision-making processes addressed in Component 3. Issues of gender, institutional capacity, tenure and other governance issues cut across the entire research portfolio. Accordingly, the ultimate impacts of CRP6 described in the Introduction will be the joint products of synergistic impact pathways that interweave research from all five components. As a result, the mapping of any particular activity to one or another component is to a certain extent arbitrary and could change over time.

A unifying characteristic across all of the components is that they address the environment–livelihoods nexus. Each component addresses aspects of forest and tree management options that influence livelihoods and environmental quality and resilience. Research under the various components contributes in complementary ways to understanding how and where technical, institutional and policy interventions can improve the functioning of forest and tree systems as a way to reduce poverty while maintaining environmental goods and services.

A second unifying characteristic across all of the components is that they focus on understanding the origins and impacts of the drivers of change that affect the social, economic and biophysical systems of forests and trees that affect human welfare and environmental integrity. Further, all components seek to identify ways in which these “drivers” can be modified and managed to improve livelihoods and sustain or enhance the provision of environmental services. As desirable as win–win solutions are, trade-offs are common, and the need for improved governance mechanisms to arbitrate those trade-offs is a particularly strong cross-cutting focus of CRP6.

One strategy to capture synergies among the components is to focus a significant portion of the research effort on a set of selected representative landscapes. As described in Annex 4, it is intended, funding permitting, that a number of “sentinel landscapes” will be chosen to complement other CGIAR research sites and cover the landscape continuum in different biomes. As much as possible, research questions posed by all five of the CRP6 research components would be addressed at each of the sentinel landscapes. Such an approach is consistent with the CGIAR’s comparative advantage in conducting global comparative research in addition to promoting multidisciplinary learning and synergies.

2.1 Component 1: Smallholder production systems and markets



2.1.1 Introduction

Trees in fields, farming landscapes and forests contribute to human well-being in many ways. Some of their most fundamental contributions are as direct inputs to the livelihoods of resource-poor rural people. This involves interactions between: (1) 1.4 billion hectares of forest;[1] (2) almost a billion hectares of agricultural land with more than 10% tree cover;[2] (3) 65,000 tree species;[3] and (4) some 5 billion people[4] in the developing tropics alone. Despite the tremendous importance of the tree products and environmental services that underpin livelihoods for the rural poor, these products and services remain little understood, poorly managed, barely recognized, inadequately appreciated and underinvested in. This is surprising given that several studies[5] have shown that forest-based production contributes about 20% of the total household income of the poorest people in forested areas, through products that are consumed directly or processed and sold. Trees, if appropriately managed,

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[1] FAO. 2010. Forest resource assessment. FAO, Rome. http://www.fao.org/forestry/fra/en/

[2] Zomer, R.J. et al. 2009. Trees on farm: analysis of global extent and geographical patterns of agroforestry. ICRAF Working Paper No. 89. World Agroforestry Centre, Nairobi.

[3] Simons, A.J. et al. 2005. Agroforestree database: a tree species reference and selection guide. Version 3.0 CD-ROM, World Agroforestry Centre, Nairobi; Mabberley, D.J. 2008. A portable dictionary of plants, their classifications, and uses. 3rd Edition. Cambridge University Press, Cambridge, UK.

[4] WRI. 2007. Earthtrends searchable database. World Resources Institute, Washington, DC. http://earthtrends.wri.org/searchable_db.

[5] For example: Sunderlin, W.D. et al. 2005. Livelihoods, forests, and conservation in developing countries: an overview. World Development 33: 1383–1402; Vedeld, P. et al. 2007. Environmental incomes and the rural poor. Forest Policy and Economics, 9(7): 869–879.

help diversify rural livelihoods and contribute to the sustainability of agricultural production through tighter nutrient and water cycling, which increases soil and water productivity.[6]

Tree products, integrated production systems in which trees are grown or where forest fragments remain on farms, and tree product development typically fall through the cracks of national government and development agency approaches; there is little collection of information about them, limited promotion of their benefits and underinvestment in their development.[7] A wide variety of management systems, from wild harvesting through intensive cultivation and husbandry, yield fruits, vegetables, oils, medicines, essences, wood, bamboo and other fibers that are critically important for subsistence uses, for generating employment and income and for meeting emergency needs.[8] Furthermore, trees may sustain the productivity of agricultural systems through tighter carbon, water and nutrient cycling and the provision of livestock fodder and shade, particularly in seasonally dry environments.

Tree products from natural forests and woodlands contribute revenues valued at US$18.5 billion annually,[9] without including all contributions to poor households. These contributions to livelihoods are in danger as deforestation and forest degradation reduce the availability of important resources. Forest area decline, overextraction and increasing demand have put unsustainable pressure on wild stands, creating both the opportunity and the need for more intensive production and cultivation of tree products. Forest-dependent people may also lose access to resources and be made worse off when new conservation areas are created or ownership rights are claimed by, or assigned to, more powerful actors. More positively, the global trade of the top 20 tropical tree crops exceeds US$80 billion,[10] even without taking into account the hundreds of species that do not have large international markets. There is considerable potential to contribute to poverty alleviation by smallholders creating and capturing more value from tree products.

Component 1 will identify opportunities for improving income generation, household consumption and broader livelihood assets by enhancing management of production systems, improving the function and efficiency of marketing systems and encouraging supportive policies and institutions.

Most tree species that provide useful products locally (fruit, medicine, oils, beverages, sawnwood, fuelwood, charcoal and industrial compounds) remain essentially wild. This means there is a huge opportunity for increasing incomes through their domestication and commercialization in cultivated settings or sustainable harvest where they remain components of natural forest. Many such species have not benefited from characterization, selection and breeding by scientists. What has been done by local farm and forest managers is little understood and often not valued. Information on management requirements of these

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[6] Schroth, G. and Sinclair, F.L. (2003). Trees, crops and soil fertility: concepts and research methods. CAB International, Wallingford, UK.
[7] Weinberger, K. and Lumpkin, T.A. 2007. Diversification into horticulture and poverty reduction: a research agenda. World Development 35(8): 1464–1480.
[8] Belcher, B.M. 2005. Forest product markets, forests and poverty reduction. International Forestry Review 7(2): 82–89; Simons, A.J. 1996. ICRAF's strategy for domestication of indigenous tree species. In: Domestication and commercialization of non-timber forest products in agroforestry systems, 8–22. FAO Special Publication, Forest Division. FAO, Rome.
[9] FAO. 2010. Forest resource assessment. FAO, Rome.
[10] FAO. 2010. Forest resource assessment. FAO, Rome.

species is lacking and, again, until recently, local knowledge has not been taken seriously.[11] This limits these species' value both to the harvester/grower and to the consumer.

Moreover, local, national and international markets for many of these products are poorly developed and inefficient. The socioeconomic systems and the policy contexts in which these products are produced and managed are neither well understood nor adequately supported. The lack of knowledge about quality tree germplasm, inappropriate farm management practices, insecure forest and tree tenure[12] and limited market integration are constraints that can be addressed, thereby improving livelihoods and the environment. The research in this component will identify and help to exploit these opportunities to enhance poor people's livelihoods by improving the quality, quantity and type of trees, their management, their marketing and their governance.

The factors constraining tree production are complex and interrelated, and, in many cases, require integrated solutions. The policy and institutional environment strongly influences people's rights and incentives to manage forest and tree resources, with national and regional policy frequently subverting existing management systems and local institutions. Poorly functioning markets, lack of credit and limited information severely undermine the potential contributions even from high-value products. Poor rural people face many constraints that limit entrepreneurship. Even where these constraints can be overcome, technical constraints in commercially oriented management systems, planting materials and practices prevent the poor from taking advantage of opportunities to earn more income, create employment and improve livelihoods at household and community levels.

The research under this component aims to understand and improve the systems in which forest, tree and agroforestry products are produced, locally used (for food, fuel and construction), processed and sold, as a way to enhance livelihoods. Alleviating poverty through better management of tree cover requires protecting poverty mitigation functions, enhancing income and employment options, and taking advantage of opportunities to build and strengthen local institutions through policies and project-level interventions.[13]

2.1.2 Thematic focus

Component 1 includes the following three interrelated themes encompassing the management of tree production systems (including interactions with other system components when cultivated on farms and the sustainable harvest of products from wild resources in natural forests); enterprise development and the processing and marketing of tree products; and greater social recognition and more equitable rights associated with forest and tree production.

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[11] Sinclair, F.L. and Joshi, L. (2001) Taking local knowledge about trees seriously. In: Lawrence, A. (ed.) Forestry, forest users and research: new ways of learning, 45–61. ETFRN, Wageningen, Netherlands; Sinclair, F.L. et al. 2010. Systematic approaches to combining local and scientific knowledge about ecosystem services of trees. International Forestry Review 12(5): 474.
[12] Larson, A. et al. 2008. Tenure rights and beyond: community access to forest resources in Latin America. CIFOR Occasional Paper No. 50. CIFOR, Bogor, Indonesia.
[13] Belcher, B.M. 2005. Forest product markets, forests and poverty reduction. International Forestry Review 7(2): 82–89.

Research Theme 1: Enhancing productivity and sustainability of smallholder forestry and agroforestry practices, including food security and nutritional benefits, through better management of production systems.

Research Theme 2: Increasing income generation and market integration for smallholders through utilization of forestry and agroforestry options.

Research Theme 3: Improving policies and institutions to enhance social assets and to secure rights to forests, trees and land.

Together, these three themes address the nested sets of opportunities and constraints in small- and medium-scale tree and forest production and marketing. Medium-scale enterprises are not the primary focus, although they do have some relevance, in two ways. First, small-scale enterprises often face similar constraints to medium-scale enterprises and hence are amenable to similar solutions. Second, small-scale enterprises are often integrated into the value chain where medium-scale local enterprises purchase raw or semi-processed products from smallholders. The objective of the research is to provide analyses and knowledge that will support new policy, institutional and technical approaches to protect, create and capture livelihood values, in order to help people out of poverty and to distribute the benefits of forest and tree resources more equitably.

Research on eco-certification forms part of both Theme 2 of this component and Component 5. The eco-certification aspect in Component 1 will deal primarily with issues pertaining to agroforestry products such as shaded cocoa and coffee, whereas in Component 5, the emphasis is on forestry products, principally timber. Close links will emerge between the two in relation to products that are found in both forests and agroforestry systems, such as smallholder timber and charcoal. The policy and governance issues covered in Component 1 relate specifically to smallholder productivity in terms of people’s access to forest and tree resources, how trees condition land rights and differential usufruct to tree products. These issues all have immediate impacts on smallholder decision making about forest and tree management and hence the role forests and trees play in rural livelihoods.

2.1.3 Objectives and expected outcomes (10 years)

The overall objectives of Component 1 are to enhance the productivity of forest and tree production systems, to increase smallholder participation in tree product markets and to understand and strengthen institutional arrangements (including tenure security and local collective action) underpinning the management and use of forests and trees. The research will analyze and address constraints and opportunities in smallholder agroforestry and forestry production and marketing enterprises, with the following expected outcomes.

Predominantly Theme 1

- Technical innovations increase the productivity, sustainability and profitability of smallholder forest and agroforestry production.
- Smallholder natural-resource-based enterprise development is encouraged and facilitated.

Predominantly Theme 2

- Accessibility, effectiveness and efficiency of markets for forest and tree products is increased.
- Innovative extension approaches increase the speed, appropriateness and targeting of the spread of superior tree germplasm and tree management options.

Integrated across Themes 1 and 2

- Smallholder production and marketing systems attract efficient private-sector input suppliers (e.g., quality planting material, production and harvesting inputs, and postharvest processing equipment).

Predominantly Theme 3

- Policy and institutional changes provide tenure security and incentives for small- and medium-scale forest and tree product producers, processors and traders.
- Local-level institutions that regulate use and management of forest and tree resources are supported and strengthened (including their aggregation into higher-level structures) to improve their effectiveness, to enhance market access and to increase opportunities for influencing policy and practice.
- Rules, norms and strategies for conflict resolution and equitable benefits capture among multiple resource users are identified and strengthened.

Integrated across all three themes

- Recognition of actual and potential contributions of forest and tree products to livelihoods is increased among national-level government agencies and national and international programs and projects.
- National Agricultural Research Systems (NARS) increase problem-oriented research on social, economic, policy and technical issues including local knowledge and practice relevant to smallholder forest and tree production systems.
- Women and other disadvantaged actors have greater incentives, rights and capacity with which to benefit from forest, tree and agroforestry products.

These outcomes will contribute to the following CRP6 impacts: increased social and economic benefits from forest and agroforestry goods and services; reduced risks to rural livelihoods; and enhanced access of women and other disadvantaged groups to benefits at all levels.

2.1.4 Geographic priorities

CRP6.1 covers a wide geographic range, including West, Central, East and Southern Africa, South and Southeast Asia and Meso-America, the Andes and the Amazon, with opportunities for poverty reduction and conservation across ecological zones and systems. To provide focus, and to take advantage of synergies between this component and other components within CRP6, significant co-location of work is intended in sentinel landscapes. For example, we anticipate co-located research along forest transition gradients in Mali in the Sahel with CRP1.1 and on shaded cocoa systems in West Africa and shaded coffee in East Africa with CRP1.2. During the inception workshop with partners, we will use the land use transition framework to select study sites to address priority issues at key points along the forest transition curve, from natural forest through to degraded or secondary forest, cropland–agroforestry systems and plantations. Common elements and issues at each stage in the transition will bring focus to the work. The development of generic approaches and tools that can be customized for local implementation lies at the heart of the Component 1 research strategy. While a large proportion of the work will co-locate at sentinel landscapes (if possible), some innovations, such as improved, high-value tree germplasm or tree management options conferring eco-certification benefits for commodities such as coffee and cocoa, have generic potential for rapid scaling across single points in the transition. Scaling-up research is a key component of Theme 2 and will incorporate the different needs of forest and cultivated tree options.

In core forest and logged-over forest areas, for example in the Amazon and Central Africa, we will explore opportunities for increased commercialization and improved/intensified production of timber products and non-timber forest products (NTFPs). Research and support are needed to help market and enterprise development. Research is also needed on policies affecting trade, credit, infrastructure and agricultural incentives in zones with more intensive agriculture. Major opportunities exist to integrate trees into food crop systems to enhance crop productivity and provide environmental services and greater income, an endeavor referred to as "Evergreen Agriculture".[14] Research in this area will be focused on identified breadbasket areas in Africa, specifically:

- southern Mali,
- northern Ghana,
- the Beira Corridor in Mozambique,
- the southern highlands of Tanzania, and
- Ethiopia.

Strategic issues include the need for improved planting material (selection, domestication), improved management/technology and improved market access, marketing and enterprise development.

At the right-hand end of the transition are plantations, an under-researched area that includes small- and medium-scale plantations for poles, wood, fuel, fiber and non-timber products; at the other end are poorly understood and heretofore ignored local practices of tree management and "domestication of landscapes". New opportunities are emerging with changing land and tree tenure, reduced supplies from natural forests, increased demand and new institutional arrangements (e.g., contract farming for wood or fiber). At each stage, there are opportunities to better understand and improve the contributions of forest and tree resources to local livelihoods. The specific requirements vary according to the context, but there are sets of researchable issues on production and productivity, on markets and enterprise development and on the policies and institutions that govern these systems. Systems, locations and environments in the forest/agricultural domains of humid, subhumid, semi-arid and drylands, with significant numbers and/or density of poor people, will be targeted. For example, in Africa, we propose to undertake fieldwork, surveys, analyses,

[14] Garrity, D.P. et al. 2010. Evergreen Agriculture: a robust approach to sustainable food security in Africa. Food Security 2: 197–214.

policy reform, data set assembly, species targeting and market interventions in forest and farm environments associated within the following five of the 14 main agricultural landscape domains identified by Dixon et al.:[15]

- tree crop (No. 2),
- forest based (No. 3),
- highland perennial (No. 5),
- cereal root crop mixed (No. 8) and
- maize mixed (No. 9).

This will involve working in dry forest/crop areas in Sahel and sub-Sahelian savannahs, humid West Africa coastal forests, Congo Basin forests, Afro-montane forests in East and West Africa, high-potential highlands of East Africa, Miombo woodlands and adjacent maize croplands. Areas in Latin America and Asia will be similarly prioritized during component implementation.

2.1.5 Research Theme 1: Enhancing productivity and sustainability of smallholder forestry and agroforestry practices, including food security and nutritional benefits, through better management of production systems

Rationale

As smallholder forest and tree management has received comparatively little research attention, it offers unrealized potential for new insights into novel principles of management, as well as increases in production, productivity and profitability through improved management and improved planting material.[16] This applies to wood and fiber production and to many NTFPs and agroforestry tree products (AFTPs).[17] Other constraints, such as lack of or limited access to credit, land/tree tenure, marketing support and climatic vulnerability, are partly addressed in Themes 2 and 3.

Forest and tree management on farms is more complex than annual crop management because of the life cycle, trait differences, size, perenniality and multiple tree forms, even within the same species. There has been little research on small-scale systems, in which management conditions change with evolving market requirements, trees interact with other system components, and production environments are dynamic because of intensifying pressure on land and climate change. Against this background, research and technical support are urgently needed to meet the needs of small-scale producers. The specific sets of constraints and opportunities are unique to each situation, and will require careful assessment as part of the research in each site. Nevertheless, there are similar types of production and management problems. Basic silvicultural recommendations on spacing, thinning, pruning

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[15] Dixon, J. et al. 2001. Farming systems and poverty: improving farmers' livelihoods in a changing world. FAO and World Bank, Rome and Washington, DC.
[16] Akinnifesi, F.K. et al. 2008. Contributions of agroforestry research and development to livelihood of smallholder farmers in Southern Africa: 1. Taking stock of the adaptation, adoption and impact of fertilizer tree options. Agricultural Journal 3: 58–75.
[17] Simons, A.J. and Leakey, R.R.B. 2004. Tree domestication in tropical agroforestry. In: Nair, P.K.R. et al. (eds) Advances in agroforestry, 167–182. Kluwer Academic Publishers, New York.

and fertilization exist for a limited number of tree species.[18] Such species are typically grown in large plantations in block arrangements where close spacing forces individual trees toward more marketable forms (e.g., straight trunks). Trees in agricultural landscapes are mainly planted: (1) as single scattered trees in cropland; (2) in linear arrangements on borders or contours; or (3) in small blocks (not necessarily with regular spacing).

Some of the forests managed by smallholders are highly diverse and complex, whereas others are fragmented or degraded. As a result, the selection of products and markets and other management decisions made by forest smallholders differ greatly from those of industrial-scale managers.[19] In managed forest environments, smallholders and communities often manage integrated systems for a variety of products and services. Multiple-use forest management has gained attention as a means of increasing sustainability and income for forest managers.[20] However, these diverse multiple-use systems, with highly variable biophysical, social and economic characteristics, remain poorly understood, resulting in missed opportunities. This research will support scale-appropriate, systems-oriented interventions based on more complete understanding of such systems and their management to improve management and livelihoods.

Small-scale forest managers and farmers in tropical agroforestry systems tend to have low awareness of “quality” planting material and poor access to “good quality” planting material. Such systems fall short of their potential in providing useful tree products (and services). Achieving a diversity of species and effective tree management requires a range of approaches for gradual or radical transformation of the supply and use of selected tree germplasm; this is both more productive and appropriate for local ecological, social and economic conditions on farms. This theme aims to provide practical and direct approaches to increase the value of forest products and trees in small-scale systems.

The scientifically uncharacterized status of most forest and tree products (fruit, vegetables, honey, medicines, oils, beverages, bushmeat, building materials, sawnwood and industrial compounds) implies unrealized potential for both the harvester/grower and the consumer. Low or inconsistent quality of products, and unpredictable or erratic timing of harvests, can drastically reduce market potential and profitability. As the value of some of these products tends to accrue disproportionately to women and marginalized families, improvements in the quality, quantity and type of trees available can directly improve livelihoods of these groups.

Species choices and varieties available for small-scale planted systems are typically limited. Farm and market surveys reveal the need for trees that grow fast, fruit early, are pest and drought resistant, and provide multiple products. Nursery surveys, however, reveal poor matching of these needs to available planting stock. Of equal concern are the high level of inbreeding and low diversity of founder populations introduced to farmlands, leading to chronic underproduction in future generations of cultivated trees.

[18] Allison, G.E. and Simons, A.J. 1996. Propagation and husbandry. In: Stewart, J.L. et al. (eds) *Gliricidia sepium*: genetic resources for farmers, 49–72. Oxford Forestry Institute, UK.
[19] Pinedo-Vasquez, M. et al. 2001. Post-boom timber production in Amazônia. Human Ecology 29: 219–239.
[20] García-Fernández, C. et al. 2008. Is multiple-use forest management widely implementable in the tropics? Forest Ecology and Management 256: 1468–1476; Guariguata, M.R. et al. 2010. Compatibility of timber and non-timber forest product management in natural tropical forests: perspectives, challenges, and opportunities. Forest Ecology and Management 259: 237–245.

The opportunity for private sector engagement with recurrent germplasm sales has strengthened investment in annual crops, which tend to involve only a few species and substantive public sector investment over many decades. In contrast, the plethora of possible species, low recurrent annual demand (not absolute demand) and the technical complexity of handling large, long-lived taxa have led to a deficit in both public and private sector investments in tree species. Moreover, there is a lack of knowledge of the fundamental aspects of the biology, ecology and growth of many tree species compared with their annual crop counterparts. Often, local knowledge about trees and their management, accrued over many years, may complement scientific understanding.

Production of NTFPs, management of trees on farms and tree management and domestication are all heavily influenced by social processes of control over use and overuse of wild populations and the land on which trees regenerate or can be planted. In later stages of domestication, explicit steps of genetic selection for specified "ideotypes" dominate, but early steps implicitly affect the genetic pool available for such selection. Many annual food crops have been so extensively bred that further advances in productivity require highly sophisticated genetic approaches. In contrast, many tree species used in agroforestry are virtually wild, meaning simple improvement strategies, cognizant of system compatibility, have the potential to generate huge genetic gains rapidly.

This research theme focuses on developing design principles, technology options and decision support tools that facilitate adoption and adaptation of improved forestry and agroforestry practices by farmers directly and via national governmental and NGO extension processes. There is tremendous scope for improving knowledge about the management of forests and trees on nurseries and farms and for targeting agroforestry interventions tailored to local ecological, economic and social circumstances and gender differentials. Efforts must include reconciling local and external knowledge to support the generation of locally relevant options and development of the enabling environment, in terms of policies and institutions, required for adoption and optimal management of forests and trees on farms. This theme addresses the need to understand the principles of managing integrated farming systems with trees and the synergies and trade-offs between economic returns, market production and the long-term sustainability of intensified and diversified production systems.

Methods and research approach

The research in this theme will identify and address key technical constraints and opportunities for enhanced quality and productivity of forest and tree products in selected small-scale management systems. The work will develop new approaches for diagnosing problems and designing interventions, improving understanding of small-scale forest and tree management and improving the tools and techniques available for characterizing and improving tree germplasm.

Research will take a multidisciplinary approach combining social and biophysical scientists to address the diverse issues faced by smallholder foresters and agroforesters. It will rely on participatory action research methods to identify, test and validate management practices appropriate for the conditions faced by smallholders. Specific methods will include forest inventory as well as rapid appraisal methods, producer surveys and ethnography. In addition, remote sensing will assist with assessing how local management practices fit into and shape land use mosaics.

Systematic approaches to acquisition of local agroecological knowledge,[21] will be combined with participatory modeling techniques to explore the relevance of local and scientific understanding in order to improve productivity of smallholder agroforestry and forestry practices; this will include identifying knowledge gaps and developing decision support tools.[22] Well-established tree domestication methods will be combined with molecular techniques to understand variability within tree populations and, where appropriate, to assist selection.[23] Tree improvement strategies will take into account system compatibility issues arising from interactions between trees and other system components[24] as well as the realities of farmer practice[25] and will combine participatory on-farm and on-station trials with simulation modeling to derive appropriate understanding of management options. Tree diversity will be incorporated into the design and improvement of forest and agroforestry options using mapping of vegetation types combined with consideration of climate change scenarios.[26]

Previous experience with *Allanblackia* spp.[27] will be used to exemplify an integrated approach to tree domestication for high-value species, when rapid scaling-up of germplasm supply of a species is required. The timelines, human resources and investment required for effective domestication, including germplasm scaling-up, will be documented and key decision points and bottlenecks explained. Lessons learned from this real-life case study (where domestication is well under way but by no means completed) will be systematized to support more effective domestication of other priority high-value species.

[21] Sinclair, F.L. and Walker, D.H. (1998). Qualitative knowledge about complex agroecosystems. Part 1: representation as natural language. Agricultural Systems 56: 341–363; Waliszewski, W.S. et al. 2005. Implications of local knowledge of the ecology of a wild super-sweetener for its domestication and commercialization in West and Central Africa. Economic Botany 59(3): 231–243.

[22] Vanclay, J. et al. 2006 Realizing community futures: a practical guide to harnessing natural resources. Earthscan, London.

[23] Dawson, I. and Jamnadass, R. 2008. Molecular markers for tropical trees: a practical guide to principles and procedures. Technical manual 9. World Agroforestry Centre, Nairobi.

[24] van Noordwijk, M. et al. (eds). 2004. Below-ground interactions in tropical agroecosystems: concepts and models with multiple plant components. CAB International, Wallingford, UK.

[25] Tiwari, T.P, et al. 2009. Rapid gains in yield and adoption of new maize varieties for complex hillside environments through farmer participation. I. Improving options through participatory varietal selection (PVS). Field Crops Research 111: 137–143.

[26] Kindt, R. et al. 2007. Use of vegetation maps to infer on the ecological suitability of species using central and western Kenya as an example. Development and Environment Series 7-2007.

[27] http://www.allanblackia.info

Research questions

Broad research questions (Component 1, Theme 1)	Gender-specific aspects of the question	Examples of science outputs
How to increase investment in species-specific tree improvement using generic domestication techniques for priority NTFP and tree species to ensure quality planting material is available?	What interventions (e.g., policies) can improve women's access to important NTFP and tree species for germplasm collection and use?	New/improved tree and crop germplasm NTFP and tree domestication strategies
What approaches, tools and methods can be used to adapt tree and forest management techniques to the scales, resource types, objectives and opportunities of smallholders and community forest managers?	How to ensure promotion and domestication of high-value NTFP and tree species are based on men's and women's differentiated preferences (products and species)?	Best practice guidelines Forest and tree management tools
How and why do different tree species x management options confer affordable sustainability benefits for farmers in terms of higher soil and water productivity in the medium to long term?	How do gender-differentiated roles and control of resources affect species and management preferences and ultimate choices? What changes in women's control of tree and land resources are necessary for their preferences to prevail in decisions about tree planting, retention and management?	Development of associative tree ideotypes and hence system-compatible tree germplasm Tools for matching trees and tree mixtures to sites and circumstances
How can innovative management techniques be used to improve NTFP and tree use to diversify farming systems and enhance rural livelihoods?	How does the introduction of innovation or intensification affect gender roles or differential access to resources and benefits?	Tools for promoting tree diversity on farms and in farming landscapes
How can innovative management techniques (locally derived and science based) be identified, tested and evaluated more efficiently?	How do knowledge and preferences of women and men differ in relation to choices of tree species and management options?	Databases of scientific and local assessments of tree attributes that confer productivity gains and system compatibility
Which farmer forest and tree management skills can be enhanced with respect to establishment, protection, spacing, thinning, selection, pruning, coppicing, harvesting, irrigation and fertilization?	How to consider gender roles and targeted training in different forest/tree management activities to promote complementarity of skills, especially in labor-scarce households?	Forest and tree management manuals Databases Demonstration sites

Research partners

A comprehensive plan for regional, country and site partners will be developed in the early phase of implementing the research program and kept under ongoing review. Some indicative organizations are shown here to illustrate the form of partnerships envisaged.

Type of research partner	Organization	Research partner contributions
Participating CGIAR center	World Agroforestry Centre	Provides research expertise in the development of design principles for agroforestry and tree management options in fields and farming landscapes across Africa, South and Southeast Asia and the Amazon.
		Provides a key link to the methods and data in AfSIS (African Soil Information Service) used for targeting interventions
	CIFOR	Provides research expertise on management and productivity of forest products and services and smallholder forestry
	CIAT	Conducts research on characterization of fruit germplasm suitable for agroforestry systems
		Contributes to design of sustainable production systems including tropical fruits
		Conducts life cycle analysis of tropical fruits under agroforestry systems
		Provides support in developing market linkages for NTFPs
International level	CIRAD	Contributes expertise through staff seconded to participating CGIAR centers, on shade coffee systems and tree–crop interactions, particularly in relation to carbon and water cycling
	SLU, Bangor, Wageningen and Gottingen Universities	Contribute expertise and advanced laboratory facilities for understanding carbon, nutrient and water cycling
	INBAR	Collaborates on action research on smallholder production systems and markets for bamboo, rattan, and NTFPs in general (through the GFAR Global Partnership Programme on NTFPs, which INBAR coordinates)
Regional level	CATIE	Provides expertise in genetic resources and breeding of tree crops
		Coordinates research in Central America
		Disseminates results via outreach activities and curricula
	Novella Africa Initiative	Public–private partnership platform in Ghana, Cameroon, Liberia, Nigeria and Tanzania focusing on extracting oil from the local *Allanblackia* species on a commercial scale. The partnership is unique in that it involves local communities and small-scale businesses, in cooperation with non-profit development partners, local governments and Unilever.
Country or site level	National tree crop, agriculture and forestry research institutes (e.g. Coffee Research Foundation, Kenya; CRIG and FORIG (Cocoa and Forest Research Institutes of Ghana, respectively)	Collaborate in research in specific countries and at specific sites
	National universities	

2.1.6 Research Theme 2. Increasing income generation and market integration for smallholders through utilization of forestry and agroforestry options

Rationale

Small-scale farmers, forest-dependent producers and entrepreneurs often lack business skills, have limited access to timber and tree product markets, or both. There are notable exceptions.[28] Poor access to transportation (due to lack of infrastructure or inability to pay), information barriers and social barriers all stand in the way of profitability.[29] Such producers typically have difficulty producing consistent-quality products in sufficient quantities to gain market power. Without good organization and stable markets, they tend to be price takers with high marketing risks and costs and low returns. At the same time, forestry and agricultural extension systems in the developing world are declining or collapsing. Agricultural extension agents typically lack knowledge about trees appropriate to smallholders, and often are ignorant or dismissive of local markets and marketing systems. Forestry extension agents are often trained to serve industrial timber enterprises and have little awareness of the products, scales and constraints relevant to smallholders, community forest management and forest product markets that serve the poor. In some cases, commercial suppliers and companies, with their own interests, are stepping into this role. Products such as fuelwood and charcoal are often extremely important economically but are ignored by researchers, extension staff and policymakers alike.

Government agencies and NGOs seeking to facilitate smallholder marketing also face obstacles. Staff often lack the appropriate training and tools to assess market opportunities or help farmers exploit available opportunities such as adding value to farm products. These facilitating organizations are also hampered by a lack of knowledge, understanding and appreciation of markets, local and international demand for products, or ways to intervene to support small producers and entrepreneurs. Methods are needed to assess demand and develop business investment models for tree product investors. Insufficient credit and other types of financing further constrain investment by small-scale rural producers. There has also been little development in postharvest handling and processing, resulting in spoilage and poor-quality products.[30]

The lack of enabling conditions and incentives to commercialize products compound the problems. Inadequate institutional support (e.g., credit, market information) and skewed policies, barriers and disincentives make it difficult for smallholders to market their produce. There is an absence of quality assurance schemes for NTFPs and AFTPs and a lack of

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[28] For example: Berkes, F. and Davidson-Hunt, I.J. 2010. Innovating through commons use: community-based enterprises. International Journal of the Commons 4(1):1–7; Simao Seixas, C. and Berkes, F. 2010. Community-based enterprises: the significance of partnerships and institutional linkages. International Journal of the Commons 4(1): 183–212.

[29] Franzel, S. et al. 2009. Bark for sale: the economics of *Prunus africana* as an agroforestry tree for small-scale farmers in Cameroon. In: Cunningham, A.B. (ed.) Bark: use, management and commerce in Africa. Advances in Economic Botany Vol. 17. New York Botanical Garden Press, New York; Ham, C. et al. 2008. Opportunities for commercialization and enterprise development of indigenous fruits in Southern Africa. In: Akinnifesi, F.K. et al. (eds) Indigenous fruit trees in the tropics: domestication, utilization and commercialization, 255–272. CAB International, Wallingford, UK.

[30] Jordaan, D. et al. 2008. The feasibility of small-scale indigenous fruit processing enterprises in Southern Africa. In: Akinnifesi, F.K. et al. (eds) Indigenous fruit trees in the tropics: domestication, utilization and commercialization, 273–287. CAB International, Wallingford, UK.

services for production and marketing.[31] Trade for some products is overregulated (e.g., on-farm timber), whereas in other cases it is underregulated (e.g., herbal medicines).[32] Many policymakers still view private traders as an overly opportunistic class rather than as a resource that can generate wealth in rural areas. They also often fail to perceive the potential of NTFPs and tree products for generating significant incomes for smallholder farmers. Furthermore, they often fail to understand and seize the new opportunities that are offered by changing demographic conditions, including the "deagrarianization"[33] of rural communities, rapid rates of urbanization and increased circular migration and the economic potential of remittances.

Research under Theme 2 will investigate constraints that limit the functioning of small- and medium-scale resource-based enterprises (SMEs), and will develop ways to support and improve such enterprises. Research is also needed to guide technical support and policy reform that will benefit these small enterprises, by targeting increased income and employment opportunities and creating incentives for better resource management. Key science opportunities in this theme include: (1) assessing innovative extension approaches, such as volunteer farmer trainers and rural resource centers for building capacity of smallholder producer organizations; (2) assessing and addressing key constraints and opportunities for commercial forest and tree products (e.g., charcoal, fuelwood, cheap timber and other forest products for burgeoning urban settlements, indigenous fruits, natural products and fodder) that are not achieving their potential due to market failure and poor market development; (3) understanding how to implement community-based marketing systems for tree planting material and other inputs (i.e., seed and seedlings; processing equipment); and (4) assessing the efficiency and equity impacts of sustainability standards (also termed "eco-certification") and comparing them with payments for environmental services (PES).

Methods and research approach

The research in this theme will focus on small-scale agroforestry and forest product enterprises and market development and function. It will develop tools and approaches to analyze market opportunities and constraints, identify typical constraints and opportunities in selected systems and develop and test interventions to support enterprise and market development. It will also focus on extension approaches. Given the decline of state-funded extension services, volunteer farmer trainer programs have emerged as an innovative and potentially more sustainable approach. Gender-differentiated methods are required in assessing market opportunities and designing extension approaches. Women are often confined to low-return value chains (e.g., low-value indigenous fruits); when such products become profitable, these value chains are taken over by men.[34]

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[31] Simons, A.J. and Leakey, R.R.B. 2004. Tree domestication in tropical agroforestry. In: Nair, P.K.R. et al. (eds) Advances in agroforestry, 167–182. Kluwer Academic Publishers, New York.
[32] Rukunga, G. and Simons, A.J. 2006 The potential of plants as a source of anti-malarial agents. Plantaphile Publications, Berlin, Germany.
[33] Wilson, G.A and Rigg, J. 2003. Post-productivist agricultural regimes and the South: discordant concepts? Progress in Human Geography 27: 681–707
[34] Kiptot, E. and Franzel S. In press. Gender and agroforestry in Africa: are women participating? ICRAF Occasional Paper, Nairobi.

The methods used in the assessments will include:

1. **Qualitative methods.** These will include both individual and group interviews and will focus on eliciting people's perceptions of their needs, approaches/interventions, problems encountered and their views of impacts. Methods will include participatory research tools, such as semi-structured interviews, matrix ranking and scoring and time lines.[35] These methods are important for developing sound hypotheses and questionnaires for collecting quantitative data as well as for triangulating results obtained from quantitative analyses.
2. **Random, controlled experiments and natural experiments in the rollout of marketing or extension interventions**.[36] These could be either *ex ante* or *ex post*, and involve establishing a control counterfactual as well as various treatments involving single or multiple extension approaches in order to compare their effects with each other and with the controls.
3. **Econometric analysis.** Econometric modeling will be used to assess factors influencing the flow of information among farmers, the flow of information from farmer trainers to others, and the effectiveness of the dissemination process in bringing about adoption. To evaluate volunteer farmer trainer programs, econometric modeling will be used to assess the factors influencing the number of farmers trained by volunteer farmer trainers. Independent variables will include meso variables (population density of area), socioeconomic characteristics of the trainers (age, gender, etc.) and characteristics of the technologies being disseminated (e.g., complexity).
4. **Cost–benefit analysis** will be used to assess the benefits and costs of interventions from the perspectives of various stakeholders.
5. **Gender analyses.** Data collected will be disaggregated by gender. For example, data on farmers' perceptions of interventions, farmers' access to and use of information and inputs, farmers' ability to implement practices, and benefits of practices will be analyzed by gender.[37] Wherever possible, gender-specific subgroups will also be analyzed. For example, we hypothesize that women in male-headed households have different perceptions and activities, and accrue different benefits, from those leading female-headed households.
6. **Value chain analysis.** Value chain analysis methods are well established, but few involve scientific rigor and few are appropriate for the analysis of most tree and non-timber forest products. We will adapt present methods to solving market-related problems and assessing the performance of markets.

[35] Gonsalves, J. et al. (eds) 2005. Participatory research and development for sustainable agriculture and natural resource management: a sourcebook. International Potato Center, Manila.
[36] De Janvry, A. et al. 2010. Recent advances in impact analysis methods for ex-post impact assessments of agricultural technology: options for the CGIAR. SPIA report 3.1. SPIA, Washington, DC.
[37] Rubin, D. et al. 2009. Promoting gender equitable opportunities in agricultural value chains: a handbook. USAID, Washington, DC.

Research questions

Broad research questions (Component 1, Theme 2)	Gender-specific aspects of the question	Examples of science outputs
What improved methods and rapid appraisal tools can be used to analyze the actual and potential value of forest and tree products for poor and women farmers and for subsector and value chains (including inputs, nurseries)?	How to increase women's participation in value chains and reduce inequity in household benefits? Appraisal tools should be gender sensitive and inclusive.	Rapid appraisal tools of market chains Viability and profitability studies Value chain reports Fair pricing guidelines
What scaling-up and novel extension approaches are effective in promoting the spread of knowledge and materials (e.g., seed), particularly among women and the poor, are sustainable and help build capacities of communities to access information and innovate? How does the impact of innovative extension approaches vary by commodity, by land use system, by social setting and by region?	How to ensure scaling-up and extension approaches and interventions are specifically targeted to cultural and gender differences, according to men's and women's different participation in commodities, land use systems and social settings?	Novel extension approaches Scaling-up protocols Rural resource centers
What are key marketing interventions for helping farmers improve returns from NTFP and agroforestry enterprises and improve smallholder competitiveness? How should the interventions be sequenced?	Collective marketing enables smallholders to "break into" the market, but gender relations can break down the collective if not attended to.	Marketing strategies Franchising options Outgrower schemes
What are the multiplication and deployment systems for improved tree germplasm that ensure genetic integrity, provide disease-free planting material, and are adapted to various local conditions?	Are the methods of multiplication accessible for both men and women?	Cultivar multiplication and deployment systems for tree crops identified and evaluated Locally adaptable tree seed and seedling systems and means of selecting appropriate models for different settings, developed and tested for both high-value and high-volume species.
What innovative and sustainable ways can be devised and implemented to improve the supply of market information, technical assistance and appropriate finance to differentiated, local end-users of forest- and tree-based production systems?	Community-based market information platforms are innovative and can be effective in supplying timely market information and getting feedback, but conflicts of interest and power relations between men and women in mixed platforms need investments in repairs and maintenance.	Market information systems Information hubs Microcredit schemes Decentralized extension approaches Demonstrations
How can certification of good agricultural practices and sustainable timber practices incentivize farmers to modify their tree-planting decisions?	How to improve women's participation in value chains and reduce inequity in household benefits? Appraisal tools should be gender sensitive and inclusive.	Certification checklists Generic criteria Publications

Research partners

A comprehensive plan for regional, country and site partners will be developed in the early phase of implementing the research program and kept under ongoing review. Some indicative organizations are shown below to illustrate the form of partnerships envisaged.

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	World Agroforestry Centre	Provides research expertise on agroforestry product marketing, extension and eco-certification
	CIFOR	Provides research expertise on marketing of forest products and services
	Bioversity	Provides expertise in genetic resources and germplasm, manages tree crop genetic resources networks (CacaoNet and COGENT)
	CIAT	Provides expertise on life cycle analysis of tropical fruits under agroforestry systems
		Provides methodological support in developing market linkages for NTFPs
International level	Cultural Practice (US-based NGO)	Contributes expertise on gender-differentiated value chain analysis and assessment of extension approaches
	INBAR	*Research partner on processing and marketing* of NTFPs, in particular bamboo and rattan
	UNCTAD Committee on Sustainability Assessment (COSA)	Provides links with certification bodies, global-and national-level policymakers and private sector companies interested in certification and the impact of certification on livelihoods
Regional level	African Forum for Agricultural Advisory Services	Leads extension network participating in research on extension approaches and disseminating policy results
	African Network for Agriculture, Agroforestry, and Natural Resources Education (ANAFE)	Provides research fellows to participate in market research and reforms curricula to include latest research results
Country or site level	District Women's Associations in(Zambia)	Collaborates in marketing agroforestry products
	Kenya Forestry Research Institute (KEFRI)	Collaborates in research on agroforestry extension approaches
	Tanzanian Association of Women Leaders in Agriculture and Environment (TAWLAE)	Collaborates in research on marketing of indigenous fruits

2.1.7 Research Theme 3. Improving policies and institutions to enhance social assets and to secure rights to forests, trees and land

Rationale

Policy and institutional frameworks shape access and control over forests, trees and land, which in turn affect the central issues discussed in the previous two themes—productivity and sustainability, income generation and market integration. Access, rights and opportunities for millions of forest-dependent and smallholder households and communities throughout the tropics and subtropics are affected by a complex mix of stakeholders, demographic pressure, economic forces and government policies.[38] Smallholders and traditional communities that have practiced low-intensity, diversified resource use are encountering a variety of pressures affecting their access to forests and land use choices. In addition to growing rural populations, ranchers, loggers and large-scale agricultural enterprises, as well as actors with interests in petroleum, mining and carbon, compete for land rights; conservation interests seek to limit resource use to protect forests; and subsistence needs and commercial opportunities may encourage overexploitation or forest conversion.[39]

Improved policies and institutions can help address these problems. For example, many land users will hesitate to invest in tree planting or sustainable forest management without secure tenure over the lands and resources they use. Securing rights may be a difficult and ongoing process, however, as actors with competing interests—including, at times, state entities—will continue to seek access and control over valuable land and resources. Policies need to ensure that people can invest in their lands and forests without the risk of losing their investments to more powerful forces outside communities (e.g., urban elite or industry over rural communities, government over customary claims). Of particular importance are policies to protect the rights of women and indigenous communities against more powerful forces.

Even if rights are secure, markets and regulatory systems may encourage forest degradation and conversion to other uses. Regulations regarding the use and trade of forest products often discourage or even prohibit smallholders and communities from harvesting or trading tree and forest resources, particularly those of higher value,[40] such as timber. In many countries, the production of charcoal is illegal, even though it is one of highest-value commodities traded. Even where smallholders are permitted to sell valuable resources, the regulatory framework and state bureaucrats often place high financial, logistic and legal obstacles in the

[38] Catacutan, D. et al. 2008. Fluctuating fortunes of a collective enterprise: the case of the Agroforestry Tree Seeds Association of Lantapan (ATSAL) in the Philippines. CAPRI Working Paper No. 76. CGIAR Systemwide Program on Collective Action and Property Rights (CAPRI), Washington, DC; Sotelo Montes, C. et al. 1999. Domesticación participativa de árboles agroforestales en la amazonia peruana – promoviendo la conservación de recursos genéticos arbóreos y el desarrollo económico. Congreso Forestal Latinoamericano, Colegio de Ingenieros del Perú, Capítulo de Ingenieros Forestales – Instituto Nacional de los Recursos Naturales – Universidad Nacional Agraria La Molina. Lima, Peru, 8–11 December.

[39] Larson, A. et al. (eds) 2010. Forests for people: community rights and forest tenure reform. Earthscan, London; Martin, F.S. and van Noordwijk, M. 2009. Trade-offs analysis for possible timber-based agroforestry scenarios using native trees in the Philippines. Agroforestry Systems 76(3): 555–567. Roshetko, J.M. et al. 2008. Future challenge: a paradigm shift in the forestry sector. In: Snelder, D.J. and Lasco, R. (eds). Smallholder tree growing for rural development and environmental services, 453–485. Springer, New York.

[40] Dove, M. 1994. Marketing the rainforest: "green" panacea or red herring? East-West Center (EWC), Honolulu, USA.

way.[41] In addition, without substantial support for smallholders and communities, markets tend to work in favor of larger and wealthier actors, so that little value accrues to those who own or extract the resource. Market constraints limit smallholder options and profitability. At the same time, opening up market opportunities can fundamentally change resource management and utilization priorities.

At the forest, territory or community scale, greater understanding of customary institutions typically governing resource use is needed, as is more information on the traditional indigenous knowledge that underlies these institutions and the processes through which they change. For example, the use of fire for land clearing and maintaining open grazing systems continues to discourage tree planting and management in many areas. At the same time, improved institutional frameworks are needed to promote sustainable adaptive management, and to address inter- and intragroup conflict over resource access and the distribution of resources. Local elites or people in positions of authority may dominate or interfere with the rights of other stakeholders; men may have greater access to resources and benefits than women. Moreover, while local institutions for the management of forests and trees are increasingly recognized, the gender differentiation and internal equity implications of such institutional arrangements are less well elaborated.[42] At all scales, innovative policies and institutions are needed to ensure that forest communities and smallholders participate both in the decisions that affect their forests and livelihoods and in resource-related benefits.

Activities under this theme will support policies and institutions for improved and more secure resource access and use, for greater participation in decisions regarding forest and tree resources at all scales, and for improved livelihood benefits from those resources. The improvement of national policies regarding tenure rights and forest law and regulations, combined with the strengthening of local governance involving indigenous communities and smallholders and the scaling-up and -out of sustainable production systems (Theme 1) and value-added products (Theme 2), will facilitate the establishment of more resilient social and biophysical landscapes. Because goods and services from forests and trees are often used and valued at varying temporal and spatial scales, spanning multiple users, uses and values, the coordinating and enforcement role of state actors is necessary for sustainable use and equitable distribution of these goods and services.

Conflicting policies between agriculture and environment are not uncommon (e.g., how to manage riverbanks). Furthermore, the failure of government enforcement of forestry (and related sectors) strategies, policies and laws in many settings raises a central question of how to improve their performance. This theme is also concerned with factors underlying the asymmetry between relevant policy intentions and their actual implementation. In particular, it will address the factors that influence whether and how state officials implement policy goals, legal mandates and organizational strategies, how their implementation further influences local agents' incentives for sustainable use/management of trees and forests and the distribution of benefits and, lastly, how state institutional incentives can be changed to stimulate more sustainable use of resources.

[41] Larson, A. and Ribot, J. 2007. The poverty of forest policy: double standards on an uneven playing field. Sustainability Science 2(2): 189–204.
[42] Mwangi, E. et al. In press. Gender and sustainable forest management in East Africa and Latin America. Ecology and Society.

This theme will address the following issues:

- ill-defined, contested or absent tenure rights over forests and trees, which lead to conflict and failure to support rural producers;
- incongruence between customary and formal forest tenure and the effect of contradictory and overlapping policies on resource ownership and use;
- the need for forest and resource use policies that balance command-and-control approaches to environmental law enforcement with the need for increased local autonomy and systems based on social control, self-regulation and local rule formulation at the community level;
- improved mechanisms that encourage adaptive management of smallholder forests and that promote tree planting and harvesting on farms;
- weak institutional capacity and mechanisms for inter-institutional linkages that inhibit active coordination and collaboration in planning and management of local forest and agricultural landscapes;
- the need for greater understanding of how technical norms and regulations can be tailored to reflect the contexts, constraints and opportunities faced by smallholders and community-level producers;
- the need for innovative methods for mediation and dialogue for decision making and benefit distribution at the local scale and for conflict management in multi-stakeholder resource systems; and
- the need for mechanisms that promote equitable distribution of the benefits of forest and tree products and services (including across genders), under various social, economic and political pressures.

Methods and research approach

As a first step, a synthesis of existing research in this theme will be undertaken to guide the identification of high-priority research topics and locations for the future. Research into the policies and institutional arrangements that frame the use and management of fragmented and secondary forests, small-scale plantations and individual trees on farms and communities will draw on a variety of methods and approaches to generate a broad understanding of the drivers or constraints influencing decisions made by smallholders as well as the positive and negative consequences of those decisions. This body of work will rely on multidisciplinary teams capable of addressing the diverse biophysical and socioeconomic facets of policy and institutional analysis related to resource governance, and will focus on several scales from the global to the local. Through the use of global comparative studies using standardized instruments, tools and methods, research in this theme will generate quantitative and qualitative data to analyze differential success or failure of policy and institutional innovations to enhance assets and provide more secure rights, and to identify conditions under which national or local policies do lead to desired changes.[43] Data collection will rely on surveys, key informant interviews and focus groups with stakeholders such as the

[43] Belcher, B.M. et al. 2005. Global patterns and trends in the use and management of commercial NTFPs: implications for livelihoods and conservation. World Development 33(9): 1435–1452; Angelsen, A. et al. In press. Measuring livelihoods and environmental dependence: methods for research and fieldwork. Earthscan Press, London.

policymakers and technicians who design and implement policy frameworks and the producers, representatives of community enterprises and related actors that must operate within the imposed frameworks.

At local and regional scales, illustrative case studies will serve to analyze the effectiveness, efficiency and equity of policy frameworks and novel innovations for influencing resource use behavior and decision making, to improve livelihoods and to provide greater security in property rights (e.g., processes for local participation in by-law reforms).[44] These studies will examine institutions used by local stakeholders to navigate official processes, to assist with negotiations with other stakeholders and to fill gaps not addressed by formal rules or agencies. In addition to the methods listed above, we will also apply ethnographic and participatory methods; these will facilitate the identification, documentation and evaluation of existing institutions as well as the identification of lessons learned or innovations developed by local stakeholders to enhance assets or secure their rights.

Gender analysis will generate insights on the gender-differentiated implications of policy implementation, while historical institutional analysis will generate insights into the political and social circumstances that influence policy and institutional reform. Gender analysis will increase understanding of the distinct views and perceptions that men and women have of policy, as well as the different opportunities and obstacles that policy frameworks might provide. Evaluation methods will be used to study the effects of national and local policy and institutional innovations designed to strengthen women's usufruct and ownership rights over agroforestry and forest resources. The research will seek to be action oriented in partnership with government or development organizations, and will follow careful designs and baselines. Research will also evaluate options to strengthen science–policy linkages in gender issues. Research will be coordinated with the sentinel landscapes program to monitor effects of policy and institutional change. Coordination on research design and methodology is further envisaged with Component 2, Theme 4, and Component 5, Theme 2, both of which place emphasis on securing community rights and access, strengthening collective action and enhancing benefits from forests and trees.

[44] Sanginga, P.C. et al. 2004. Facilitating participatory processes for policy change in natural resource management: lessons from the highlands of southwestern Uganda. Uganda Journal of Agricultural Sciences 9: 958–970.

Research questions

Broad research questions (Component 1, Theme 3)	Gender-specific aspects of the question	Science outputs
How can multilevel governance institutions best work to enhance local rights and livelihoods?	How can women participate effectively in multilevel governance institutions and what is needed to overcome barriers to participation?	Tools for facilitating collaboration necessary for multilevel governance Approaches for analyzing multilevel and polycentric governance systems Tools for overcoming barriers to women's participation
What mechanisms can improve smallholder and community access and control over forest and tree resources?	How to build bargaining power and confidence among women in seeking equitable access and control over forest and tree resources in mixed environments? How to link local women's organizations to national and international movements to increase their voice and strengthen their rights and access to forest resources and to market opportunities in forest and tree products? How can property rights security for women best be enhanced, particularly with regard to common or communal property?	Generic tools for analyzing access in the context of legal pluralism; synthesis of local experience and emerging patterns; analysis of factors that foster or constrain multilevel collective action for securing local rights and access Operational guidelines for assessing tenure constraints and opportunities
How to better integrate scientific and local knowledge to improve management institutions that govern forest and tree resources?	How to recognize and address different states/levels/types of knowledge between genders regarding forest and tree resources? What approaches ensure that women's knowledge and preferences are heard when attempting to modify resource governance systems?	Approaches for analyzing, comparing, contrasting and, where appropriate, integrating multiple knowledge systems User-friendly entry points to synthetic science-based models to complement local knowledge
What policies can protect livelihoods and enhance well-being given greater pressures (e.g., market integration, REDD+, biofuel expansion)?	How to ensure the inclusion of pro-women policies to adjust negative results caused by gender power relationships?	Analytical tools Synthesis of site-level experience
How can forest policies better respond to needs for tree management in agricultural lands and what institutional reforms can lower barriers between forestry and agriculture to serve the different tree germplasm and information needs for forestry and agroforestry development?	How do reforms of forest policies in response to needs in agroforestry affect female farmers or tree managers?	Smarter policy formulations that do not have perverse outcomes on tree resources on agricultural land
How can technical norms and regulations be tailored to reflect the contexts, constraints and opportunities faced by smallholders and community-level producers?	How to ensure gender differences in knowledge and learning styles are understood in the cultural context?	Analysis and synthesis of ways to link knowledge with action
In what ways can local-level institutions for collective use and management of forest resources	What elements of gender-differentiated rules, norms and practices for collective use and	Methods and approaches for incorporating and/or recognizing local-level

Broad research questions (Component 1, Theme 3)	Gender-specific aspects of the question	Science outputs
(including rights and access) be recognized and taken into account by higher-level, rules, strategies and procedures without compromising their functions and effectiveness?	management can be reasonably formalized without undermining men's and women's capacities for collective organization? What are the sustainability and benefit distribution effects of different group structural and functional attributes?	institutions (including rights and access) that are sensitive to gender-differentiated needs and priorities
What innovations in incentives, including rewards, sanctions, responsibilities and discretion, can improve the implementation of policies and laws by officials (especially frontline bureaucrats)?	In what ways are forestry officials' implementation practices (e.g., enforcement) gender differentiated? How do they affect men's and women's compliance and incentives for sustainable forest management?	Organizational strategies and interventions for improving officials' incentives

Research partners

A selection of indicative organizations are shown below to illustrate the form of partnerships envisaged for Theme 3.

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	World Agroforestry Centre	Provides research expertise on agroforestry policy development including the recent Agroforestry Policy Initiative
	CIFOR	Provides research staff and expertise on forest policy, governance institutions and forest property rights
International level	IUCN, WEDO, International Forest Resources and Institutions (IFRI) research program;	Explore opportunities for collective approaches to policy reform in the forestry sector
	Ecoagriculture Partners; advanced research institutes (e.g., IIED, CIRAD, International Center for Research on Women (ICRW) , RRI, universities	Provide access to IFRI's multisite, extended period global data sets Contribute to expanding the scope and depth of research and provide training in research methods
Regional level	CATIE, RECOFTC	Develop research priorities Collaborate in regional research and on policies for forestry and agroforestry
	CORAF, FORNESSA, ASARECA, NEPAD–CAADP Pillar 4 on research, African Centre for Technology Studies	Collaborate in research in specific regional contexts
Country or site level	Government agricultural, forest and environment ministries, NGOs active in advocacy, university departments/faculties of forestry and environment, gender/women's studies	Collaborate in research in Kenya
	Examples from Kenya: KARI, KEFRI, University of Nairobi (IDS), Kenya Forests Working Group, IUCN Kenya, ICRW regional office, Nairobi	

2.1.8 Sentinel landscapes

Many research questions in Component 1 would be efficiently addressed through coordinated research in a network of sentinel landscapes (Annex 4) with strategically chosen satellite sites that broaden the variability in key parameters over which germplasm, management options, extension approaches and policies are evaluated. Key criteria for selecting sentinel sites for this theme would include:

- sites, in contrasting major biomes, where the forest transition (from fairly natural forest through agriculture) can be sampled; this is essentially a tree cover gradient but is also likely to be confounded with population density, market access and agricultural intensification;[45]
- sites, in contrasting national policy contexts, that ensure a spread of policy environments, particularly in terms of the level of decentralization in governance of natural resources (principally forests, trees, water and land);
- efficiency of co-location with other CRPs (principally CRP1.1 and CRP1.2) and/or partners where system diagnostic research is being conducted and opportunities exist for evaluating tree options and their knock-on effects on rural livelihoods, and CRP5 where targeting of vulnerable agroecosystem niches for enhancing tree cover is already being conducted.

The effect of the uses of sentinel landscapes on geographic priorities, as determined in consultation with partners during program implementation, is set out in Section 2.1.4.

2.1.9 Impact pathways

The work in this component recognizes the important contributions of forest and tree products to rural livelihoods and environments and aims to increase the quality and quantity of those contributions through technical, institutional and policy improvements. The research takes a systems approach. It recognizes that small-scale forest managers and producers are socially and economically differentiated and operate in complex and highly constrained environments. The three themes will address the three main types of constraints in a range of systems. The research will generate impacts through several main, interrelated pathways, at two scales.

At the scale of individual production, processing and marketing systems, the research will analyze opportunities and constraints facing small-scale operators and develop appropriate interventions. Theme 1 research will seek technical solutions to improve production, productivity and profitability. It is anticipated that gains can be realized through improved scale-appropriate management techniques and the development and delivery of improved tree varieties for use in planted systems. Box 2.1 provides an illustrative example of the potential to increase smallholder production.

Theme 2 research will focus on enterprise (single farm to small company) development and management and market links. It will investigate market potential and identify where potential is unrealized. Depending on the system, it is expected that basic weaknesses in skills

[45] Robiglio, V. and Sinclair, F.L. In press. Maintaining the conservation value of shifting cultivation landscapes requires spatially explicit interventions. Environmental Management.

and capacity, poor information availability and a variety of market failures will be found. Some of these weaknesses could be addressed by training and information support for business management, market development and marketing.

Box 2.1 Example of potential impact: The Novella Africa Initiative to upscale smallholder production and incomes from *Allanblackia*

Unilever discovered that *Allanblackia* oil had huge potential for use in a wide range of food and cosmetic products because of its high quality and consistency at room temperature; it estimated potential demand as at least 200,000 tons per year. However, there were challenges. First, there were too few trees in the wild to generate anywhere near the quantity needed, which meant the species had to be domesticated for more intensive management. Unilever decided that domestication should take the form of smallholder production. Thus, the next challenge arose: seed germination is poor and, even when successful, there is a long time from growing from seed until full production.

In 2004, the World Agroforestry Centre was formally invited to join the Novella partnership consisting of Unilever, international partners SNV and IUCN, and country research and development partners Novel Development Ghana Ltd, Novel Development Tanzania Ltd, the Forestry Institute of Ghana, Amani Nature Reserve and the Tanzania Forestry Research Institute. The World Agroforestry Centre, together with project research partners, was challenged to significantly increase the propagation, survival and growth rates of *Allanblackia*. The effectiveness of the new vegetative propagation methods was evident in just two years. Although wild trees do not bear fruit for up to 12–15 years, the new vegetative propagation methods dramatically sped up growth and fruiting so that full production could be expected by seven years. Soon after this breakthrough, the partners began work to multiply the vegetative material from the most productive trees.

Outcomes since 2006 include the establishment of four gene banks carrying about 500 superior accessions, or distinct varieties, the use of protocols for vegetative propagation by national partners for multiplying planting material and the establishment of 10 large-scale commercial nurseries selling *Allanblackia* seedlings while also providing training for on-farm planting. By 2008, this enabled smallholders in those countries to plant 100,000 *Allanblackia* improved seedlings (e.g., grafted or marcotted).

Source: World Agroforestry Centre

However, it is likely that the policy and institutional environment may also be constraining the development of small enterprises and market development. Theme 3 research will analyze these aspects and recommend improvements for governance, collective action, property rights institutions and policy. It will support policy and institutional outcomes through awareness raising, training, meetings, support for government champions and, importantly, through sustained support for national policy research, civil society advocacy organizations and implementing agencies. Impact at this scale will depend in large part on local partners, as well as on international partners that are working locally, that will contribute to the problem identification, definition and analysis, and that will follow up research recommendations with direct interventions.

Important as these types of case-level impacts are, the real power of this research will come through the lessons developed by comparing and contrasting situations across a range of cases. By identifying common patterns in the kinds of problems encountered by small-scale forest-product producers and forest-based enterprises, and by learning from responses to targeted interventions (implemented by partners), Component 1 researchers will be able to develop generic tools and recommendations for wide application. For example, efforts to select and/or improve particular tree varieties will be used to develop streamlined, efficient protocols that can be adopted and adapted by national research organizations to select and enhance other varieties and species for local conditions. The analysis of problems in rural forest- and tree-based enterprises in a range of cases is expected to yield improved methods for market analysis and policy analysis, as well as appropriate and effective interventions that have been tested in the case study sites.

These analytical tools and proven approaches for intervention will be valuable to government agencies, national and international development agencies and conservations agencies that are working in rural development. The work will have a wide impact if the priority issues identified by the research reflect and influence the priorities of the larger conservation and development community, and if those organizations adopt and implement the analytical approaches, tools, methods and recommendations generated by this component and CRP6 generally. Component 1 aims to:

1. influence the research agendas of national programs and international agencies by demonstrating the importance of the issues and by developing efficient tools and methods for researching social, policy and technical constraints and opportunities in these systems;
2. encourage policy reforms that will facilitate small-scale forest enterprises;
3. facilitate effective engagement in the sector by national and international development and conservation agencies by developing and testing project-scale interventions that support forest enterprise development and management; and
4. stimulate public and private investment in small-scale forest- and tree-based enterprise sectors by producing scale-appropriate technical innovations that will increase productivity, sustainability and profitability.

These outcomes, and the intended improvements in rural livelihoods and natural resource conservation, go beyond what can be achieved by research alone. They require partnerships and broad uptake and use of research results and recommendations. A schematic of the “impact pathways” is given in Figure 2.2 (gender-specific impacts are discussed and illustrated in Section 3.1). It shows a series of research outputs that will inform the actions of other organizations. Ideally, some of these organizations will be involved in the research as “research partners”, “policy and practitioner partners” and “knowledge-sharing partners”, as described in Section 3.2 (Partnerships). The research outputs will also be shared through a variety of other means, including peer-reviewed publications, policy briefs and a range of popular communications, as described in Section 4.1 (Communications and Knowledge-sharing).

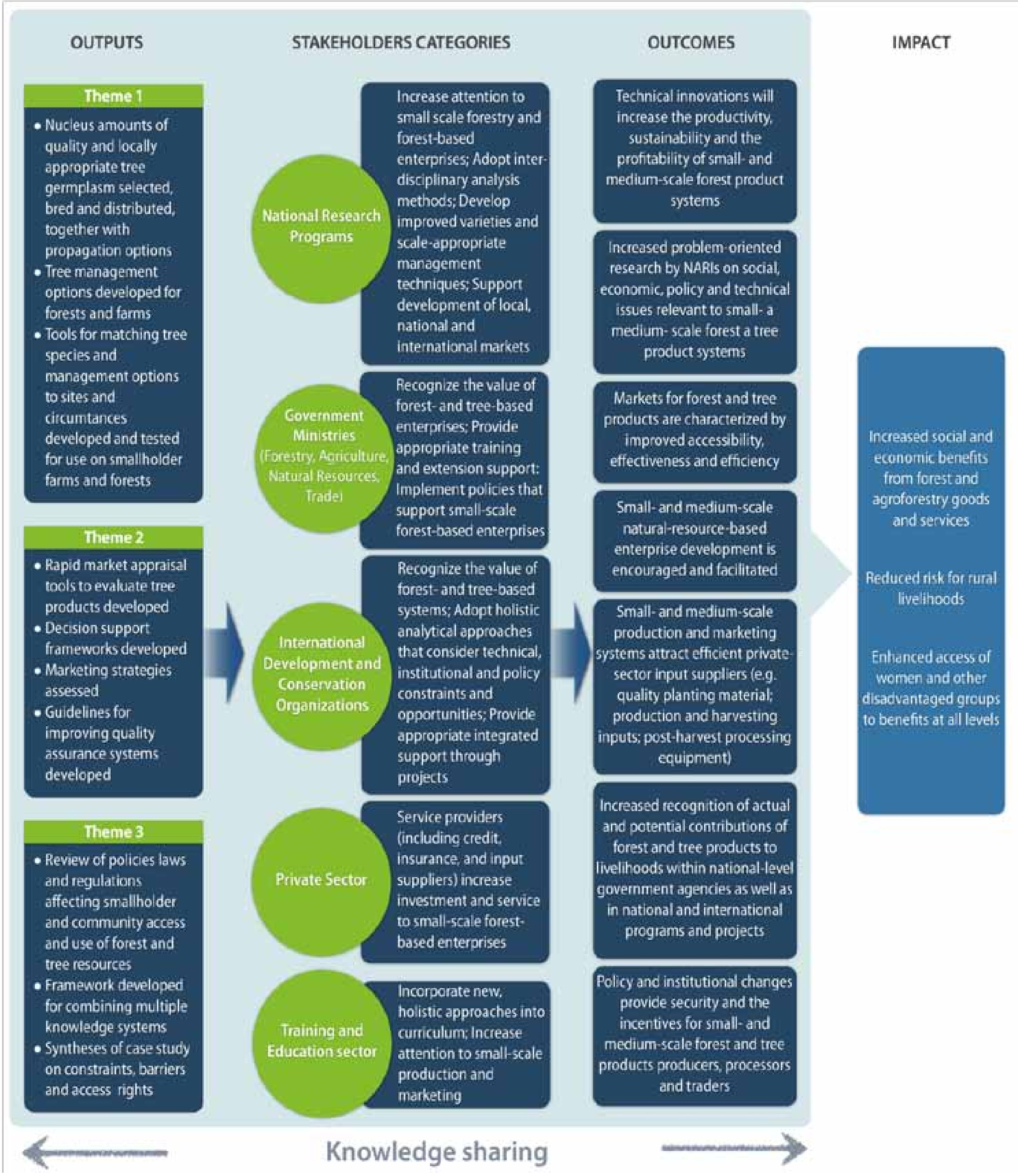


Figure 2.2 Impact pathways for Component 1

2.1.10 Milestones

During the initial planning as part of the implementation phase, we will determine, through dialogue with partners, the priority geographic contexts in which outputs and milestones will be achieved. Hence, different milestone sequences will apply to different contexts. Revised milestones for the first three years will also aggregate outputs from ongoing projects that are subsumed into CRP6.1. Below are indicative key milestones for the outputs shown in Figure 2.2.

Theme 1

Output 1: Nucleus amounts of quality and locally appropriate tree germplasm selected, bred and distributed, together with propagation options

Years 1–2: Farmers/forest managers consulted, partners identified, species for multiplication selected and prioritized for region

Years 3–4: Context for tree improvement defined for each species, including system compatibility and propagation options, baseline status of germplasm established and improvement strategy identified

Years 5–10: Improved germplasm evaluated through laboratory and field assessments (then ongoing) and appropriate germplasm for various contexts selected

Output 2: Tree management options developed for forests and farms

Years 1–2: Farmer/forest manager partners identified, management constraints and opportunities identified, existing knowledge compiled and gaps identified

Years 3–4: Initial best practice options developed through understanding of local knowledge, trials/knowledge acquisition initiated to address gaps and refine options

Years 5–10: Initial options refined through integration of local knowledge, trial results and field testing

Output 3: Tools for matching tree species and management options to sites and circumstances developed and tested for use on smallholder farms and forests

Years 3–4: Partnerships established, once germplasm and management options have been set for Outputs 1 and 2 above

Years 5–6: Targeting methods from CRP5 used in conjunction with AfSIS in Africa to target the most vulnerable sites for the region

Years 7–8: Tools developed and undergoing tested on farms and in forests

Theme 2

Output 1. Rapid market appraisal tools to evaluate tree products developed

Years 1–2: Existing appraisal tools assembled and assessed

Years 3–5: Rapid appraisal tools applied and evaluated in different situations, e.g., for different types of products and for different types of analyses, such as gender analysis

Years 6–8: Rapid appraisal tools refined and incorporated into decision support tools according to the appropriate methods under different situations

Output 2. Decision support frameworks developed

Years 1–10: Decision support tools for novel extension approaches assessed, including their ability to involve and empower women and the poor. This will be accomplished for at least three novel extension approaches (timing and geographic location to be determined at component implementation workshop):

1. rural resource centers (timing to be planned)
2. volunteer farmer trainer programs (timing to be planned)
3. civil society mobilization approaches such as SCALE (Sustainable Collective Action for Livelihoods and the Environment) (timing to be planned)

Output 3. Marketing strategies assessed

Years 1–2: Approaches tested for enhancing the role of women in collective action for marketing agroforestry and forestry products

Years 3–5: Impact of market information systems for agroforestry products assessed

Years 6–8: Demand for e-advisory services using mobile phones assessed and strategies for providing services designed and tested

Output 4: Guidelines for improving quality assurance systems developed

Years 1–2: Lessons assessed for improving smallholder access to established quality assurance systems for sustainability standards

Years 3–5: Lessons assessed on how the poor and women can accrue greater benefits from certified markets

Years 6–8: Impact of certification evaluated

Theme 3

Output 1: Review of policies, laws and regulations affecting smallholder and community access and use of forest and tree resources

Output 2: Framework developed for combining multiple knowledge systems

Output 3: Syntheses of case study on constraints, barriers and access rights

Year 1: Detailed outcome mapping and strategy developed, including partnerships, communications and capacity strengthening; conceptual framework for research developed; research and implementation partnerships established and guided by policymaker needs; research design and data-gathering instruments developed for analysis of relevant legal frameworks, policy and institutional innovations and their impacts on producer behavior; protocol developed to ensure data collection includes impacts on women and marginalized groups; roles and responsibilities of partners defined in work plan and agreed upon; national and subnational sites selected; inception workshop held

Years 2–4: Research activities undertaken in sentinel sites and other priority research sites for CRP6.1; data analyzed at multiple levels (case study, national, regional, global); results validated through stakeholder feedback (workshops) and peer-reviewed publication; synthesis report and policy briefs completed

Years 4–5: Recommendations and best practice guidelines produced; policymakers engaged to evaluate implications for existing legal frameworks and develop policy reform pilots and proposals; reforms adopted and monitoring program established in a wider set of sites for testing the reforms

Years 5–9: Annual monitoring report generated at multiple scales (national, global), workshops organized (at national and global levels) to evaluate trends; public awareness raising conducted, including via workshops, conferences at multiple levels and website and media presentations; guidelines, strategies and policy briefs disseminated

Year 9: Multi-stakeholder workshops held to evaluate original recommendations in light of monitoring data; application and continued relevance or recommendations validated

Year 10: Observe improvement in smallholders’ access to and control over trees and forestlands; improved productivity and incomes from the products of forests, agroforestry and trees; improved distribution of benefits to women and other disadvantaged actors; observed rehabilitation of degraded forests, and stabilization or expansion of forest fragments; observed improvement in resource quality and quantity of smallholder forests and trees due to improved access and rights

2.1.11 Role of partners

Table 2.1 Illustrative list of policy and knowledge-sharing partners for Component 1

Levels/Types	Policy and practitioner partners*	Roles/contributions	Knowledge-sharing partners	Roles/contributions
International level	FAO	Raises policy awareness of livelihood opportunities from trees and forests	Panos	Uses content in training journalists
	FSC	Translates research results into standards and guidelines for producers	The Global Forum for Rural Advisory Services (GFRAS)	Disseminate information on appropriate extension approaches
	UNCTAD Committee on Sustainability Assessment (COSA)	Assesses impact of certification systems on smallholders		
Regional level	COMIFAC	Translates research results into policy guidance for Congo Basin governments	CATIE	Uses content in graduate curriculum
	OTCA (The Amazon Cooperation Treaty Organization)	Coordinates policy dialogue, dissemination	RECOFTC	Assists with dissemination
	Regional Economic Commissions (e.g. COMESA) NEPAD – CAADP program African Forest Forum AGRA (Alliance for a Green Revolution in Africa)	Provide financing and technical support to national policy reforms and dissemination	African Network for Agriculture, Agroforestry and Natural Resources Education (ANAFE)	Curriculum reform for 132 universities and technical institutes in 35 African countries
Country or site level	Ministries of forestry in research and target dissemination countries	Identify improved policies and collaborate on action research in pilot policy and institutional change	Local media organizations	Raise awareness of livelihood opportunities in forest and tree products and their policy constraints
	Ministries of agriculture in research and target dissemination countries	Identify improved policies and collaborate on action research in pilot policy and institutional change	VDS (Association des Volontaires pour le Développement au Sahel), Burkina Faso	Dissemination
	ANAFOR (National Forestry Development Agency, Cameroon)	Define research priorities	Producer organizations and other civil society organizations	Engage in policy advocacy on behalf of smallholders and forest communities; dissemination and training in entrepreneurship and marketing practices
	NGOs involved in policy advocacy (e.g. Greenbelt movement in Kenya)	Define research priorities	NGOs	Engage in dissemination, policy advocacy and testing of institutional innovations

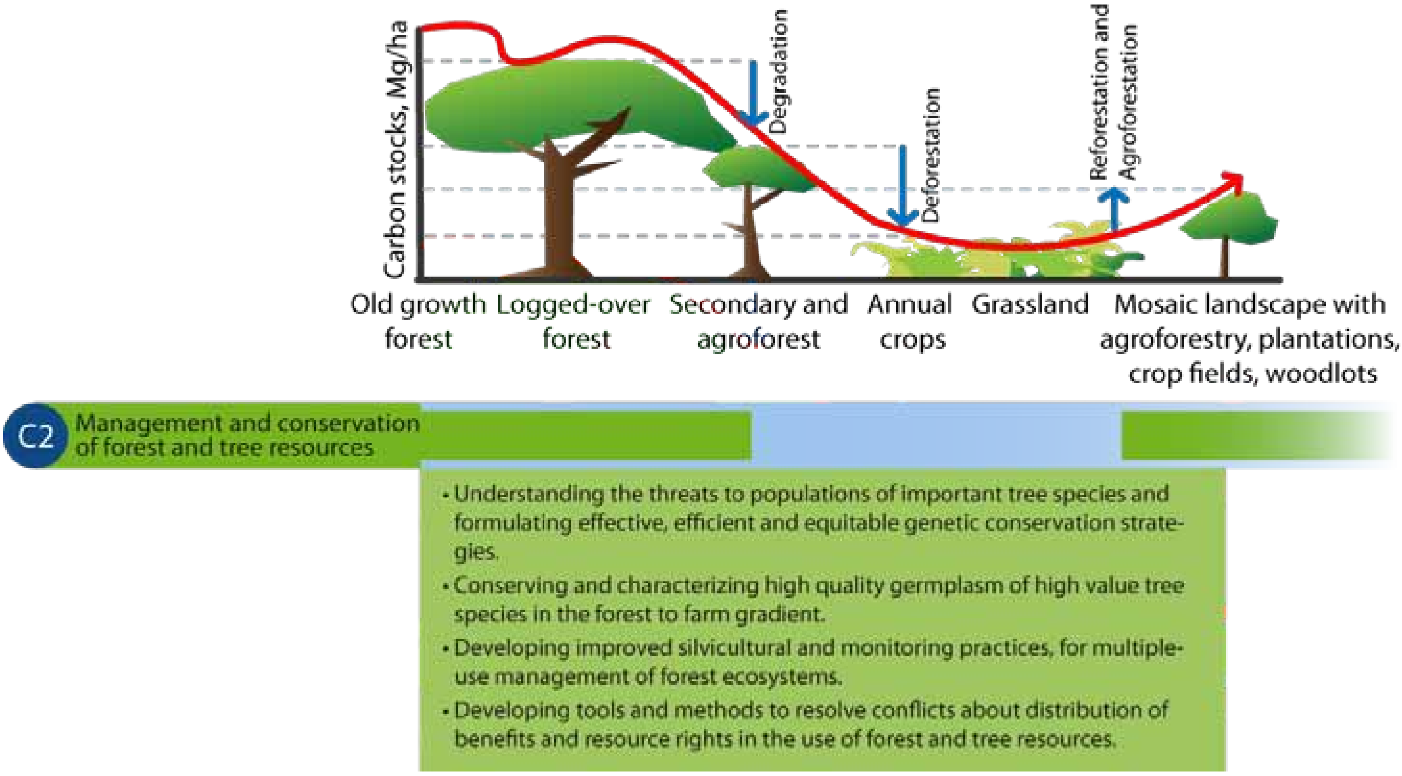
2.1.12 Prioritization

It is important to integrate the three themes within Component 1 to ensure the research contributes to overall outcomes of improvements in livelihood and sustainability. Research under Theme 1 will generate germplasm and management options. Research under Theme 2 will examine market integration and extension to ensure that options are scaled out and higher value is obtained from products. Research under Theme 3 will examine the enabling policy and institutional environment that conditions what options are viable for smallholders. Experience has shown that development programs that neglect one or more of these three elements are unlikely to yield successful outcomes.

The emphasis of the research across these themes will vary according to local circumstances. Key bottlenecks exist in relation to management options, their extension and market integration or policy and institutional reform. At a global scale, innovation in all three areas is required simultaneously to address rural poverty and underpin sustainable food production for urban dwellers. Considerable investment will be required for Theme 1 because the generation of improved tree germplasm and management options will be subject to the finest-scale spatial variation and will need to operate across a wide range of tree species, agroecological contexts and social, economic and policy environments. It will be necessary to make considerable progress over the next decade in determining which options are likely to work where and for whom, in ways that can underpin locally customized promotion. However, generating the necessary data to achieve this progress will be expensive and time consuming.

The ecological and socioeconomic environment for which germplasm and management options are being developed and selected is dynamic, due not only to anticipated climate change but also to major demographic shifts and changing patterns of pest and pathogen prevalence. Although it is tempting to see a progression from Themes 1 through 3—and this holds for individual innovations—there remains an overall need for research in all three themes to address changing circumstances. As Themes 2 and 3 inherently operate across wider spatial and temporal scales, each dollar of investment leverages a greater proportion of the development space than does investment in Theme 1, However, Themes 2 and 3 rely on the germplasm and management options generated as part of Theme 1 research, in order to make available options that rural people can adopt and adapt in response to extension, market development and policy reform. Priorities vary geographically, as set out in Section 2.1.4. Prominence of each of the research themes will vary according to location, and prioritization across locations will be a key element of the early part of the component implementation.

2.2 Component 2: Management and conservation of forest and tree resources



2.2.1 Introduction

Overexploitation of forest resources continues, even though sustainable forest management (SFM) principles have been acknowledged and accepted for decades. Forest biodiversity continues to decline rapidly[46] despite the fact that legally established protected areas cover an estimated 13% of the world's forests.[47] At the same time, in spite of substantial improvements in many countries, millions of people living in and around biodiversity-rich forests continue to suffer from poverty and reduced income from dwindling resources. A new approach to research is urgently needed to understand why accepted principles and practices do not produce expected outcomes when SFM is applied as well as the reasons for its non-implementation. Research is also needed to continue refining new management approaches at multiple scales to achieve sustainable production of resources from forests and trees that benefit the rural poor.

Persistent and increasingly urgent challenges require holistic research approaches premised on the need for multidisciplinary and multiscale studies. Complex problems involving human interactions with diminishing ecosystem resources—such as declining tree species that are used concurrently for fuel, timber, medicine and food—usually cannot be solved by addressing single factors in isolation from the system as a whole; social and biophysical approaches to problems must be merged and research must include multiple scales from landscapes to genes.

[46] Butchart, S.H.M. et al. 2010. Global biodiversity: indicators of recent declines. Science, 328: 1164–1168.
[47] FAO. 2010. Forest resource assessment. FAO, Rome.

One such challenge is the extent of degraded forestland—some 500 million hectares—found throughout the tropics. Some of the degraded forest requires interventions to regain productivity for the well-being of the rural poor and the restoration of essential environmental services. However, under some conditions, such degraded forest areas, including those that may have been deforested decades previously, can recover rapidly without any need for direct human intervention, even at large spatial scales.[48] Clarification is needed on how and when to invest both financial and human resources to actively rehabilitate degraded areas, and which species and seed sources within species are best adapted to particular ecological conditions. This is especially important in the context of recently agreed global commitments to rehabilitate degraded ecosystems within the next decade.[49]

A notable lack of decision support systems for directing forest rehabilitation efforts underlies the failure of projects in many countries to achieve their stated objectives.[50] Decision support systems can help managers who face complex problems to preferentially allocate their efforts to sites where ecosystems are sufficiently resilient, but where degradation or the landscape context is inhibiting natural recovery, as opposed to sites that are likely to recover with no or minimal intervention.[51] Such systems can also help managers choose species and genetically adapted seed sources that will increase the probability of survival and sustained rehabilitation of ecosystems. In the face of global climate change, it is essential to integrate good practices for all areas of management, from genes to trees and to rehabilitated forest management in maintaining connectivity while supplying key goods and services.

Another challenge is to enhance our understanding of the status of and threats to populations of priority tree species, as well as to identify best approaches for their conservation as a means of improving livelihoods in the context of SFM. Tree species are unlikely to be maintained in the absence of landscape management approaches. By the same token, forest landscapes will not be sustainable in the long term without consideration of the inter- and intraspecific diversity of trees[52] and the design of improved, low-impact silvicultural practices that maintain adequate levels of genetic diversity of harvested populations.[53] Many important but vulnerable tree species are not conserved in protected areas, and it is essential that viable populations be maintained in production forests. Furthermore, the integration of silvicultural and harvesting methods for timber that harmonize long-term productivity, and for coexisting non-timber forest products (NTFPs) whose productivity is vulnerable to loss of forest cover,[54] is a largely unexplored area—a shortfall that this component seeks to address.

[48] Lugo, A.E. and Helmer, E. 2004. Emerging forests on abandoned land: Puerto Rica's new forests. Forest Ecology and Management 190: 145–161.
[49] Convention on Biological Diversity, 2011–2020 strategic plan. http://www.cbd.int/decision/cop/?id=12268
[50] Holl, K.D. and Aide, T.M. 2010. When and where to actively restore ecosystems? Forest Ecology and Management doi:10.1016/j.foreco.2010.07.004
[51] Rodrigues, R.R. et al. 2010. Large-scale ecological restoration of high-diversity tropical forests in SE Brazil. Forest Ecology and Management doi:10.1016/j.foreco.2010.07.005
[52] Geburek, T. 2005. The role of biodiversity in forest ecosystems and for sustainability. In: Geburek, T. and Turok, J. (eds), Conservation and management of forest genetic resources in Europe, p. 435–458. Arbora Publishers, Zvolen, Slovakia.
[53] Jennings, S.B. et al. 2001. Ecology provides a pragmatic solution to the maintenance of genetic diversity in sustainably managed tropical forests. Forest Ecology and Management 154: 1–10.
[54] As is the case for the obligate out-crossing Brazil nut tree (*Bertholletia excelsa*) in Amazonia whose long-term productivity depends on non-managed populations of specific pollinators; see Garibaldi, L.A. et al. 2009. Pollinator shortage and global crop yield: looking at the whole spectrum of pollination dependency. Communicative and Integrative Biology 2: 37–39.

The genetic resources of wild and semi-domesticated tree species and their varieties are of utmost importance for human well-being as sources of fruits, medicines, fiber, resins, oil and bioenergy—all contributing to improved health, food during vulnerable periods, and income generation. These species are fundamental for future breeding and domestication, and help maintain future options. This diversity is seriously threatened along the forest-to-farm gradient; hence, coordinated *in situ, circa situ* and *ex situ* conservation efforts and sustainable management practices must be strengthened and initiated. There is also a need for effective long-term approaches to maintain genetic diversity and ecosystem functions of other useful tree species including wild relatives and cultivars of important tree crops, such as cacao, coconut and coffee. This will require research and careful attention to the maintenance of ecological functions within ecosystems, including the conservation of keystone species and processes, as well as biodiversity more generally.

Intraspecific variation constitutes the adaptive potential of a species in the short and medium term. This is vital to provide the raw genetic material for selecting or improving useful characteristics of trees and for responding to environmental change. Unfortunately, intraspecific diversity of trees is disappearing both on farms and from natural populations. The result is "silent extinctions" as mechanized agriculture displaces forests and traditional farmland, livestock grazing prevents regeneration, and overharvesting for fuel and other products continues. Forest regeneration and management decisions typically ignore genetic factors. As populations of trees are lost, accelerated by climate change, management options also are lost forever,[55] both for sustaining production in forests and for domestication. Such options include: countering effects of drought and salinity; enhancing resistance to pests and diseases through selection and breeding; developing new marketable commodities for poor farmers; and improving the quality and quantity of forest- or tree-sourced food.

Forest management systems in the tropics are still largely dominated by polycyclic silvicultural systems (selective logging). These systems, focusing exclusively on the extraction of a few valuable timber species, routinely disregard impacts on other forest resources and environmental services such as genetic diversity, bushmeat or NTFPs, which are used by communities that live in or use forest areas gazetted to timber producers, hydrological regulation and carbon sequestration. Efforts to minimize "conflicts of use" over species that provide both timber and non-timber benefits, or to incorporate cost-effective approaches to integrating timber and NTFP extraction are scarce.[56] Harvesting cycles for timber production usually span long periods of at least 30 years and limit the production of regular incomes for local populations. However, integrating the harvest of NTFPs between cutting cycles can ensure continuous revenue. Further, the development and implementation of more diversified silvicultural systems based on a range of tropical forest income options would stimulate the interest of multiple actors—indigenous and traditional populations and smallholder farmers—and offer alternative management options to logging companies. Such multipurpose forest management approaches need to incorporate current knowledge (both "scientific" and "traditional") on forest ecosystems. New integrated and holistic approaches for maintaining genetic diversity must be developed as an integral part of SFM. This includes strategic and effective *in situ* conservation, both in protected areas and in managed forests along the forest-to-farm gradient.

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[55] Palmberg-Lerche, C. 2002. Thoughts on genetic conservation in forestry. Unasylva 209: 57–61.
[56] Guariguata, M.R. et al. 2010. Compatibility of timber and non-timber forest product management in tropical forests: perspectives, challenges and opportunities. Forest Ecology and Management 259: 237–245.

Component 2 will focus on developing and testing new forest and tree management paradigms, building on existing knowledge and practice, while considering the multiple uses and users of trees as well as the range of forest products that contribute to the well-being of rural people. We will also focus on the influence of dominant power structures, including the relative status of women and other marginalized actors in decision making. Our approach will be **transformative** and **innovative**, with direct participation by a wide spectrum of international and local stakeholders, and will involve, *inter alia*, the following.

Cross-sectoral, global comparative approach. Collaboration with private sector, research and civil society organizations, from timber producers to conservation and development NGOs, will foster the transfer of tested practices and experiences from settings where they are well established to those where they are not. This international- or regional-level exchange and knowledge sharing will help disseminate best practices and will strengthen regional platforms for promoting SFM and ensuring that diverse forest and tree resources will increasingly benefit the poor across the forest-to-farm spectrum. Sentinel landscapes (see below and Annex 4) will contribute to global comparative research, grounded in local realities but also addressing questions that are relevant across regions and continents and that require long time frames to answer.

Integration of local values and needs. Development of management approaches for production forests and for conservation of tree genetic resources across forest–farm landscape mosaics will include local communities' values and voices. We will seek ways to increase the participation of communities in decisions regarding production forest management, thereby increasing their bargaining power in the formal forest sector. In addition, communication of our research approaches and results will raise awareness among policymakers and concession holders of local values and provide them with tools to generate new ways of "doing business".

Gender. Participation in research from planning to implementation and sharing of benefits will involve all relevant user groups, including both men and women where possible, with an aim of giving all groups equitable opportunities to contribute knowledge and define priorities for improving the conservation and sustainable use of forests and trees. To date, this is a largely overlooked aspect in forest management research.

Technology. We will use, whenever needed, new and emerging technologies, such as the application of genomics and other molecular tools, to screen useful tree species for adaptive traits in resource management and for tracking illegally harvested timber, NTFPs and trade in wildlife products including bushmeat. We will also use modeling tools (e.g., multi-agent systems) to test proposed improved forest resource (timber, non-timber, bushmeat) management paradigms and the latest GIS applications to conduct spatial analyses of allelic and species richness and threats to priority species.

Strengthening local capacity. We will foster and guide the development of young scientists in priority countries by supporting a network of PhD student fellowships associated with research at sentinel landscapes. Students will be co-supervised by scientists at local universities and by scientists involved in the component and they will carry out research that will contribute to global comparative studies. We will also develop training materials intended for managers, students and practitioners, using relevant case studies organized in thematic modules. The training materials, to be produced in several languages, will be available for download from the Internet, complete with teachers' notes and electronic presentations.

2.2.2 Thematic focus

The research carried out in this component focuses on resources at the management unit level (e.g., forest–farm gradient, community forests or timber concessions) considering both biophysical (ecosystems, populations and species) and socioeconomic aspects.

This component has four integrated themes, which link management, conservation and sustainable use of forest and tree resources:

1. understanding the threats to populations of important tree species and formulating effective, efficient and equitable genetic conservation strategies;
2. conserving and characterizing high-quality germplasm of high-value tree species along the forest-to-farm gradient;
3. developing improved silvicultural and monitoring practices for multiple-use management of forest ecosystems; and
4. developing tools and methods to resolve conflicts over distribution of benefits and resource rights in the use of forest and tree resources.

Our research themes are linked with other CRP6 components and research themes. Some management units considered in Component 2 are equivalent to "landscapes" given their size and geographic variation, which implies the need for close exchange, input and feedback from/to Component 3 (particularly regarding sentinel landscapes). Understanding the status of genetic and ecological diversity, and designing more resilient management systems through multiple uses, will provide valuable information for mitigating and adapting to climate change (Component 4). Understanding patterns of diversity and threats to tree species of socioeconomic importance and characterizing important germplasm (e.g., tree crop cultivars) will inform the trees on farm and domestication aspects of Component 1. More specifically, Research Themes 3 and 4 will have a close link with Component 5 in terms of governance mechanisms and the translation of research findings into policy recommendations for improved forest management.

The extensive links between Component 2 and the other CRPs are set out and explained in Annex 3.

2.2.3 Objectives and expected outcomes (10 years)

The overarching objective of this component is to increase the likelihood that important forest and tree resources will be available for future generations while improving the well-being of the poor who are dependent on these resources for their livelihoods.

Expected outcomes

1. Status of and threats to at least 100 priority tree species, important to both men and women in Africa, Asia and Latin America, will be better understood and mitigation and conservation initiatives will be undertaken by national partners (government agencies, NGOs) and other stakeholders.
2. National agencies in at least five countries per region will have developed and be implementing strategies for the conservation and sustainable use of forest and tree resources including intraspecific tree genetic diversity.
3. Germplasm of wild relatives and cultivars of tree crops (e.g., cacao, coffee, coconut) and priority wild tree species with important traits will be conserved and characterized.

4. Production forests will be managed for multiple uses and improved multifunctionality by integrating management of timber and NTFPs in at least five priority countries.
5. Local communities will be better represented in decision making regarding the management of production forests, ensuring more equitable benefit sharing and reducing conflicts over land use and resource rights in at least five priority countries.

Through these outcomes, Component 2 will contribute to the following impacts targeted by CRP6: (1) conservation and increased use of forest and tree genetic resources; (2) increased social and economic benefits from forest and agroforestry goods and services; (3) enhanced access of women and other disadvantaged groups to benefits at all levels; and (4) reduced deforestation and degradation.

2.2.4 Geographic priorities

Priority regions and countries are characterized by a congruence of poverty and high biological diversity, and a strong need for improved forest and tree resource management due to the dependence of poor people on forests for livelihoods along with high levels of threats to these habitats. Several activities will be of global relevance (e.g., work with the Convention on Biological Diversity).

Geographic priorities within this component are also defined in part by the location of important genetic material in tree species identified as high priority by people living in high-poverty areas. In some cases, priorities will be clear only after preliminary studies indicate where high diversity, serious threats to priority species or forest ecosystems and/or the potential for multiple uses coincide with areas key to the well-being of poor people. For tree crops, priority locations would also include countries where collections are held (such as Côte d'Ivoire or Trinidad).

At the regional level, priorities are:

- in Latin America: Amazon Basin, Andes, dry forest areas and Mesoamerica.
- in Africa: Congo Basin, West Africa, Miombo and other Sudanian (Sahel) and Somalia-Masai dry forests.
- in Asia-Pacific: South, Southeast and Central Asia and Melanesia.

At the country level, priority countries where we expect to undertake research and demonstrate outcomes are:

- in Latin America: Argentina, Colombia, Brazil, Bolivia, Costa Rica, Peru.
- in Africa: Cameroon, Democratic Republic of Congo, Gabon, Ghana, Kenya, Liberia, Mali, Malawi, Mozambique, Niger, Nigeria, Tanzania, Uganda.
- in Asia-Pacific: China, India, Indonesia, Malaysia, Papua New Guinea, Philippines, Sri Lanka, Uzbekistan.

2.2.5 Research Theme 1: Understanding the threats to populations of important tree species and formulating effective, efficient and equitable genetic conservation strategies

Rationale

Erosion of genetic resources has been recognized generally as a serious threat to forest sustainability and human welfare, but the problem has received scant attention, especially in forested landscapes. Reasons for this inadequate attention include the dearth of readily available tools for measuring and monitoring change, and a perception that the problem is too complicated or not as important and immediate as other challenges. This situation is aggravated by the fact that loss of genetic variability is invisible. As a result, thousands of tree species or populations are under threat.[57]

Best practices for conservation of useful forest tree genetic resources across the forest transition curve, including production forests and agroforests, have not been developed for most species nor applied in many countries. National agencies need support to develop, document and synthesize findings through case studies, and to apply the findings in conservation and management plans. Research is needed to identify the best combination of approaches (*in situ*, *ex situ* and *circa situ*) for species that are important for livelihoods and subsistence in areas of high diversity and/or high poverty. CRP6 proponents and partners will analyze biological and other factors (including cost–benefit analysis) to determine which approaches, separately or in combination, are best suited to particular circumstances or to particular groups of species.

Establishing criteria for developing national, subnational or regional lists of priority species and populations, and the drivers of threats to them, is the first step in defining strategies to ensure the future availability of socioeconomically important species. Identifying impediments to policy implementation in cases where countries already have conservation strategies is also important. The process of defining criteria will ensure the inclusion of tree species and traits that are valued by women, as well as those valued by men. This represents a significant change—and a challenge—to the way important genetic resources have been identified in most countries; however, it is clear that the different user groups will have different priorities at the community level (see Section 3.1 on gender).

Wild and semi-domesticated fruit and other tree species with different uses and wild relatives of tree crops are increasingly threatened in their natural ranges.[58] Germplasm of these species is valuable, and conserving it through use may improve its chances of survival. Several tools will be applied to understand diversity in wild and semi-domesticated fruit species (e.g., molecular analysis combined with basic morphological studies), to evaluate nutritional/biochemical qualities (starch properties, oil compositions and beta-carotenes), and to strengthen capacity for management and use of diversity by farmers, communities and national agencies. Methods and best practices that have proven effective for conservation elsewhere will be adapted and tested for target species. Documentation of users' knowledge and practices of *in situ*, *circa situ* and *ex situ* conservation and management will be enhanced. The research will improve our

[57] IUCN. 2010. IUCN Red list of threatened species. Version 2010.2. http://www.iucnredlist.org.
[58] Dawson, I.K. et al. 2009. Managing genetic variation in tropical trees: linking knowledge with action in agroforestry ecosystems for improved conservation and enhanced livelihoods. Biodiversity and Conservation. 18: 969–986.

understanding and account for differences in knowledge, priorities and roles of men and women in managing and conserving diversity of these resources.

Methods and research approach

Determining priority species for conservation action is complicated by the high diversity and many uses of tree species in tropical forests. For example, in Cameroon alone, just one small country in Africa, at least 74 tree species produce edible fruit[59] that people consume during times of food shortage. Some of the species are widespread, others are narrowly distributed, some have conservation designations, a few are partially domesticated and others are still completely wild and almost unknown to science. The situation is similar in many tropical countries.

The approach for developing criteria to define cost-effective species and conservation priorities will include creating and testing decision support tools in collaboration with local people, including women and disadvantaged groups. Factors that must be considered in developing such tools are the species' importance in meeting the subsistence needs of local people, income generation potential and provision of ecological services, perceived threats, costs of conservation, and opportunities for increasing use and conservation. Improved econometric tools will be developed and applied.

Understanding the status and threats to genetic resources of priority tree species with distributions that extend along forest–farm gradients and across national borders requires close collaboration with partners, for example through networks such as the Latin American Forest Genetic Resources Network (LAFORGEN), to share information, material for genetic analyses and data between institutions. As tools for genetic analysis improve and become more affordable, genetic diversity data have become more available, and it is feasible to carry out studies to obtain data that were not available in the past. A factor in choosing species for genetic analysis is their potential as models, yielding insights and lessons that could be applied to other species with similar reproductive biology and ecological characteristics. Where data are lacking, ecological proxies will be identified, tested and used to identify areas of probable high genetic diversity. Because of the small number of recorded occurrences for many species of interest, distribution will be predicted using available presence points to create descriptors of "ecological niches" for particular species.

In situ, circa situ and *ex situ* conservation status, estimated using available protected area and gene bank data as well as expert knowledge, will be combined with threat and opportunity maps. Threat maps will be developed by mapping threat factors, including predicted climate change impacts across the species distribution. Opportunity mapping will relate to market access and requirements. Combining these factors with known or predicted genetic diversity hotspots will result in genetic resource status and threat assessments for priority species. Using our research and practitioner networks, this information will be shared with managers and policymakers at national and subnational levels to define conservation targets and will be incorporated into strategies for sustainable management and conservation.

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[59] Eyog Matig, O. et al. (eds). 2006. Les fruitiers forestiers comestibles du Cameroun. International Plant Genetic Resources Institute (IPGRI) Regional Office for West and Central Africa, Cotonou, Benin.

Research Questions

Broad research questions (Component 2, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
What are the most important criteria for identifying priority tree species and populations for conservation action at subnational, national and regional levels?	How could the different priorities of men and women be considered more equally when defining common priorities? How can understanding the different gender roles help refine priorities?	Criteria for prioritizing useful diversity from local to country level developed and tested together with local and national partners
What are the status, trends threats and major drivers of loss of intra- and interspecific forest and tree biodiversity of socioeconomic importance? Considering that most countries have policies for biodiversity conservation, what impedes implementation?	Do men and women value species and traits differently and play different roles in and/or experience different effects from the drivers of diversity loss? Who loses, relatively and quantitatively when different types of diversity are lost?	Genetic diversity, useful traits, conservation status and threats assessed for priority species groups Methods for threat analysis and understanding of *in situ* conservation status, along with identification of viable solutions
What are the most effective and practical indicators of genetic diversity (including ecological proxies) across landscapes (including semi-natural, managed and planted forests)?		Practical, applicable, interpretable indicators of genetic resources for use across the landscape gradient Methodology for rapid *in situ* evaluation of diversity of useful traits of wild and semi-domesticated fruit tree species
What is the best combination of *in situ*, *ex situ* and/or *circa situ* (on-farm) conservation approaches and how can challenges to their implementation be overcome for priority tree species (including fruit trees and tree crops across the forest-to-farm spectrum?)	How can one encourage equitable participation in strategy development and outcomes? How do conservation strategies affect men and women and their access to resources? What kinds of checks should be included in tools to address gender impacts? Women are important processers and quality controllers of many fruits. How can their role be recognized?	Methods, guidelines and decision support tools developed and disseminated for complementary *in situ*, *ex situ* and *circa situ* conservation strategies for priority tree species and populations that facilitate their use in improvement and development activities Systems and procedures established for effectively conserving genetic diversity of tree crops
Which elements must be included in guidelines or strategies for conservation of genetic resources for uptake and adoption in high-poverty areas and by different user groups, including women and men?	How can equitable participation and influence in the strategy development processes, by different user groups, be encouraged?	Genetic diversity conservation strategies developed for socioeconomically important tree species, for high-poverty areas Methodologies and incentive mechanisms identified for *in situ* and on-farm conservation of tree crop genetic resources

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	Bioversity	Develops and guides projects, carries out research
	World Agroforestry Centre	Develops and guides projects, carries out research
	CIAT	Collaborates in fruit tree research
	CIFOR	Collaborates in the development of guides and undertakes research on the ecology, dynamics of important species
International level	CAMCORE	Provides data, participates in specific parts of research
	CIRAD	Participates in research, contributes expertise, data and sites
Regional level	LAFORGEN, SAFORGEN, APFORGEN, EUFORGEN	Members (government and university scientists in Latin America, Africa, Asia Pacific, and Europe) carry out parts of research projects, participate in sampling, provide data and expert information, and facilitate access to policymakers
Country or site level	FRIM (Malaysia); IRAD (Cameroon); Silo National de Graines Forestières (Madagascar); INERA (Burkina Faso); FORIG (Ghana); KEFRI (Kenya); Amani Nature Reserve (Tanzania); Université de Parakou (Bénin); various East African Universities; INTA (Argentina); EMBRAPA (Brazil)	Collaborate in specific parts of research projects
	BFW, BOKU (Austria)	Provide high-tech facilities for genetic analysis, participate in design, execution and interpretation of specific research projects in Africa

2.2.6 Research Theme 2: Conserving and characterizing high-quality germplasm of high-value tree species in the forest-to-farm gradient

Rationale

Under some circumstances, genetic resources can best be conserved through use. This is particularly true of many fruit tree species and tree crops. Research is needed to understand how to maintain genetic diversity of wild and semi-domesticated fruit species along the forest-to-farm continuum, and what kinds of incentives are needed for managers and farmers to use (and thus conserve) diverse cultivars of tree crop species. Different approaches and incentives may be needed to involve men and women in the use and conservation of diversity, depending on their access to knowledge and resources. Knowledge of genetic aspects of reproductive materials is weak for many useful tree species, and characterization and documentation are lacking on variation in important traits. Research is needed to address these constraints to increase knowledge of high-quality adapted germplasm.[60]

This research theme builds on Theme 1 and complements Component 1 of this CRP by focusing on characterizing and using advanced genomic methods, and documenting and conserving germplasm of priority species and varieties. Wild and semi-domesticated varieties of fruit tree species and their wild relatives are important for present and future food production, nutrition, income and resilience in the face of climatic uncertainties. Research is needed to develop participatory methods to characterize and document useful diversity across the forest-to-farm spectrum and to involve relevant user groups.

For important tree crops such as cacao, coffee and coconut, research will be carried out to characterize and evaluate germplasm material to facilitate its use in breeding or domestication (c.f. Component 1). Where appropriate, users will be included as participants in the research through activities to identify priorities and desired traits, and to provide expert opinion on local conditions. Again, it is important to involve both men and women to benefit from their differential knowledge and ensure that research results are broadly useful and accessible. National research systems, to be supported, will play an important role by incorporating the development of improved material at the regional or global level, and by facilitating local research.

Methods and research approach

Research will involve the characterization of populations of important species by traditional and novel approaches. Traditional methods will involve phenotypic observations in natural stands and in nursery, on-station and on-farm field trials, with approaches to characterization designed by scientists, farmers and forest-harvesting communities. Field trials will be undertaken across environmental gradients in order to understand the roles of plasticity and adaptation in tree-site matching. This is a key factor in determining recommendation zones for conservation and use in forest and farmland in the light of global challenges (such as climate change, which may result in mismatching between current tree species and population distributions and prevalent environmental conditions). Field trials of a few select species will also identify material for incorporation into formal breeding programs. Novel approaches to characterization will involve laboratory studies based on molecular markers and genomic techniques. Data from the field and laboratories will be combined with spatial data using modern statistical methods applied in association with genetic studies in model systems that take into account stochastic variation, which can create spurious positive linkages between the “phenome” and the genome.

The results of different phenotypic characterization strategies for female and male farmers and forest harvesters that identify how these actors recognize and value variation will be compared with the underlying variations revealed within populations based on other methods. This will reveal which phenotypic approaches are likely to result in the largest gains for initial production and the greatest long-term benefits for sustainable provision of products and services, which may be inversely related. Proxies for selecting material for different purposes will be identified. Trade-offs between short- and long-term benefits will be tested through cost–benefit analysis to find an optimum for given conditions, leading to the development of a generic model. Approaches developed for management will be tested along the forest-to-farm continuum to

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[60] Koskela, J. et al. 2009. The use and movement of forest genetic resources for food and agriculture. Background Study Paper No. 44. The Commission on Genetic Resources for Food and Agriculture, FAO, Rome.

assess short- and long-term benefits for use and conservation. A cost–benefit analysis of different methods for domestication of important species—based on centralized and decentralized strategies and combinations of the two—will be undertaken.

Box 2.2 Developing a global strategy for the conservation and use of cocoa genetic resources

The future of the world cocoa economy depends on the conservation and sustainable use of a broad genetic base to adapt to biotic and abiotic stresses and changing environments. Effective and coordinated conservation efforts are needed, to safeguard and have access to the diversity existing in forests as well as within farmers' fields and in *ex situ* gene banks. With this in mind, CacaoNet was launched in 2006 under the leadership of Bioversity International as a global network to optimize and coordinate the conservation and use of cacao genetic resources. One of the first internationally agreed priorities for CacaoNet was the development of a global strategy for the conservation and use of cacao germplasm.

An expert working group was created to draft the strategy based on broad consultation. Members of the expert group divided up responsibilities along different components, i.e., *in situ* conservation, *ex situ* conservation (including "virtual" strategic global base and active collections), germplasm characterization (morphological and molecular), germplasm collection and acquisition, germplasm exchange (legal aspects and safe movement), information management at different levels, and facilitation of the use of cacao germplasm.

A central component of this strategy is the proposed creation of a Global Strategic Base Collection (GSBC), providing a rational and cost-effective basis for the long-term conservation of cacao genetic resources. Composition of the GSBC will be based on an innovative selection process, strongly based on molecular genetics and designed to ensure that the known genetic diversity is comprehensively represented without bias. Selected accessions will be conserved as a virtual collection in their countries of origin and duplicated for safety purposes in one of the international collections, including the use of cryopreservation. Furthermore, a Global Strategic Active Collection (GSAC) will be created as a dynamic and dispersed collection composed of accessions that are in the public domain and with combinations of characteristics of immediate value to breeders.

Any distribution of this germplasm, whether it is intracountry, intercountry or interregional, requires that safe movement procedures and methods are in place, in order to minimize the risk of spreading pests and diseases. A specific component of the strategy will cover the organizational, managerial and policy considerations relevant to germplasm dissemination. The strategy will also consider ways to improve communication about the importance of safe germplasm movement to the cacao community.

An essential prerequisite for the efficient conservation and effective use of germplasm is the management of relevant information, and the development of CacaoNet's information management system (IMS) as another key component of the strategy. Central to the development of the IMS is CANGIS (CacaoNet Germplasm Information System), a web-based inventory of passport, morphological characterization and evaluation data for CacaoNet accessions. Additional data are accessible through links to existing databases. A germplasm ordering system will also be established for easy access and monitoring of exchanges. The widely dispersed nature of accessions also means that a particularly important aspect of the strategy will be the successful integration of local and diverse gene bank information management systems.

The development of the CacaoNet Strategy is a highly participative process, taking into account the views of as many cacao genetic resources specialists and other stakeholders as possible. This has allowed the global cocoa genetic resources community to focus on a common strategy governed through the CacaoNet platform (www.cacaonet.org).

Research questions

Broad research questions (Component 2, Theme 2)	Gender-specific aspects of the research question	Examples of science outputs
How can key genetic traits in wild and local populations be quickly identified such that high-quality germplasm of socioeconomically important tree species can be conserved?	What traits are important for men and women, taking into account their different roles and resources? What knowledge do they each have and how do they identify valuable traits?	Assessment of feasibility of using genomic tools to find sources of variation in important adaptive and useful traits Methodologies/standards for phenotypic and genetic characterization of genetic resources developed and agreed
What are the most cost-effective ways of conserving desired traits in wild and local populations?	What role can women and men play in conserving valuable local and wild populations that they have access to and use?	System and procedures established for effectively conserving important genetic diversity
How can users (e.g., researchers, breeders, farmers) get rapid access to desired genetic resources and local germplasm?	Are the primary users of genetic resources seeking priority traits identified by women and men for their different roles and resources?	Information systems and databases on genetic resources established or strengthened Systems and procedures established for making important genetic diversity of tree crops available to breeders
What institutional frameworks are effective and cost efficient to ensure genetic resources conservation, access and use of trees and tree crops?	How do we ensure that gender-specific aspects are built into a sustainable institutional framework?	Global partnership frameworks for the evaluation and conservation of and access to tree crop germplasm for important traits established

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	Bioversity International	Provides expertise in genetic resources and information management, manages tree crop genetic resources networks (CacaoNet and Cogent)
	World Agroforestry Centre	Provides research expertise in agroforestry tree genetic resources and information management
	IITA; CIAT	Provide expertise in genetic resources
International level	IUCN	Collaborate in developing best strategies for *in situ* management of genetic resources of key agroforestry species
	FLD	Provides input into establishment of field trials and strategies for conservation through establishment of breeding seed orchards for key agroforestry species
	SCRI	Collaborates in development of genomic libraries using cutting-edge technologies; conducts genotyping and sequencing of priority species to evaluate genetic diversity of adaptive and other traits along the forest–farm gradient
	CIRAD; IRD; United States Department of Agriculture	Provides expertise on conservation methods and approaches,

Type of research partner	Organization	Research partner contributions
		characterization, information management, breeding
	Mars Inc	Provides expertise on characterization and breeding
	Unilever	Analyzes oil diversity and helps identify best varieties of *Allanblackia*
Regional level	CATIE (Costa Rica)	Manages international cocoa collections, expertise in genetic resources and breeding
	Secretariat of the Pacific Community (SPC, Fiji)	Provides expertise in genetic resources
Country or site level	KEFRI (Kenya); KARI (Kenya); NARO; TAFORI; FORIG (Ghana); Amani Nature Reserve (Tanzania)	Analyze phenotypic variation along forest–tree gradients in landscape; facilitates
	Kunming Institute of Botany (China)	Provides biodiversity of tree genetic resources and its management in SW China
	National universities in most partner countries	Collaborates with lecturers to train postgraduate students who will be undertaking the project work
	Cocoa Research Unit (Trinidad and Tobago); Centre National De Recherche Agronomique (Côte d'Ivoire); Cocoa Research Institute of Ghana; CEPLAC (Brazil); INIAP (Ecuador); INIA (Venezuela); MCB (Malaysia); ICECRD (Indonesia); ICCRI (Indonesia); CRI (Sri Lanka); PCA (Philippines); Central Plantation Crops Research Institute (India); CICY (Mexico); Mikocheni Agricultural Research Institute (Tanzania); ICHORD (Indonesia); EMBRAPA (Brazil); CCI (PNG); VARTC (Vanuatu)	Manage tree-crop collections and breeding
	Production Centre Ornamental Gardening and Forestry (Uzbekistan); National Institute of Deserts, Flora and Fauna (Turkmenistan); Institute of Forestry (Kyrgyzstan); Institute of Forestry (Tajikistan)	Participate in specific aspects of research projects
	Academy of Agricultural Sciences, Almaty, Kazakhstan	Coordinate activities among stakeholder groups
	University of Reading (UK); University of Queensland (Australia); Rural Development Administration (Korea)	Provide expertise on conservation methods and approaches, characterization, information management

2.2.7 Research Theme 3: Developing improved silvicultural and monitoring practices for multiple-use management of forest ecosystems

Rationale

Despite the global community's collective efforts to promote SFM, tropical forests are under increasing pressure with increasing population and demands for new agricultural land, forest products and environmental services. Past efforts have resulted in an increase in production forests under improved management. Their number, still low,[61] is expected to increase in the near future and CRP6.2 can contribute significantly to this expansion.

At the same time, in many tropical forested countries, the basic tenets of forest management have not changed substantively over the past decades. Reduced impact logging (RIL) guidelines and forest management units (FMUs) are commonly advocated as a positive change in management, but the overall tenets are still largely based on European models "exported" to the tropics in the 1950s. This is despite growing evidence of the potential contribution of forest-dwelling people by way of their traditional management systems,[62] and the wide availability of powerful new tools for managers, such as GIS and remote-sensing imagery. Consequently, existing management plans in the tropics are frequently based on unrealistic technical prescriptions that hinder implementation by many operators.

Furthermore, in the tropics, most existing management models appear to be viable only for large concessions in unlogged forests, whereas there is an increasing number of small- to medium-scale enterprises (some directly managed by local communities) working in secondary or previously logged forests. The latter such enterprises require adapted models that encompass multiple goods and services. Research is therefore needed to reevaluate existing management approaches for tropical production forests to facilitate the design of more socially and environmentally friendly management rules.[63]

Timber-dominated management models are increasingly being challenged to explicitly include other goods and services. Although the elements for implementing multiple-use forest management have been known theoretically for decades, integrated approaches remain rare. However, there is emerging evidence[64] that different types of community-managed forests for multiple goods can be equally—if not more—effective in maintaining forest cover vis-à-vis nearby protected areas.

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[61] Nasi, R. et al. (eds). 2006. Exploitation et gestion durable des forêts d'Afrique Centrale: la quête de la durabilité. ITTO, CIFOR, CIRAD, L'Harmattan, Paris.
[62] Parrotta, J.A. et al. 2008. Sustainable forest management and poverty alleviation: roles of traditional forest-related knowledge. IUFRO World Series Vol. 21. International Union of Forest Research Organizations, Vienna.
[63] Nasi, R. and Frost, P.G.H. 2009. Sustainable forest management in the tropics: is everything in order but the patient still dying? Ecology and Society 14(2): 40. [online]: http://www.ecologyandsociety.org/vol14/iss2/art40/
[64] Hayes, T. and Ostrom, E. 2005. Conserving the world's forests: are protected areas the only way? Paper presented at the Indiana Law Review's Symposium on The Law and Economics of Development and Environment at the Indiana University School of Law. Indianapolis, IN, USA. 22 January 2005; Ellis, E.A. and Porter-Bolland, L. 2008. Is community-based forest management more effective than protected areas? A comparison of land use/land cover change in two neighboring study areas of the Central Yucatan Peninsula, Mexico. Forest Ecology and Management 256: 1971–1983.

Methods and research approach

This research theme will identify bottlenecks to minimize trade-offs in both the design and the implementation of multiple-use forestry systems. It will include timber harvesting as a primary economic output at the industrial scale or in community managed forests, but will also focus on NTFPs and environmental services as secondary outputs.

Research will take place at various scales, as follows.

- First, at the level of the FMU, where the most acute trade-offs are to be found, we will analyze regulatory frameworks, certification, knowledge capacity and silvicultural approaches, as there are scant data on how the trade-offs operate in the context of multiple-use forest management for different stakeholders, and the appropriate management interventions to ameliorate these.
- Second, we will work at the landscape scale (with links to Component 3 of CRP6), because, in some circumstances, multiple use is assumed to be more feasible there than at the stand level.

At both scales, different tools will be applied for promoting multi-stakeholder dialogue and consensus building, in order to enhance forest multifunctionality. Multi-criteria decision analysis will be carried out to assess the minimum set of institutional, organizational and policy conditions required to promote multiple-use forest management and to minimize trade-offs. Further, research will involve the development and validation of commercially viable yet locally accepted silvicultural systems through participatory approaches that harmonize Western and traditional knowledge into harvesting practices for more than one forest product. This includes minimizing conflict over use of timber species that have other values. Spatial analysis will be used to optimize management outcomes at landscape scales when segregation of uses is a preferred approach.

We will apply a combination of top-down and locally based monitoring approaches to assess the effectiveness of management outcomes in promoting multiple-use management. We will conduct diachronic analyses of time-series data using both remote sensing tools (e.g., to monitor resource availability or regeneration trends following intervention) and field methods such as permanent sample plots (e.g., to monitor biodiversity change or forest integrity changes before and after intervention). We will also adopt synchronic approaches using snapshot censuses of various diversity components, floristic and vegetation structure in impacted and non-impacted sites presenting similar conditions (e.g., comparing certified and non-certified forests for biodiversity outcomes).

Research questions

Broad research questions (Component 2, Theme 3)	Gender-specific aspects of the research question	Examples of science outputs
What forest management policies and practices can provide sustainable incomes and incentives for maintaining environmental services, while protecting the natural resource base, and under what conditions?	What factors affect distribution of incomes from different approaches? How are nonmonetary benefits (e.g., domestic use) affected? Who do incentives target; what factors influence targeting? What are the constraints on women benefiting?	Development of tools, methods and guidelines for better monitoring and management of tropical production forests for multiple uses and beneficiaries
How can we go “beyond timber”? What management interventions are needed to maximize the total array of benefits (environmental, social, economic) from forests?	How can men and women share responsibility as resource managers, users and knowledge holders? How can forest managers be sensitized and their capacities to identify and consider gendered roles, preferences and knowledge be enhanced? What processes and accountabilities are required to ensure that the analysis of forest products takes into account postharvest processing possibilities and constraints by men and women for different products?	New silvicultural tools, harvesting guidelines and approaches that avoid local extinction of commercial timber species and attempt to integrate biodiversity considerations (including bushmeat) and other environmental or cultural services into management plans
Does forest certification contribute to the achievement of SFM in tropical production forests or is it simply adding cost and complexity without sufficient corresponding commercial advantage?	Who participates and what are the conditions for participation in the development of standards? What alternative processes and strategies can be adopted to broaden participation? Who benefits in terms of resource conservation and increased incomes and why? How can market-based mechanisms on a global level address and ensure distributional equity and outcomes at the site of production? What innovative solutions and institutions (responsibilities and accountabilities) can be crafted at different governance levels (local, national, global) to facilitate equitable outcomes?	Identification of stand-level trade-offs in multiple-use management systems as they relate to regulatory frameworks, certification and knowledge capacity and silvicultural approaches
What is the minimum set of criteria to include for allocating efforts to rehabilitate degraded ecosystems for the provision of multiple goods and services at the stand and landscape levels?	Differential gender appropriation of the provision of forest goods and services from rehabilitated forests and gender-specific traditional knowledge as an input of silvicultural practice	Decision support systems, best practice guidelines including genetic, ecological and silvicultural approaches
How can agreements be facilitated in existing large and complex stakeholder networks around tropical production forests?	Analysis and recognition of power relations (including influencing factors) in order to design procedures and strategies for increasing the bargaining power of marginalized actors. What resources are irreplaceable for each gender and should thus be addressed as a priority?	Guidelines and mechanisms developed for use of government agencies, certification bodies, private enterprises and communities

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Provides scientific expertise on multiple-use systems in tropical forests with emphasis on silviculture, management planning, certification, monitoring
International level	CIRAD	Provides scientific expertise on tropical forest management; provides access to network of PSPs; participates in research at most sites
	Tropenbos International	Participates in research at specific sites
	Joint Research Center of the European Commission	Provides scientific expertise in remote sensing, database management; participates in development of observatories and in sentinel landscapes
	Tropical Forest Foundation	Provides scientific expertise in silviculture, RIL; participates in research at specific sites
Regional level	CATIE (esp. Central and South America)	Provides scientific expertise on tropical forest management; provides access to International Model Forest Network; engages in capacity building; participates in research
Country or site level	SPDA (Peru)	Provides expertise in design and implementation of multi-stakeholder platforms for improving forest management; provides expertise in influencing forest policy
	IRAD (Cameroon); IRET (Gabon); University of Kisangani (DRC); Forest Research Institute of Papua New Guinea (PNG FRI); Iwokrama International Center (Guyana)	Participate in research at specific sites and co-supervise MSc/PhD students
	Université Catholique de Louvain (Belgium); Université Libre de Bruxelles (Belgium); University of Florida (USA)	Participate in research at specific sites and co-supervise MSc/PhD students

2.2.8 Research Theme 4: Developing tools and methods to resolve conflicts about distribution of benefits and resource rights in the use of forest and tree resources

It is widely acknowledged that local men and women have forest management strategies that are potentially valuable to the development of new silvicultural systems. Many stakeholders are involved in the formal and “informal” (including customary) management of forests designated for production. Some, such as indigenous communities, migrants, timber companies, frontline forestry officials and local NGOs, are involved directly. Others, such as international NGOs, national governments, end consumers and companies that trade wood or carbon credits, may be involved in less direct ways. Different groups often have conflicting or overlapping rights and responsibilities. Companies, for example, may be allocated usage rights in areas inhabited by local forest dwellers and/or used by forest-adjacent communities. However, there may be unrealized scope for synergies in production forest management.

The devolution of forestry governance, a global trend over the past two decades, offers great promise. Decentralized systems are anticipated to provide opportunities for better incorporating local values, knowledge and aspirations into forest resource management.[65] At this stage, however, the extent to which such governance reforms have achieved (or are achieving) anticipated policy objectives is unclear.[66] Forest decentralization has occurred against the backdrop of an extended history and practice of industrial forestry concessions in many parts of the world. Most of these concessions arose as a consequence of direct allocation by governments to forestry sector investors (such as in the Congo Basin). Community concessions are on the rise (e.g., in Latin America), and agreements and arrangements between industrial concessions and local authorities/communities (global) are forming a new trend, increasingly pursued as a means for due consideration of local economic, social and cultural needs. In addition, recent rigorous analytical research[67] demonstrates the central role of women in forest management, although the potential contribution of women to sustainable production forest management remains a neglected aspect of production forestry.

Overall, there is a general lack of empirically grounded analysis with systematic data collection on the interactions between communities and timber concession holders. The World Bank,[68] for example, has collected data from experts, with the aim of identifying the most important attributes of successful partnerships, while other researchers[69] have established the motivations for and impacts of different community–company arrangements, although their methodological aspects beg further clarity. Other studies have collected field data to address issues related to, but not congruent with, the interactions between timber concession holders and local communities.[70] There has been little data collection on the interactions between communities and concession holders; most existing studies lack a community perspective.

Without methodological clarity or the inclusion of the perspectives of a critical actor (e.g., local communities), it is difficult to assess what aspects of concession management are working (or not); hence, it is difficult to propose policies, practices and strategies that are likely to deliver the broad goals of equity, efficiency and effectiveness in production forestry management. In an analysis of the impacts of forest concession management on customary tenure systems in Central Africa, researchers found that the concession yields insignificant benefits to local communities. In post-1996 Bolivia,[71] where, unlike in East Kalimantan,[72] community rights are

[65] Agrawal, A. and Ostrom, E. 2001. Collective action, property rights and decentralization in resource use in India and Nepal. Politics and Society 29: 485–514.
[66] Andersson, K.P. et al. In press. Unpacking decentralization: a case study of Uganda’s forestry reforms. CAPRi Working Paper. IFPRI, Washington, DC.
[67] Agarwal, B. 2000. Conceptualizing environmental collective action: why gender matters. Cambridge Journal of Economics 24(3): 283–310; Agarwal, B. 2009. Rule making in community forestry institutions: the difference women make. Ecological Economics 68: 2296–2308; Agarwal, B. 2010. Does women’s proportional strength affect their participation? Governing local forests in South Asia. World Development 38(1): 98–112.
[68] World Bank. 2009. Rethinking forest partnerships and benefit sharing: insights on factors and context that make collaborative arrangements work for communities and landowners. Report No. 51575-GLB. Agriculture and Rural Development Department, World Bank, Washington, DC.
[69] Nawir, A.A. et al. 2003. Towards mutually beneficial company–community partnerships in timber plantations: Lessons learnt from Indonesia. Working Paper no. 26. CIFOR, Bogor, Indonesia.
[70] Mendoza, G. and Prabhu, R. 2000. Multiple criteria decision making approaches to assessing forest sustainability using criteria and indicators: a case study. Forest Ecology and Management 131(1–3): 107–126; Donovan, D. and Puri, R. 2004. Learning from traditional knowledge of non-timber forest products: Penan Benalui and the autecology of Aquilaria in Indonesian Borneo. Ecology and Society 9(3): 3 [online] http://www.ecologyandsociety.org/vol9/iss3/art3/; Becker, C. and Ghimire, K. 2003. Synergy between traditional ecological knowledge and conservation science supports forest preservation in Ecuador. Ecology and Society 8(1): 1 [online] http://www.ecologyandsociety.org/vol8/iss1/art1/.
[71] Larson, A.M. et al. 2010. New rights for forest-based communities? Understanding processes of forest tenure reform. International Forestry Review 12(1): 78–96.

legally recognized, local communities can directly manage concessions or even lease/sell management rights to external commercial actors. Local communities with land rights have the first option rights to apply for management rights. Because logging concessions in East Kalimantan overlap with customary/*adat*-held forests, conflicts over access and use are prevalent, unlike in Bolivia. Such cross-country comparisons are valuable, although scarce. Their policy relevance and validity can be greatly enhanced both through a broader, systematic comparison of contrasting models and property regimes and by including an analysis of the actual practice of rights as opposed to rights-in-law alone.

Methods and research approach

We will focus on generating knowledge of the relative ability of different production forestry models/approaches to contribute to the enhancement of the benefits, skills and knowledge of forest-adjacent and forest-dwelling communities. A broad range of approaches are currently practiced in different parts of the world: lease–lease back arrangements in Papua New Guinea; community concessions and company–community agreements in different parts of Latin America; formal benefit-sharing agreements in Africa, Asia and Latin America; and outgrower forestry schemes and voluntary systems (such as certification, eco-forestry and corporate social responsibility) in all three continents. A careful research design that is grounded in comparative methods will be employed to isolate the factors that condition successful community–company interactions. We anticipate that property rights/tenure security (for communities/ groups and for individuals within communities) will prove a fundamental incentive for the capture of benefits of management and for engendering sustainable management.

Research will explore the values, knowledge and perceptions of local men and women in relation to production forests. The potential contribution of women to sustainable production forest management, a much-neglected aspect of production forestry, will be assessed; measures for enhancing their participation in relevant aspects of the enterprise will be identified. This research output will also generate knowledge on the relative ability of different production forestry models/approaches (e.g., outgrower schemes, community concessions) to contribute to the enhancement of the benefits, skills and knowledge of forest-adjacent and forest-dwelling communities. It will examine the factors that determine how forests are managed and benefits distributed among relevant stakeholders under each production model, including the responsibilities, accountabilities and coordination mechanisms of communities, private companies, government agents and other relevant actors. In particular, it will seek to understand and identify incentive mechanisms and procedures for enhancing the benefits of production forestry for women under the different models.

Analyses will reveal the range of property rights regimes that exist at the company concession–community interface in diverse contextual settings and will help determine how such regimes create, allocate and enforce entitlements and responsibilities among actors. The analyses will identify rights allocation regimes that have the potential to resolve existing conflicts, and governance processes and practices that are inclusive and have the potential to enhance equitable access and benefit distribution from production forests. Many forest-adjacent communities, including those residing close to production forests, are among the poorest and sit at the lower end of a power continuum compared with governments and private companies. We will seek to understand how communities can build cooperation and synergies both internally

[72] Palmer, C. 2004. The role of collective action in determining the benefits from IPPK logging concessions: a case study from Sekatak, East Kalimantan. CIFOR Working Paper No. 28. CIFOR, Bogor, Indonesia.

and with external actors. Factors that strengthen or undermine collective action for sustainable use and/or securing rights to production forests will be assessed, as will the extent to which communities are aware of their rights and responsibilities. We will assess institutional channels through which claims to land and forest resources can be or are contested, including mechanisms for resolving disputes and their effectiveness.

A comparative research design will be used to identify and select cases with contrasting institutional characteristics, not only with regard to specific community–company benefit-sharing arrangements, but also with respect to broader institutional arrangements such as levels of interaction with government actors or the existence (or not) of statutory recognition of community rights to forest resources. Such a research design will enable the testing of hypotheses, for example, that legal recognition and enforcement of community rights result in greater benefits to communities and more favorable community–company relationships. Further, hypotheses will be crafted to test whether intra-community distribution of benefits is conditioned by company–community relationships or company policies/strategies, among possible variables.

A broad range of tools and methods spanning multiple disciplines are relevant. Household surveys will be used to collect data on: socioeconomic attributes; production forest dependency; access to and share of flow of forestry benefits; inequalities; values and beliefs; and local community perceptions of forest timber concession operations. Where possible, intra-household surveys will be used to differentiate within-household preferences, values and benefits of concession use and management. Focus group discussions among differentiated resource users (including women, youth, ethnic minorities/indigenous people) will be used to collect group-level data on: local forest use, preferences, values and beliefs; local/customary rules governing forest resource, access, use and management; historical dimensions of forest access and use; local systems of accountability and enforcement; community–company relationships; community–local/central government relationships; forest-related conflicts; and resolution mechanisms.

On the company side, where possible, key informants will provide information on company policies and strategies with respect to local communities, including benefit-sharing programs, dispute-resolution mechanisms and their implementation. Similar interviews will be conducted with other actors in government and civil society organizations. Behavioral experiments of various kinds (economic experimental games, role-playing games) will be conducted with representative samples of community members to elicit data on individuals' preferences, resource use and decision making, in order to isolate the factors that influence these parameters within the context of forestry concessions. Thus, both qualitative and quantitative data will be collected, allowing the use of multiple data analysis techniques, including in-depth interpretation and classification of institutional dimensions, as well as regression analysis.

Research questions

Broad research questions (Component 2, Theme 4)	Gender-specific aspects of the research question	Examples of science outputs
What do local people (men, women, old, young, dominant and marginalized ethnic groups) value about the production forests in which (or near which) they live?	How do differential roles in the community explain and affect valuations among multiple interests and to what extent are people able to express their views and influence decisions on forest management?	Guidelines/uses developed for forest resources that incorporate and recognize local values
What strategies exist and can be developed for bringing together the ideas of formal production forest managers and local community members (including women and other marginalized groups)?	How have existing strategies performed and how can they be structured and improved to better meet objectives? How do groups' and individuals' power relationships help to explain their attitudes and their actions? How would recognition of sensitization and capacity-building needs help to achieve common understanding?	Guidelines and mechanisms for forest resource use developed that reconcile/resolve trade-offs and build common understanding between forest managers and communities
How can agreements be facilitated in existing large and complex stakeholder networks around tropical production forests?	Analysis and recognition of power relations. What resources are irreplaceable for each gender and should thus be addressed as a priority?	Guidelines and mechanisms developed for use of government agencies, certification bodies, private enterprises and communities

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Leads research; oversees and coordinates methodological development and implementation of research project
International level	FAO	Links to policy at national, regional and global level
	PROFOR	Analyzes benefit-sharing arrangements; links to policy at national, regional and global level
	ICRW	Conducts gender analysis and methodology development
	IUCN	Links to policy and advocacy and national, regional and global levels
	IFRI (International Forestry Research & Institutions research program)	Shares multi-country, extended-period (15 years) data sets on institutional, socioeconomic and biophysical aspects of forests and forest management
	ITTO	Links to policy at national, regional and global levels
Country or site level	FORDA, Indonesia	Engages in national- and regional-level policy development
	Forest Research Institute of Papua New Guinea	Engages in research and policy development at national and subnational levels
	University of Kisangani (Cameroon)	Engages in research and policy development at national and subnational levels
	Universidad de Sao Paolo (Brazil)	Engages in research and policy development at national and subnational levels
	WOCAN	Engages in gender advocacy at national and subnational levels
	WEDO	Engages in gender and advocacy at national and subnational levels
	Ministries/departments of gender and development	Engages in policy advocacy at national and subnational levels

2.2.9 Sentinel landscapes

Component 2 would use sentinel landscapes to gather baseline data and monitor changes in people, institutions, forests, trees and genetic resources. These landscapes would cover a gradient of socio-ecological conditions and would include networks of study sites that would be remeasured at regular intervals. The factors that threaten forests, trees and genetic resources and/or their response to experimental treatments and current management activities would be tracked. Long-term monitoring (including remote sensing) would allow us to establish and test the factors that condition success or failure of interventions aimed at enhancing the capture and distribution of benefits of production forests between local men and women.

Ideally, sentinel landscapes would allow us, through a mix of diachronic (permanent plots, repeated censuses) and synchronic (large scale inventories, screenings) approaches, to understand the effects of the main social and environmental factors on the structure, diversity, dynamics, C-storage capacity and resilience of forests, trees and genetic resources and to test the effects of management options. This knowledge base would then be used to design improved conservation strategies and multiple-use management systems for trees and forest ecosystems that also take into account the values, needs and priorities of different resource users, and minimize conflicts among them.

2.2.10 Impact pathways

The research team for Component 2 will be accountable for the successful delivery of the outputs related to the conservation and use of forest and tree resources; it will also engage and share responsibility with key partners for the dissemination and adoption of the project's outputs to achieve the expected outcomes. The indicators, methods and best practices developed will provide the scientific and practical foundations for enhancing certification schemes to include appropriate attention to conserving genetic diversity and promoting equity in the distribution of benefits. Capacity will be enhanced in project countries to carry out the processes of identification and development, dissemination and adoption of best practices in conservation, management and use of forests and tree genetic resources. The adoption of these practices will lead to an increased level of conservation of important forest and tree resources for future generations; the availability and use of a broader range of trees and their products will improve the well-being and food security of people living in areas of high poverty, as well as ecosystem resilience.

Stakeholder analysis will enable the project team to integrate target groups into the research process to ensure the relevance and uptake of research findings. In addition to engaging with the national and regional forestry research community (NARS), this will involve extension services, farmers or NTFP-collector groups (including both men and women), forest enterprises (including small-scale, NTFP-focused enterprises) and national and international NGOs. Local people will participate in the research and be the ultimate beneficiaries through enhanced management capacities, reduced levels of local conflict and greater inclusion in decision-making processes governing production forests.

Research outputs will be used at multiple levels as illustrated in the following examples.

- Practical indicators of genetic resources will be useful for policy partners (e.g., ITTO), managers and certification schemes (e.g., FSC) to take into account genetic diversity in management plans or standards.

- Methodology for a rapid *in situ* evaluation of diversity of useful traits of wild and semi-domesticated fruit tree species will be useful for producer organizations, managers and breeders.
- New silvicultural tools, harvesting guidelines and approaches for multiple-use management, integrating NTFPs (including bushmeat) and other services into management plans will be of interest to international policy/practice partners (e.g., FAO, ITTO), the World Bank and other development banks, government agencies and training institutions.
- The identification of stand-level trade-offs in multiple-use management systems as they relate to regulatory frameworks or certification will help in the design of better adapted certification standards and more favorable policies at the national level. This output will be of considerable use to certification schemes (e.g., FSC standards for Small and Low Intensity Forest Management (SLIMF)) and government agencies in charge of production forests.
- Integrating NTFPs (including wildlife and bushmeat) into multiple-resource forest management will conserve important environmental services and safety nets for the poor, as well as building local confidence and capacity in management of both timber and non-timber products. We will collaborate with international organizations (e.g., CPF, ITTO, FAO), national and local governments, industry and national and international NGOs in the development and dissemination of improved silvicultural and monitoring practices for conservation and sustainable management of production forests, to reach end users more effectively.
- A more holistic approach to forest management will also have indirect benefits (see Box 2.3), such as reducing conflicts between companies and local people through attention to NTFPs, many of which are collected by women. At national and local levels, research will empower **development and knowledge-sharing** partners to provide tools and knowledge to governments, companies and communities for the development and adoption of sound policies, standards and management arrangements.

The adoption of these practices is expected to contribute to the following impacts: (1) conservation and increased use of forest and tree genetic resources; (2) increased social and economic benefits from forest and agroforestry goods and services; (3) enhanced access of women and other disadvantaged groups to benefits and decision making at all levels; and (4) reduced deforestation and degradation (see Figure 2.3 and Section 3.1 for gender-specific impact pathways).

Box 2.3 The benefits of better managed production forests

Better managed production forests suffer less unnecessary damage during harvesting, thus ensuring a better living environment for local communities (e.g., less pollution, maintenance of water quality and conservation of important local resources); this results in greater ecological and economic value of the remaining forest stands, less forest degradation and more CO_2 stocks in the logged-over forests.

Carbon: The potential global contribution of improved tropical forest management to carbon retention is substantial. With a total area of about 350 million hectares of tropical moist forests designated for production, research[1] shows that improved timber harvesting practices would retain at least 0.16 gigatons of carbon per year (Gt CO_2 yr^{-1}), amounting to about 10% of the total emissions linked to deforestation.

Degradation, biodiversity: Production forests sustainably managed for multiple uses[2] allow combined economic benefits—mixing short-term returns from NTFPs or wildlife and long-term returns from timber—with as much as 30% less damage to the residual stand. This is potentially applicable to more than 100 million hectares of timber concessions in Central Africa, Amazonia and Southeast Asia.

Economics: Improved management practices (including RIL) increase the efficiency of the timber sector, allowing an optimal use of equipment (20% lower heavy machinery needs) and less waste (up to 20% of logs are forgotten in conventional logging operations). This ensures generally a better financial return on a hectare basis and the need to use a smaller forest area for the same production level.[3]

Given the rate of adoption of management[4] and certification in the tropics,[5] we can expect our research to contribute to the adoption of ecologically and socially sustainable production and management practices for 9.3–27.8 million hectares of production forests. This may result in secondary benefits of between 0.01 and 0.03 Gt CO_2 yr^{-1} of averted emissions, as well as in a significant decrease in biodiversity loss due to forest degradation, with 3–9 million hectares of more productive forests not unnecessarily degraded by harvesting activities.

References:

[1] Putz, F.E. et al. 2008. Reduced-impact logging: challenges and opportunities. Forest Ecology and Management 256: 1427–1433.
[2] Guariguata, M.R. et al. 2010. Compatibility of timber and non-timber forest product management in tropical forests: perspectives, challenges and opportunities. Forest Ecology and Management 259(3): 237–245.
[3] Putz, F.E. et al. 2008.
[4] ITTO. 2006. Status of tropical forest management 2005. ITTO Technical Series no. 24, ITTO, Yokohama, Japan.
[5] Auld et al. 2008. Certification schemes and the impacts on forests and forestry. Annual Review of Environmental Resources 33:187–211.

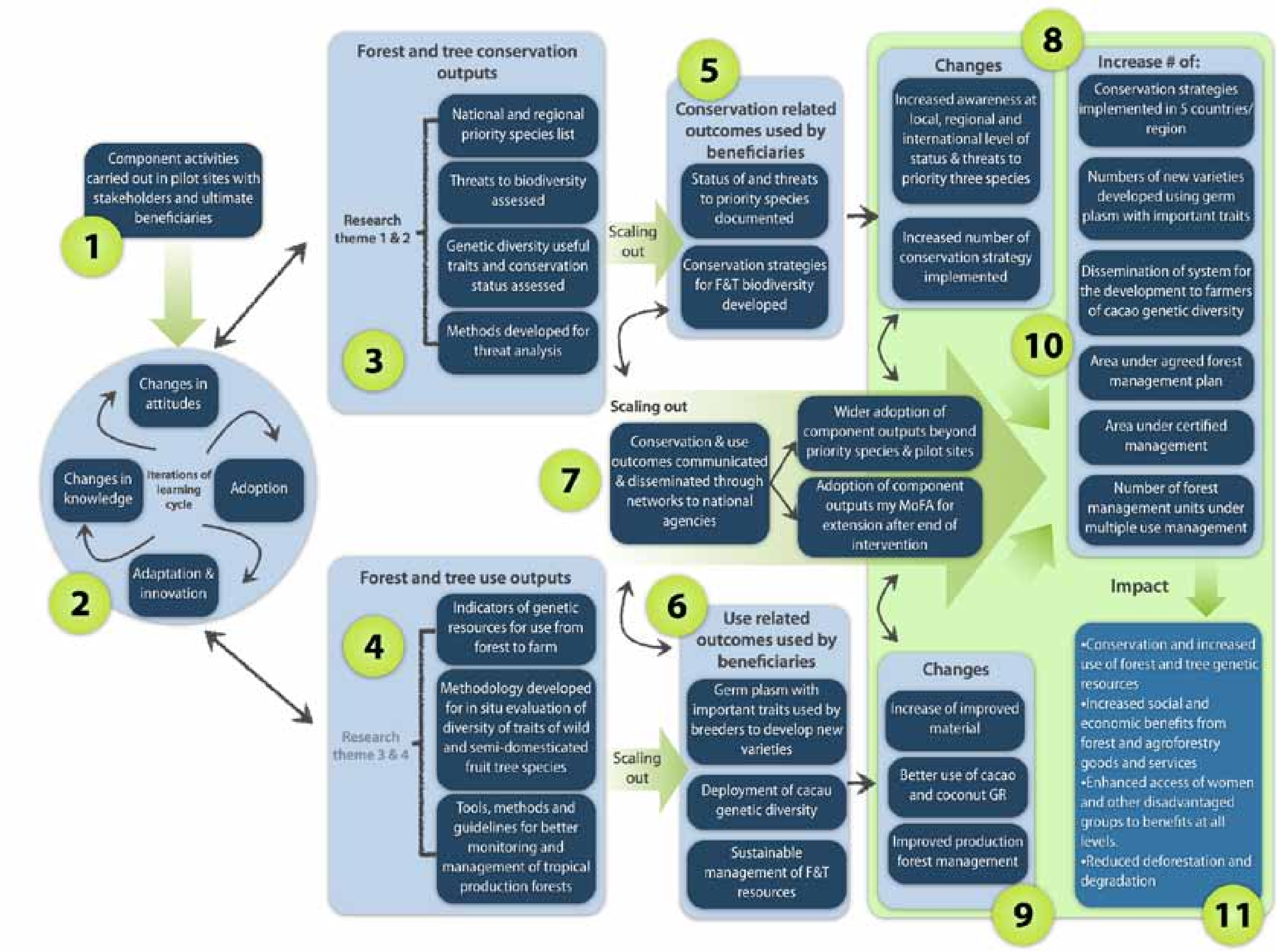


Figure 2.3 Impact pathways for Component 2

2.2.11 Milestones

Years	Research Theme 1	Research Theme 2	Research Theme 3	Research Theme 4
1–2	Existing partnerships reinforced and new partnerships established, memoranda of understanding and subcontracts in place with research partners in relevant countries. Roles and responsibilities agreed for each stage, capacity-strengthening elements established for PhD and postdoctoral fellows (including women) from national institutes. Priority sites, species, populations identified and standardized methodologies to be used across sites agreed upon with partners ideally associated with sentinel landscapes. Data-sharing agreements developed. Monitoring and evaluation systems developed and agreed (in collaboration with other component teams).			
	Continuation of ongoing relevant projects. Joint fundraising to develop new projects or expand existing projects to new countries.			
2–4	Sampling carried out, lab analysis conducted, data assembled from diverse sources, baseline data collected in pilot sites using participatory methods, genetic status of first group of priority species evaluated. Threat analysis, evaluation of genetic variability in traits for first-level priority species, data analysis, journal publications.	Phenotypic observation carried out, field trials across environmental gradients to understand plasticity and adaptation established for key species; sampling carried out, genomic libraries developed and genotyping/sequence analysis undertaken; spatial data assembled; students trained; genetic status of first group of priority species evaluated, results obtained.	Literature reviews and scoping assessments on past experiences and lessons learned on several dimensions of multiple-use forests carried out. Multi-stakeholder dialogue platforms established. Bottlenecks identified and opportunities for targeted interventions discussed with partners and proposed. Continuation of ongoing relevant projects	Research conducted in selected priority country sites. Institutional factors and conflicts mapped for each site. Community value and community–company conflict profiles developed. Community-level monitoring indicators developed. Various manuals and guidelines developed (coordination between government, companies and communities, approaches for lowering company–community conflicts, improved benefit sharing)
	Completion of most preexisting projects and start of new portfolio of relevant projects. Joint fundraising to develop new projects or expand existing projects to new countries.			
4–6	Guidelines and strategies drafted; community training carried out at pilot sites.	Data (field, traditional knowledge and laboratory) combined with spatial data to link phenomes with genomes; field trials of a select few species for incorporation into breeding programs established.	Interim research outputs synthesized to further guide changes in policy and develop best practices for designing multiple-use systems and monitoring their outcomes.	
	Case studies developed for modular training materials on forest genetic resources, multiple forest use (including non-timber forest products), resource conflict resolution.			
	New major round of fundraising.			
	Research outputs placed in peer-reviewed journals and peer-reviewed reports and disseminated through various vehicles to national and global scientific and policy arenas (e.g., policy briefs, community feedback sessions, national policy roundtables, exchange meetings between communities, practitioners and policymakers).			

Years	Research Theme 1	Research Theme 2	Research Theme 3	Research Theme 4
7–8	*In situ* protection strengthened, *ex situ* collections established (live gene banks, seed bank collections), extension material	Evaluation of genetic variability in traits for first-level priority species, contribute to Theme 1 in prioritizing geographic areas for conservation and use in forest and farmland in the light of global challenges	Uptake by relevant certification agencies, NGOs and the private sector	Guidelines, strategies, policy briefs disseminated. Use of manuals, practitioner guides and policy briefs by NGOs, local government and companies in their community work.
	National and subnational policies changed to reflect guidelines, strategies implemented. Changes observed in conservation and management practices at local level, i.e., increased number of tree species retained in farmers' fields, increased implementation of actions to conserve priority tree species and populations by national management agencies and international forest management (such as FSC) and conservation organizations, more planting of vulnerable species.		National organizations adopt the recommendations derived from the research and are embodied in regulations and local norms. National project advisory committees play central roles in encouraging use, application and revision of manuals, guides, policy briefs and tools.	
9–10	Reduced threats and greater use of intra- and interspecific diversity, as indicated by monitoring of pilot sites; greater recognition by development organizations of the importance of tree species for food and other needs.	Evaluation field trials; impact of research taken so far assessed; contribute to the component's strategy for management and conservation of the genetic resources of priority species.	Conversion of multiple-use managed forests into other land uses is reduced with respect to mono-dominant uses and forest protected areas	Resource and recourse diagrams and community monitoring tools applied for monitoring. External impact assessments of research encouraged. Reduced conflicts between local communities and companies.
	Long-term, effective management and conservation of forest and trees and their genetic resources in three regions is in place.			
	Rights allocation regimes and alternative resource access options are understood (and put into practice) by multiple-resource users. Improved distribution of benefits to the poor (including to women and ethnic minorities) such as enhanced resource access options, increased employment opportunities and incomes, improved capacities and opportunities to sustainably manage production forests. Capacity of local communities to engage in collective action strengthened.			

2.2.12 Role of partners

Most of our work will be carried out under some form of partnership. Relevant partners belong to all three categories defined in Section 3.2.

We will develop and carry out research activities with our research partners (presented in the research partner tables for each component). At international and regional levels, collaboration with advanced research institutes (ARIs), regional centers and universities will ensure the scientific relevance of our work while at the same time covering a wider range of scientific fields. These partners will bring their own strengths and fields of expertise into our joint research. The association between Component 2 and ARI teams will constitute the core team at the global level to develop and implement research project proposals to develop international public goods (IPGs).

The global or regional networks developed for the conservation of genetic resources of crop trees (CacaoNet, COGENT) and other important tree species (APFORGEN, SAFORGEN and LAFORGEN) will contribute to Themes 1 and 2 by increasing our overall capacity in assessing genetic diversity and pre-breeding activities. National research partners will be an integral part of the research design and implementation at the country level. They will play an essential role in grounding our research in local realities, bring their knowledge of local conditions to the partnership and, in return, benefit from technology transfer and capacity building from the international partner teams. They are also important vectors for the inclusion of our joint research findings into new curricula.

Our policy and practitioner partners enter the picture to improve impact. These development-oriented organizations are the immediate and intermediate clients for research results in our impact pathway. For example, the Component 2 teams will work upstream with the UN CBD Secretariat to bring the most up-to-date scientific knowledge into the documents prepared for the Subsidiary Body for Scientific, Technical and Technological Advice (SBSTTA) and UNFCCC Conferences of the Parties. At the national level, our close engagement and partnerships with the managers (logging companies, communities, major consulting firms such as SGS) and the administrations in charge of forests keep our agenda relevant to local needs (while addressing the global IPG demand) and influence the policy decisions about the management of forests and tree resources. We will work to establish new partnerships with development organizations, such as WFP, Oxfam, CARE and others, and environmental NGOs, such as WWF, to increase the likelihood of our research results being applied at the grassroots level. We will convene periodic meetings with these organizations to foster understanding and information exchange.

The knowledge-sharing partners facilitate the communication of our findings to key target audiences, as well as to students, the media and the general public. International research networks (e.g., IUFRO), conservation organizations (e.g., IUCN) and development agencies (e.g., the World Bank) can all mobilize their networks to reach key policy and practitioner communities. Others, such as RECOFTC, can ensure that research results are incorporated into training curricula for forest-related practitioner communities. Still others, such as CATIE and the University of British Columbia, can incorporate relevant perspectives and experiences into graduate training in forest-related disciplines. At national and local levels, knowledge-sharing partners will assist in disseminating research results in the formats and languages most accessible to local users.

A non-exhaustive list of key policy/practitioners and knowledge-sharing partners at various levels is provided in Table 2.2.

Table 2.2 Illustrative list of policy and knowledge-sharing partners for Component 2

Levels/types	Policy and practitioner partners*	Roles/ contributions	Knowledge-sharing partners	Roles/ contributions
International level	CBD	Adoption of research results and translation into policy decision	CBD	Distribution of research information; development of guidelines, policy guidance documents
	FAO**	Synthesis of information for best practice guidance at global levels	FAO**	Distribution of research information; development of guidelines, policy guidance documents
	FSC	Translation of research results into standards and guidelines for producers		
	ITTO	Promotion of including multiple-use forest into SFM guidelines	ITTO	Distribution of research information; development of guidelines, policy guidance documents
	Environmental and social NGOs	Testing and use of methods or guidelines developed by research	Environmental and social NGOs	Distribution of research information; development of guidelines, policy guidance documents
	Forestry consulting firms (SGS, FRM...)	Testing and use of methods or guidelines developed by research		
	IFAD, International Development Banks	Mainstream research results in development projects		
			Panos	Use of content in training journalists
Regional level	COMIFAC	Translation of research results into policy guidance for Congo Basin governments		
	OTCA	Translation of research results into policy guidance in Amazon basin countries		
			RECOFTC	Use of content in training courses
			CATIE	Use of content in graduate curriculum

Levels/types	Policy and practitioner partners*	Roles/ contributions	Knowledge-sharing partners	Roles/ contributions
Country or site level	Ministries in charge of forests, forest resources and environment	Adoption of research results and production of relevant improved policies		
	Ministries, agencies in charge of gender and community development	Adoption of research results and production of relevant improved policies		
	Technical and extension agencies	Testing of new methods developed by research	Technical and extension agencies	Dissemination of new methods to practitioners
	Certified and managed timber companies	Field sites and resources to develop / test new management		
	Environmental and social NGOs	Testing and use of methods or guidelines developed by research	Environmental and social NGOs	Distribution of research information; development of guidelines, policy guidance documents
			Local media organizations	Use of content in training journalists and local people

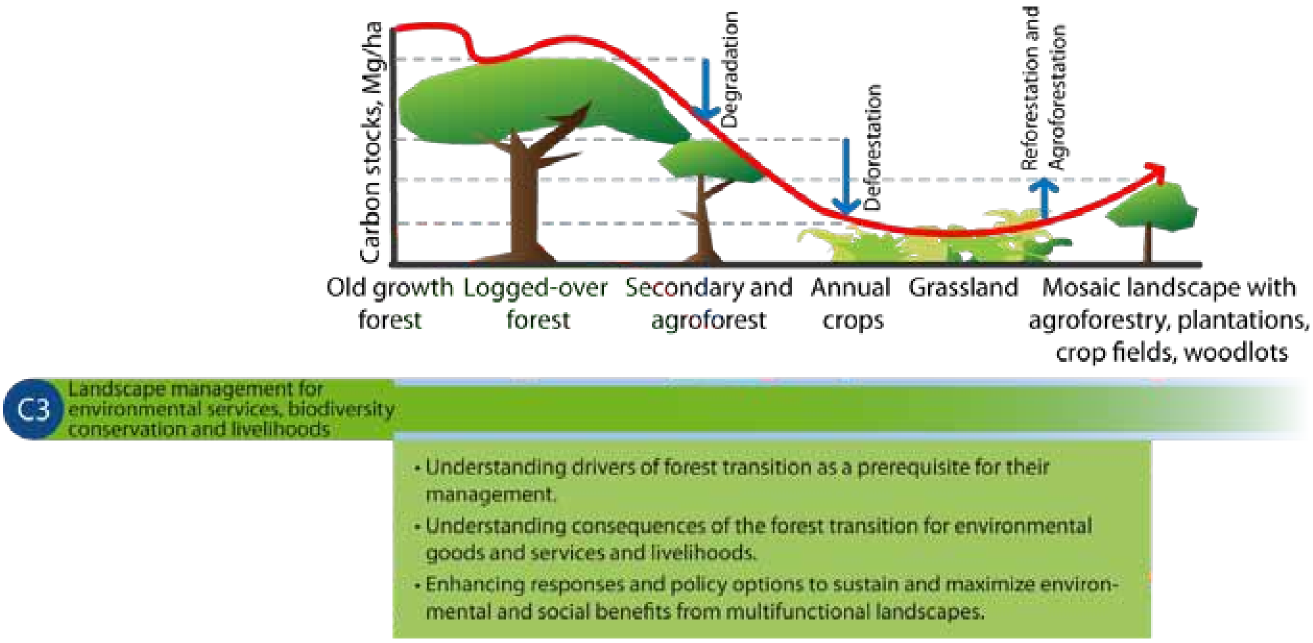
* See the list of abbreviations at the beginning of this proposal.

** Partner with substantial gender-relevant programs

2.2.13 Prioritization

Achieving the expected outcomes and contributing to the above-mentioned impacts will require detailed understanding of many different issues and stakeholders. Therefore, it will not be possible to reduce effort in a given study site without compromising the quality of research outputs. We will respond to fluctuations in the available budget by increasing or decreasing the number of cases/study sites. Priority will be given to those countries/sites/species that offer the best learning opportunities, partnerships, baseline data and potential for impacts. Other prioritization criteria would be possible synergies with other components (in the context of sentinel landscapes) or CRPs, representativeness of the entire portfolio of research and potential to generate IPGs.

2.3 Component 3: Landscape management for environmental services, biodiversity conservation and livelihoods



2.3.1 Introduction

Using the “forest transition” as a conceptual framework, this component of CRP6 will analyze the localized driving forces (c.f. Component 5) behind the decline and recovery in ecologically functional forest and tree cover and consequences for livelihoods and landscapes. The key problem this component addresses is how to manage for multiple benefits and multiple stakeholders at the landscape scale. Within this research framework, we will investigate the institutional and policy options for reducing the conversion of remaining natural forests while not compromising rural livelihoods. In addition, bolstering collaborative governance mechanisms and increased local and national institutional capacity will contribute significantly to this aim.

To leverage the unique opportunity offered by the work of Component 3, it is essential to understand trends in forest and tree cover. Historically, forested countries have experienced phases of fluctuating forest area, shifting both the quantity and the quality of tree cover in landscapes. The progress of a country or region along the so-called “forest transition curve” has tended to mirror demographic change and often concomitant economic development. Depending on stakeholder perspectives, changes can imply environmental degradation or improvement.[73] However, various trajectories along the curve can lead to the suboptimal outcomes now experienced from the perspectives of rural communities and societal

[73] For example, according to the FAO Forest Resource Assessment (www.fao.org/forestry/fra/fra2010/en), Asia is the first tropical region to record a forest transition from a decrease to a net increase of forest cover. However, new tree cover through the development of plantation forestry based primarily on a few highly productive exotic species has little in common (other than the label “forest”) with the biologically diverse vegetation that it replaces.

resilience, where tree cover loss lead to deficits in forest-based livelihoods and environmental goods and services, and biodiversity decline.

As a result, integrated landscape restoration efforts must be sensitive to terminology that connotes control of land and resource use by one side or the other.[74] A central challenge facing integrated landscape management is the institutional dichotomy between "forest" and "non-forest" land. For example, while conservation efforts continue to focus on the management of protected areas (PAs),[75] most of the world's biodiversity occurs outside PAs, primarily in fragmented landscape mosaics containing a range of land use categories. The traditional policy focus of forestry agencies on objectives related to "form" (e.g., percentage of forest cover maintained) must be transformed into objectives related to "function" and "quality" if the complex trade-offs between conservation and development outcomes are to be resolved.[76]

While the segregation of functions (e.g., strict protected areas adjacent to intensive agriculture) as an approach to natural resource management is possible, the reality is that the boundaries between land uses are often not clearly delineated. Hence, more integrated approaches are required. In addition, empirical evidence is needed to understand the longer-term trajectories and drivers of change (see Component 5), including those that are climate induced (see Component 4 and CRP7), that affect the functionality of landscapes on which human welfare depends. Holistic models are needed for the conservation of diversity, including intraspecific genetic diversity, integrating *ex situ*, *in situ* and *circa situ* (on-farm) approaches (see Component 2) that do not undermine communities' ability to achieve substantial improvements in their livelihoods.[77]

The future flows of environmental goods and services[78] from forested landscapes ultimately depend upon integrated approaches to management, use and conservation.[79] In developing countries, the non-market values present in fragmented landscape mosaics, such as environmental service provision, are often accorded little priority, and the sustainable productive potential of different land areas is often inaccurately assumed during land use planning. The inability to adequately assess such non-market values results in both damaging and inopportune loss of environmental services, as well as reduced productivity of marketed agricultural and forestry products. Managing for sustainable utilization and conservation

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[74] Even the meaning of the term "forest" has become an arena for debate, with an emerging need to differentiate between "natural forest" (in various degrees of ecological disturbance/recovery and management, such as for wildlife and other non-timber forest products (NTFPs)), "plantations" (with or without differentiation between agricultural and forestry trees and tree crops, usually inferring monocultures or few-species mixtures), "mixed tree-based land use" (often referred to as agroforestry or reforestation/restoration) or conversion into pasture for livestock grazing.

[75] However, the CBD recently set a new target: "17% of terrestrial lands will be under formal protection by 2020". Hence, understanding the human, social, economic and biological impacts of this increased protection, and ultimate annexation, will require considerable research effort.

[76] Sunderland, T.C.H. et al. 2008. Conservation and development in tropical forest landscapes: a time to face the trade-offs? Environmental Conservation 34(4): 276–279.

[77] Xu, J. et al. 2009. Functional links between biodiversity, livelihoods, and culture in a Hani swidden landscape in southwest China. Ecology and Society 14(2): 20 [online] http://www.ecologyandsociety.org/vol14/iss2/art20/.

[78] For the purposes of this document, "environmental services" can be taken to include: provisioning (food, energy, biomass), regulating (water quality, pest and disease control, carbon sequestration), supporting (pollination, seed dispersal, nutrient cycling) and cultural (aesthetic, recreation, spiritual) services.

[79] Lele, S. et al. 2010. Beyond exclusion: alternative approaches to biodiversity conservation in the developing tropics. Current Opinion in Environmental Sustainability 2: 94–100.

outcomes requires explicitly investing in negotiating and managing the inherent trade-offs between the two through more effective land use allocation practices, as well as improved modalities for assessing and managing environmental services.[80]

The characteristics of landscape governance also play a key role in determining which goods and services are given priority and how benefits are distributed. The fate and history of many formerly forested landscapes have been determined by decisions to convert forestlands to agriculture, pasturelands or plantations, or to conserve them as protected areas,[81] often without due consideration of the interests or incentives of forest communities and farmers. Weak and unclear tenure and access right regimes have proven particularly problematic, and the perspectives of local women have counted for even less. The sustainable management and use of forest resources, as well as extensive agroforestry systems, have traditionally been excluded from formal land use planning, despite their importance to forest-dwelling people and farmers. At the global level, multilateral environmental agreements establish objectives, obligations and opportunities for national policies and strategies, but rarely harness or recognize the potential of community-managed forests and agroforestry to advance environmental objectives.

However, the increasing trend toward the decentralization of forest governance,[82] coupled with efforts to enhance transparency and public scrutiny of government and private sector actions, are improving the governance systems that affect multifunctional landscapes.[83] More collaborative and transparent governance mechanisms are needed to overcome the traditional lack of cooperation between science, government, corporations and local communities.[84] An integrated multi-stakeholder assessment process that reaches out to all relevant communities has to be the basis for meaningful change. In this regard, research into tenure and land rights undertaken as part of Component 3 will examine ongoing negotiation mechanisms and land tenure reforms in fully or partially forested landscapes that can contribute to improved landscape management. Our work will also illuminate how governance processes and institutions at local and landscape levels can be reformed to become more legitimate, to

[80] Wackernagel, M. and Rees, W.-E. 1997. Perceptual and structural barriers to investing in natural capital. Economics from an ecological footprint perspective. Ecological Economics 20: 3–24; Baumgärtner, S. 2007. The insurance value of biodiversity in the provision of ecosystem services. Natural Resource Modeling 20(1): 87–127; Hooper, D. et al. 2005. Effects of biodiversity on ecosystem functioning: a consensus of current knowledge. Ecological Monographs 75(1): 3–35.

[81] Given the recent CBD 2020 target that "17% of terrestrial ecosystems are to be protected", PAs will continue to be a major tool for biodiversity conservation; exploring ways to mitigate social conflict while enhancing benefits from PAs remains a pertinent research issue.

[82] Agrawal, A. et al. 2008. Changing governance of the world's forests. Science 320: 1460–1462.

[83] Ostrom, E. 1990. Governing the commons: the evolution of institutions for collective action. Cambridge University Press, New York; Ostrom, E. 2007. Going beyond panaceas special feature: a diagnostic approach for going beyond panaceas. Proceedings of the National Academy of Sciences USA 104: 15181–15187; Giller, K.E. et al. 2008. Competing claims on natural resources: what role for science? Ecology and Society 13: 34. [online] http://www.ecologyandsociety.org/vol13/iss2/art34/.

[84] Colchester, M. 2004. Conservation policy and indigenous peoples. Environmental Science and Policy 7: 145–153; Tomich, T.P. et al. 2004. Asking the right questions: policy analysis and environmental problems at different scales. Agriculture, Ecosystems and Environment 104: 5–18; Cash, D.-W. et al. 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. Ecology and Society 11: 8. [online] http://www.ecologyandsociety.org/vol11/iss2/art8/; Kristjanson, P. et al. 2009. Linking international agricultural research knowledge with action for sustainable development. Proceedings of the National Academy of Sciences USA 106: 5047–5052; German, L.A. and Keeler, A. 2010. "Hybrid institutions": applications of common property theory beyond discrete property regimes. International Journal of the Commons 4: 571–596; Colfer, C. and Pfund, J.L. (eds). 2010. Collaborative governance of tropical landscapes. Earthscan, London.

increase the security of rights and to balance customary norms and formal policy and, ultimately, to provide insights into what kinds of land use rights lead to optimized outcomes for conservation and development.

2.3.2 Thematic focus

This component will have the following three main research themes (closely linked with research undertaken in other components of CRP6 and other CRPs):

1. understanding the drivers of forest transition at the landscape scale (e.g., demographic processes, infrastructure development, tenure reform, policy regulation and incentives, governance and power relations) and developing options for their mitigation (linked to Component 5 on global trade and investment);
2. understanding the consequences of forest transition for sustaining and provisioning environmental goods and services to benefit livelihoods of the poor and disadvantaged (linked with Component 1 on smallholder livelihood aspects, Component 2 on sustainable forest management and Component 4 on climate change);
3. integrating a network of learning landscapes in which local monitoring and evaluation, coupled with adaptive management, link stakeholder interests to actual performance and opportunities to change incentives at the landscape scale and, through cross-site comparison, at the national and regional scales.[85]

The Driver–State–Response framework (see Figure 2.4) points to the following broad groups of research questions.

1. How do national and local drivers interact to modify and/or sustain landscape composition (components/habitat types/land uses) and mosaic configuration?
2. What are the current state and role of biodiversity assets and environmental services in livelihood strategies in forest mosaic landscapes?
3. What institutional and governance frameworks define the occupation, use and management of such landscapes and guide the allocation of benefits and responsibilities?
4. What are the consequences of the landscape composition and spatial configuration for specific stakeholders?
5. How can stakeholders and their external supporters influence the structure of such landscapes (enhance productivity, better manage and protect resources, maintain services, balance trade-offs, etc.) to reduce conflict and enhance functionality?

[85] These landscapes differ from sentinel landscapes (see Annex 4) in that they represent existing and new landscape sites, some with long-term data sets, in which additional research will be undertaken as part of this component. A subset of these sites may be selected as sentinel landscapes, and will accordingly be closely aligned with relevant research outputs of all five components.

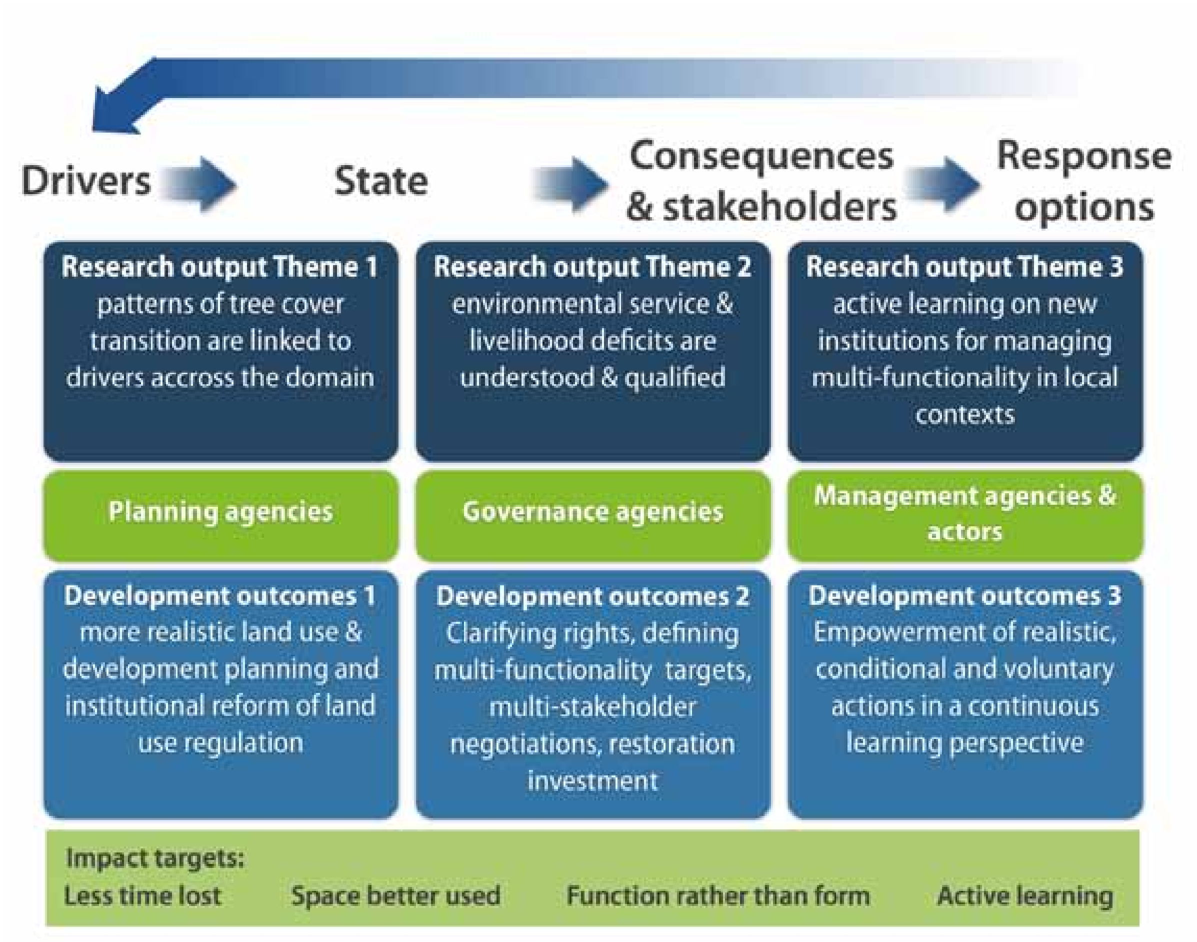


Figure 2.4 Driver–state–response framework

2.3.3 Objectives and expected outcomes (10 years)

The goal for this component is to provide knowledge and solutions for how society, across the various stages and patterns of tree cover transition, can best achieve the management of multifunctional landscapes. This research will be undertaken in a manner that balances the provisioning functions of ecosystem goods and services for local stakeholders and external markets with the maintenance of natural capital and social inclusiveness.

Within 10 years, research undertaken under the three research themes within this component will have contributed to the following changes.

1. In ***temporal*** terms: When dealing with tree-based systems across the transition, longer-term impacts should be expected, usually in the range of 10–30 years. However, research conducted under Component 3 of CRP6 will both reduce the conversion and degradation of forests and enhance the restoration/rehabilitation of forestlands. The restoration of tree cover and forest functions (including environmental services and biodiversity) will thus be accelerated while meeting the needs of poor and disadvantaged communities and contributing to national development.

   Relevant outcomes include the following. Local resource managers will have access to and be able to use cost-effective tools to appraise the likely impacts of changes in land use on watershed functions, biodiversity, carbon stocks and the economic productivity of the landscape, and to restore forests and the services they provide. What historically has taken a decade, or longer, of intensive research and negotiation support could feasibly be replicated in a third to half the time.

2. In ***spatial*** terms, Component 3 of CRP6 will lead to: (i) an increase in the area of natural and sustainably managed (woody) vegetation with effective protection; (ii) an increase in the area of multifunctional zones that provide for production within forested landscapes while maintaining biodiversity assets and the provision of environmental services; and (iii) a decrease in the area of low-value, contested and formerly forested land that can be transformed into productive agroforestry/forest landscape mosaics.

   Relevant outcomes include the following. Land use planners and practitioners will use principles and methods resulting in clearer recognition of conservation and development trade-offs in land and rights allocation, notably tenure, leading to optimized biodiversity and livelihood outcomes.

3. In ***functional*** terms, Component 3 of CRP6 will enhance rural livelihoods and environmental service provisioning, while acknowledging that trade-offs must be ultimately recognized and negotiated. Environmental services will be integrated using appropriate criteria and indicators that reflect the drivers and consequences of tree cover transitions.

   Relevant outcomes include the following. Local and national agencies will identify environmental service flows and biodiversity assets, supporting efficient and effective conservation, management and marketing of, and rewards for, the provision of environmental services. Opportunities for ecological restoration will be fully used; trade-offs will be recognized and the contest over them will be eased by negotiation.

4. ***Institutionally,*** the knowledge and solutions generated under this component of CRP6 will support the delivery of forest and tree services through innovative rewards and incentives, particularly through payments for environmental services (PES) systems. These will support social and economic relations between external and local stakeholders that strive for reciprocity, and seek a balance of fairness and efficiency.

   Relevant outcomes include the following. Local and external stakeholders will negotiate and have access to a range of conditional and performance-based arrangements that support the provision and maintenance of environmental services and biodiversity assets in productive landscapes. Community involvement will be based on collaborative decision making aided by monitoring tools for strengthening meaningful participation in conservation and land use planning, especially by women and other disadvantaged groups.

2.3.4 Geographic priorities

We will identify the geographic priorities for this research component through a systematic process of portfolio analysis. The criteria will include the use of representational approaches for the establishment of landscapes that will strengthen the power of this research by spanning a range of climatic zones, forest types (biomes/ecoregions), human population density, associated livelihood strategies and collaborative governance approaches. A balance will be sought between humid and dry forest zones, as their primary environmental service issues differ. A detailed geographic priority-setting process will take place during the first year of CRP6 implementation, building on and rationalizing existing research sites and networks.

At the regional level, priorities are:

- Latin America: Amazon Basin, Andean region
- Africa: Humid forests of the Congo Basin and West Africa; Miombo, Sahelian and other dry forests
- Asia: South, Southeast Asia

At the country level, priority countries where we expect to undertake research and demonstrate outcomes are:

- Latin America: Colombia, Brazil, Ecuador, Bolivia
- Africa: Cameroon, Democratic Republic of Congo, Ghana, Sierra Leone, Guinea, Burkina Faso, Mali, Uganda, Kenya
- Asia-Pacific: China, Indonesia, India, Vietnam, Cambodia, Laos

2.3.5 Theme 1: Understanding drivers of forest transition as a prerequisite for their management

Rationale

Landscape transformation, and thus qualitative and quantitative tree cover transition, is often driven by a wide range of factors. These may include, among others, demographic processes, infrastructure development, changing market dynamics, tenure reforms and policy regulations and incentives. Understanding the drivers of forest loss requires an assessment of the multiple interactions that shape forest transitions at the landscape scale and how they manifest in terms of patterns and process in different biophysical, spatial and institutional settings.[86]

The aims of this research theme are to:

- develop and share knowledge and replicable analytical methods on the spatial and temporal patterns of qualitative and quantitative tree cover transitions and the roles of national and local drivers of landscape change;
- provide analyses of the winners and losers (e.g., indigenous peoples, poor and disadvantaged, large-scale ranchers and farmers, elites, corporations, foreign investors, land speculators) in various phases of current transformations and of the existing and emerging opportunities to shift the balance between them; and
- identify and influence public policy and market-based instruments to enhance the institutional architecture, at multiple scales, for negotiating the trade-offs between biodiversity conservation, environmental service provision and economic development.

[86] This is in contrast to Component 5, which will assess and address the influence that external pressures from large-scale investments associated with global market demand and expanding domestic markets have on social, economic and ecological dynamics, primarily at national level. However, these factors can also have impacts at the landscape scale, and this synergy and complementarity between the two components will strengthen the overall impact of CRP6.

Methods and research approach

This component builds on current and emerging practices in the Global Earth Observation System of Systems (GEOSS)[87] science community through active cooperation at the landscape level, coupled with national and global syntheses of tree cover and forest change. The development and application of models that improve our capability to record and predict trends in land use and cover changes form an essential contemporary requirement of planning processes. Land use and cover change (LUCC) models that link drivers and actors to observable change[88] will be the main research method applied within this theme. An understanding, at the driver and actor levels, of historical, geographic, demographic, political and ecological contexts is a prerequisite both for any planned interventions and for the exploration of alternative scenarios for land cover change.

LUCC models are underpinned by a variety of research tools that assist in the mapping of local, public/policy and science-based interpretation of the landscape through “legends” of maps that have meaning across disciplines and stakeholders. The current terminology of “forest” and “forest-derived” land cover types is notoriously confusing and often inadequate for the formulation of policy instruments. Remote sensing and geographic information systems (GIS) technologies can provide both spatial and temporal framing, but these are only of use when accompanied by complementary research undertaken on the ground. This can include recording historical trends, participatory rural appraisals (PRAs), participatory border delineation and mapping exercises, multi-stakeholder analysis and policy and governance analysis aimed at developing a common platform for dialogue and analysis for local governance, national planning and international debate. Coupling these with quantitative techniques such as biodiversity assessment monitoring through permanent sample plot (PSP) methods and other biophysical approaches will provide the multi- and interdisciplinary methods required to understand both the drivers of forest loss and their impacts on biodiversity and, potentially, livelihoods.

The primary reasons for undertaking a scientific analysis of changes in land cover are the consequences of such change on a wide range of stakeholder interests and the various ways stakeholders can try to modify land cover change in their favor. The utility of concept-based models will depend strongly on the types of entry point the models provide for feedback.

Four main types of “feedback” are as follows.

1. Land use, or the direct benefits that agents derive from their impact on land cover: this usually involves direct learning and relatively short response cycles, although there is ongoing debate about how much an economic lens misses real motivations of different agents.[89]
2. Land use planning, or the attempts by stakeholders of land cover beyond the land user, to change the rules that are part of the set of drivers influencing land users.

[87] http://www.earthobservations.org/geoss.shtml
[88] Hersperger, A.M. et al. 2010. Linking land change with driving forces and actors: four conceptual models. Ecology and Society 15(4): 1. [online] http://www.ecologyandsociety.org/vol15/iss4/art1/.
[89] Villamor, G.B. et al. 2010. Diversity deficits in modelled landscape mosaics. Ecological Informatics doi:10.1016/j.ecoinf.2010.08.003

3. Agent-specific modifications of incentive structures that are conditional on performance, such as forms of PES and related institutions.[90]
4. Generic changes in rules and economic incentives through policy change that is expected to enhance environmental services and/or economic performance at the (sub)national scale.

A fifth component of the system (5) is at the interface of 1–4 in the form of Negotiation Support Systems,[91] in which multiple stakeholders, usually based on their own understanding and interpretation of the Drivers–State–Response relationship, negotiate a range of options to manage the trade-offs between their respective stakes.

CIFOR and the World Agroforestry Centre have completed more than a decade of research on the underlying causes of deforestation. This effort must now be shifted further down the research-development continuum and refocused on the impacts of land use change for livelihoods, for example to answer the question: "how do land use changes pay off, and where and under which circumstances?" With our global mandate and competences in both social and natural sciences, both institutions have a comparative advantage in carrying out comparative analyses. Such studies will inform decision makers at various levels about policies and conditions that favor or impede sustainable development and forest conservation. Deforestation remains a major topic on global and national agendas. Carefully targeted research will be able to reach the various constituencies and inform decisions regarding deforestation and the links to livelihood change.

Research questions

This research theme will explore and analyze the links between the drivers of land use and tree cover change at global/national/local scales, and identify opportunities to negotiate and influence the reversal of current degradation and acceleration of ecological restoration and rehabilitation, through both reforestation and agroforestry transformation.

Broad research questions (Component 3, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
• What are the major drivers and patterns of qualitative and quantitative tree cover transitions, and how do they vary with scale in space and time? • What are the consequences of commercial logging and forest conversion for migrant-based agriculture or plantations? • What is the impact of infrastructure development and how can negative consequences on the environment and	• How are the perceptions, appreciation and experiences of tree cover transitions influenced by gender? What are the gender impacts of such transitions? • How do different factors that influence transition, including governance arrangements, incentives and	Empirical (including time series) data sets of quantitative and qualitative tree cover transitions across continents Analysis of the links between the drivers of land use and tree cover change at global/national/local scales, including its relationship with: • demographic change, including changes in rates of urbanization, circular and other migration patterns, and human population density • road networks, and other

[90] van Noordwijk, M. and Leimona, B. 2010. Principles for fairness and efficiency in enhancing environmental services in Asia: payments, compensation, or co-investment? Ecology and Society 15(4): 17 [online] http://www.ecologyandsociety.org/vol15/iss4/art17/.
[91] van Noordwijk, M. et al. 2001. Negotiation support models for integrated natural resource management in tropical forest margins. Conservation Ecology 5(2): 21 [online] http://www.consecol.org/vol5/iss2/art21

Broad research questions (Component 3, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
livelihoods be mitigated? • How do local stakeholders interact with external ones in various stages of forest transition? • How do governance systems and their reform influence stages in forest transition at the forest/agrarian interface?	institutional reform, interact with gender dynamics to produce better outcomes?	infrastructure (e.g., pipelines, hydrocarbon fields, dams, mines) • processing industry (linked to Component 5) • national supply/demand and import/export data and overall economic development • forest categorization and forest policy regimes Identification of opportunities to negotiate and influence the reversal of current degradation patterns and acceleration of forest rehabilitation and agroforestry transformation

Research partners

The partnership arrangements will increase in complexity across the three themes from a more technical research approach in Theme 1, to a multidisciplinary approach in Theme 2 and then a more explicit multi-stakeholder, location-specific approach in Theme 3.

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Contributes interpretation of forest types and forest policy domains, as well as human livelihood (poverty) perspectives for forest-dependent people
	World Agroforestry Centre	Contributes research on the drivers of forest transition (tree cover dynamics within broader land use change patterns) and its interface with agriculture at the landscape level
	CIAT	Quantifies and models agricultural drivers of forest transition
International level	CIRAD	Contributes expertise on forestry/agroforestry interface
	NASA	Undertakes analysis of land cover change
	IUCN	Provides comparisons of forest transitions (e.g., in LLS)
	GEOSS	Links the world's many stand-alone biodiversity monitoring systems and connects them to other Earth observation networks that generate relevant data, such as climate and pollution indicators
	IITA	Has shared interest in modeling agricultural drivers of forest transition—coordination with CRP1.2 via ASB partnership
	IFPRI	Has shared interest in modeling agricultural drivers of forest transition—coordination with CRP2 via ASB partnership
	Universities of Louvain-la-neuve, Macaully Land Use Research Institute, Gottingen, FOCALI university network in Sweden, University of Maryland	Analyze forest transition patterns in relation to drivers of change
	Forest Trends	Conducts case studies of forest transition and its relation to policies
	Rights and Resources Initiative (RRI)	Provides analysis of options for tenure reform and "boundary organization" interface with advocacy organizations and national policymakers
	WRI	Analyzes changes in forest cover and its relationship to

Type of research partner	Organization	Research partner contributions
		drivers and policies
	IMFN	Implements sustainable management of forest-based landscapes through the Model Forest approach
Regional level	CATIE	Conducts forest transition analyses in Central America and Amazon
	ICIMOD	Conducts land use change analysis in greater Himalaya subregion
	AIT	Conducts land use change analysis and research
	RECOFTC	Engages in research uptake and dissemination through training
Country or site level	FORDA (Indonesia)	Collaborates in analysis of national and local patterns of forest transition in Indonesia
	NAFRI (Laos), MARD (Vietnam)	Conduct research on land use planning processes
	Ministries of forestry (Guinea, Sierra Leone)	Engage in landscape management and restoration
	Embrapa (Brazil), LIPI (Indonesia)	Conduct land use monitoring
	Indonesian Soil Research Institute	Collaborate in analysis of national and local patterns of forest transition in Indonesia
	IRAD (Cameroon)	Undertakes forest transition studies
Private sector and NGOs	RSPO (Roundtable on Sustainable Palm Oil)	Conducts analysis of forest transition data in relation to proposed industry self-regulation
Private sector	IPOC (Indonesian Palm Oil Commission)	Conducts analysis of land use trajectories preceding oil palm and drivers of smallholder oil palm expansion in relation to emerging standards and policies

2.3.6 Theme 2: Understanding the consequences of the forest transition for environmental goods and services and livelihoods

Rationale

The role of the different spatial configurations of forests and trees in the provision of environmental services needs to be realistically assessed[92] so that appropriate incentives, property rights arrangements and regulatory approaches can be negotiated and updated through learning. Research shows that institutions and arrangements for the management of multifunctional landscapes should be assessed in terms of their efficiency (realistic, conditional, voluntary), fairness (pro-poor, pro-women, pro-untitled landholders, including objectively measurable equity) and environmental sustainability. Existing results show that there is potential for using new property rights arrangements and flexible policy instruments, often implemented through decentralized forms of government, to strengthen community forest management and provide incentives for farmers and ranchers to invest in agroforestry and other tree-based forms of land use.[93]

[92] Malmer, A. et al. 2010. Carbon sequestration in tropical forests and water: a critical look at the basis for commonly used generalizations. Global Change Biology 16: 599–604.
[93] Vandermeer, J.H. (ed.). 2003. Tropical agroecosystems: new directions for research. CRC Press, Boca Raton, Florida, USA; van Noordwijk, M. et al. 2004. Belowground interactions in tropical agroecosystems. CAB International, Wallingford, UK. Scherr, S.J. and McNeely, J.A. (eds). 2007. Farming with nature: the science and practice of ecoagriculture. Island Press, Washington, DC.

Mechanisms and contracts that provide conditional rewards for environmental services have the potential to provide farmers and ranchers with incentives to conserve forest patches and adopt restoration and agroforestry systems and other land uses associated with environmental stewardship, if the appropriate tenure and rights conditions are in place, thus promoting a greater degree of biodiversity conservation. The management of multifunctional landscapes requires research tools and management mechanisms that strike a balance between (1) the provision of goods and services; (2) short-, medium- and long-term resource and biodiversity conservation and use objectives; (3) efficiency and fairness; (4) the interaction of biology and policy in the pursuit of sustainable development of socio-ecological systems,[94] and the likely increasing vulnerability of tree performance in the face of growing climate variability.[95]

This research theme will explore questions directed toward developing tools for understanding the roles of trees and various forest types in providing a wide range of environmental goods and services, and in maintaining biodiversity in landscape mosaics. It will also develop tools for assessing trade-offs between these services and the direct benefits of subsistence and marketed goods. Research under this theme will provide methods and tools to assess and design PES schemes and other reward mechanisms and incentives for reconciling conservation and development objectives. Lessons learned from PES implementation can have considerable application for the design and implementation of other compensation or incentive schemes such as REDD+. Thus, there is close synergy between Components 3 and 4.

Methods and research approach

A wide range of methods are used for understanding the various consequences of land cover change for ecosystem functioning through “lateral flows” (water, sediment, biodiversity and landscape aesthetics). Current approaches in landscape ecology, ecohydrology and conservation biology will be combined with methods that have their foundations in social and economic science disciplines. For example, new approaches to ***biodiversity scaling in landscape mosaics*** have recently been proposed,[96] incorporating two important aspects of biodiversity in nature: ***scale*** and ***spatial variation*** in the supply of limiting resources. These concepts can be used to understand and forecast species diversity in ecological communities in landscape mosaics—an area in which the institutions involved in the implementation of CRP6 have extensive experience and continuing ambitions. In the context of CRP6 biodiversity-related research, a focus on trees and their functional diversity is appropriate, as trees provide infrastructure for the rest of the vegetation, are at the base of a major share of food webs and have intricate relations with pollinators and seed dispersal agents.

To determine the locally perceived relevance and value of environmental services, as well as the (potential) value for external stakeholders,[97] it will be necessary, in collaboration with local stakeholders, to develop indicators and effective monitoring systems to assess the environmental services provided by different systems (primary forests, agroforestry systems,

[94] Anderies, J.-M. et al. 2004. A framework to analyse the robustness of social–ecological systems from an institutional perspective. Ecology and Society 9(1): 18 [online] www.ecologyandsociety.org/vol9/iss1/art18/.
[95] Gebrekirstos, A. et al. 2008. Climate–growth relationships of the dominant tree species from semi-arid savanna woodland in Ethiopia. Trees 22: 631–641.
[96] Ritchie, M.E. 2010. Scale, heterogeneity, and the structure and diversity of ecological communities. Monographs in Population Biology 45. Princeton University Press, Princeton, USA.
[97] TEEB. 2010. The economics of ecosystems and biodiversity: mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of TEEB. http://www.teebweb.org/

mosaics of the two embedded with other land use types, etc.).[98] Such monitoring will guide decision making in landscape management and provide a basis for valuing such services and through incentive schemes, thereby creating political support for biodiversity-friendly land uses (see Box 2.4). Policy and governance research will be undertaken to determine tenurial arrangements in place within a particular landscape and, combined with multi-stakeholder analysis, provide further insights into power relations and equity issues that may need to be addressed.

Box 2.4 Payments and rewards for environmental services

Payments and rewards for environmental services (PES and RES) are widely seen as a way to provide land managers with incentives to opt for land use practices that maintain or enhance the level of environmental services (ES). Such services are expected, but have not typically been appreciated, by "downstream" or ES beneficiaries.[1] In the case of watershed services, the term "downstream" can be taken literally. However, where biodiversity conservation, landscape beauty or a reduction in net emissions of greenhouse gases are involved, the term is used as a metaphor.[2]

Many current and emerging mechanisms use the PES terminology, ranging from subsidies for forest owners paid from levies on water or hydropower users, trade in certificates of rights to pollute (based on certified emission reductions elsewhere), ecotourism and moral incentives to plant trees, to outcome-based contracts to reduce sediment loads of streams and rivers. Although all these mechanisms differ from a pure command-and-control approach, there is a need for more careful descriptors of mechanisms as a basis for comparisons of performance and for re-blending elements of both approaches to adjust to local context. Swallow et al.[3] proposed the term CRES (compensation and rewards for environmental services) for a broader set of approaches that have enhancement of ES as a common goal.

The discussion of the pros and cons of purely financial mechanisms is often antagonistic,[4] and the formulation of alternative paradigms is underway.[5] Both CIFOR and the World Agroforestry Centre have been among the early movers in the emerging fields of PES and RES, respectively.[6] This component of CRP6 will benefit from a closer relationship between the key scientists involved in these fields of study.

References:

[1] Asquith, N. and Wunder, S. (eds) 2008. Payments for watershed services: the Bellagio conversations. Fundación Natura, Santa Cruz de la Sierra, Bolivia; Porras, I. et al. 2008. All that glitters: a review of payments for watershed services in developing countries. IIED, London.
[2] Landell-Mills, N. and Porras, I. 2001. Silver bullet or fools' gold: a global review of markets for forest environmental services and their impact on the poor. International Institute for Environment and Development, London; Ferraro, P.J. 2008. Asymmetric information and contract design for payments for environmental services. Ecological Economics 65: 810–821.
[3] Swallow, B.M. et al. 2009. Compensation and rewards for environmental services in the developing world: framing pan-tropical analysis and comparison. Ecology and Society 14(2): 26. [online] www.ecologyandsociety.org/vol14/iss2/art26/
[4] Peterson, M.J. et al. 2010. Obscuring ecosystem function with application of the ecosystem services concept. Conservation Biology 24: 113–119; Pascual, U. et al. 2010. Exploring the links between equity and efficiency in payments for environmental services: a conceptual approach. Ecological Economics 69: 1237–1244; Kosoy, N. and Corbera, E. 2010. Payments for ecosystem services as commodity fetishism. Ecological Economics 69:1228–1236; Gomez-Baggethun, E. et al. 2010. The history of ecosystem services in economic theory and practice: from early notions to markets and payment schemes. Ecological Economics 69(6): 1209–1218.
[5] van Noordwijk, M. and Leimona, B. 2010. Principles for fairness and efficiency in enhancing environmental services: payments for environmental services or co-investment in environmental stewardship? Ecology and Society 15(4): 17. [online] www.ecologyandsociety.org/vol15/iss4/art17/
[6] Wunder, S. 2005. Payments for environmental services: some nuts and bolts. CIFOR Occasional Paper 42. CIFOR, Bogor, Indonesia; Wunder, S. 2008. Payments for environmental services and the poor: concepts and preliminary evidence. Environment and Development Economics 13: 279–297; Tomich, T.P. et al. 2004. Environmental services and land use change in Southeast Asia: from recognition to regulation or reward? Agriculture, Ecosystems and Environment 104: 229–244; van Noordwijk, M. et al. 2004. An introduction to the conceptual basis of RUPES: rewarding upland poor for the environmental services they provide. ICRAF Southeast Asia, Bogor, Indonesia.

[98] Schroth, G. et al. 2004. Agroforestry and biodiversity conservation in tropical landscapes. Island Press, Washington, DC.

One of the milestones in this theme will be the extension of existing ***tree*** databases (e.g., www.worldagroforestrycentre.org/resources/databases/agroforestree with information on tree utility and www.worldagroforestrycentre.org/sea/Products/AFDbases/WD/, a global reference for wood density information relevant for C-stock appraisals) to include a wider range of ecologically relevant properties, and linking these databases to operational data sets and site-level studies.

Box 2.5 CIFOR and World Agroforestry Centre landscape research methodologies

CIFOR: At the landscape scale, CIFOR has standardized a research methodology that it has implemented in many sites, often in collaboration with IUCN. The research method may be summarized as follows.

- Define the landscape: undertake PRAs and stakeholder analysis, identify all the stakeholders within the landscape and undertake participatory mapping to ascertain local perceptions of land cover and use.
- Collect baselines: assemble available background information (documentation, maps, etc.).
- Explore scenarios: what is happening within the landscape?
    - Clarify the historical context
    - Visualize the landscape
    - Develop simulation models
- Facilitate desired landscape scale outcomes (policy implications, catalogue incentives, rewards etc.).
- Identify indicators to measure progress.
- Monitor change.

Reference: Sayer, J. et al. 2007. Assessing environmental and development outcomes in conservation landscapes. Biodiversity and Conservation 16: 2677–2694.

World Agroforestry Centre: As a follow-up to the intensive studies at long-term sites, the World Agroforestry Centre has focused on replicable methods for improved natural resource management that can be used in a cost-effective and timely manner, once capacity at national and local universities and NGOs is enhanced. Methods include:

- understanding land use, poverty and drivers of change (DriLUC and PaPOLD);
- understanding agroforestry systems and their market links (RAFT, RMA and WNoTree);
- understanding the landscape and water flows (PaLA and RHA);
- understanding biodiversity in landscapes (RABA and QBS);
- understanding carbon stocks and GHG emissions (RaCSA and FBA);
- understanding tenure and resource use rights (RaTA and FERVA);
- understanding trade-offs and scenario analysis (Fallow/TALAS and RESFA).

Details and examples of applications can be found at: www.worldagroforestrycentre.org/sea/ projects/tulsea/

New insights are also emerging on the interface of social norms and monetary instruments, regarding financial incentives (payments) for environmental services. CRP6 work can contribute new paradigms in this arena, based on direct experience of action research that tries to “make things work”, while stimulating discussions with the scientific community. It will not be easy to move from analysis to action in this arena, unless fine-grained solutions in rural landscapes and tropical forest margins align with institutional change at the global level.

In such cross-scale analysis, the lack of economic research tools remain a challenge,[99] and partnerships in new fields such as experimental (behavioral) economics will need to be enhanced.

Different tools will be applied to promote multi-stakeholder dialogue and consensus building in order to enhance landscape-scale multifunctionality. Multi-criteria decision analysis will be carried out to assess the minimum set of institutional, organizational and policy conditions for promoting multiple-use forest management and minimizing trade-offs. Research will provide analyses of the range of property rights regimes that exist in diverse multifunctional landscapes and determine how they create, allocate and enforce entitlements and responsibilities among actors. Research will also identify tights allocation regimes that have potential to resolve existing conflicts, as well as governance processes and practices that have potential to enhance equitable access and benefit distribution from the productive elements of multifunctional landscapes.

Many forest-adjacent communities, including those residing close to production forests, are among the poorest and suffer from inequitable power relations compared with governments, civil society and the private sector. This research will seek to understand how communities can build cooperation and synergies, both internally and with external actors. Factors that strengthen or undermine collective action for sustainable use and/or securing rights within forested landscapes will be assessed, as will the extent to which communities are aware of their rights and responsibilities.

Research questions

Broad research questions (Component 3, Theme 2)	Gender-specific aspects of the research question	Examples of science outputs
How can "environmental service deficits" be quantified? • How do landscape-scale watershed services, carbon storage, biodiversity conservation and the sustaining of ecological functionality depend on the attributes of forestry and agroforestry systems as part of landscape mosaics across climatic, biogeographic, ecological and socioeconomic contexts? • What are the most effective methods for assessing environmental service provision and changes that result as a function of landscape-level disturbance? • What holistic combination of *in situ* (including managed forests), *ex situ* and *circa situ* (on-farm) conservation approaches are most effective for conserving key populations of priority species and their genetic diversity at the scale of landscapes?	How does preference for "quantifiable" environmental services (ES) vary between genders, based on perceived direct value of ES and foreseeable benefits, influencing level of participation?	Tools for determining and quantifying the environmental services at stake in various stages of tree cover transition Strategies and practices for managing tree species to conserve genetic resources today and for the future at the scale of landscapes Strategies and practices for sustaining ecological functionality in multiple-use landscape mosaics

[99] Bateman, I.J. 2009. Bringing the real world into economic analyses of land use value: incorporating spatial complexity. Land Use Policy 26S: S30–S42, doi:10.1016/j.landusepol.2009.09.010; Pascal, U. et al. 2009. Valuation of ecosystems services: methodology and challenges. Report to Review of The Economics of Ecosystems and Biodiversity. European Commission/UNEP/BMU-Germany.

Broad research questions (Component 3, Theme 2)	Gender-specific aspects of the research question	Examples of science outputs
• How can fairness and efficiency be combined in ways to reduce environmental service deficits? • How do outcomes of negotiations over conservation and development trade-offs vary in relation to such factors as stakeholders' negotiation capacity, scientific input and inclusiveness of participation and gender considerations? • How realistic are expectations that regulation of and incentives for enhancing tree-based watersheds, carbon storage and biodiversity services can enhance and sustain environmental services? • What are the trade-offs between efficiency, perceived fairness and measurable equity, and poverty reduction associated with alternative mechanisms for environmental service rewards for smallholder farmers, both men and women? • How can cross-sectoral policies and community-based forest policy limit or enhance the potential for environmental service rewards? • How can policies, tools, methods and approaches enhance the sustainability of financial flows, and improve governance and institutions? • Under what conditions and at what scales can PES schemes and related mechanisms produce positive outcomes for conservation and human well-being that are effective, efficient and equitable?	How do gender roles influence participation in negotiation of PES schemes? What approaches, including timing, sequencing and overall design of PES negotiation processes, are necessary for ensuring effective participation? How to understand, across the various cultural contexts, gender roles and representation in policy dialogues in light of integration? What are the gender-specific impacts of the implementation of ES schemes? How are benefits distributed between men and women, with what impacts on sustainability and livelihoods? What alternative options and arrangements can narrow and/or eliminate distribution gaps?	Adaptive landscape management in which local stakeholders are supported and enabled to enhance environmental service provision as well as their livelihoods Tested tools and governance mechanisms for managing the trade-offs between conservation and development at multiple scales
How can forestry and agroforestry initiatives best interact with the drivers of forest and landscape transitions?	How can forestry and agroforestry and the perspectives of women (and other marginalized actors) be included in policies? What strategies, and at what stages in the sequence of policy design, will ensure effective participation of women and other marginalized actors?	Overview of current policies for the agriculture–forestry interface that can be adjusted to maximize positive environmental and socioeconomic outcomes

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR	Leads analysis of consequences on forest-based biodiversity and related ES and livelihood issues; co-leads PES/RES research with a focus on Latin America, gender analysis of ES perceptions and institutional analysis of community-based resource management in forest margins and around protected areas (and its representation in models); co-leads research on tree and land tenure and associated rights
	World Agroforestry Centre	Leads analysis of watershed functions and consequences of trees-in-the-landscape for biodiversity and related ES; co-leads PES/RES research, with a focus on Africa and Asia; leads work on integrated assessment methods and agent-based modeling, which include livelihood options; co-leads research on tree and land tenure and associated rights; leads analysis of national-level institutions and their legal basis for use of economic instruments for ES enhancement
	CIAT	Quantifies and models agricultural drivers of forest transition
International level	CIRAD	Contributes expertise on forestry/agroforestry interface
	RRI	Conducts tenure and rights analysis
	IUCN/CEESP	Researches rights-based approaches to conservation
	CARE	Involved in livelihoods, tenure, rights and development
	IMFN	Implements sustainable management of forest-based landscapes through the Model Forest approach
	IITA	Has shared interest in modeling agricultural drivers of forest transition—coordination with CRP1.2 via ASB partnership
	IFPRI	Has shared interest in modeling agricultural drivers of forest transition—coordination with CRP2 via ASB partnership
	UNEP	Conducts trade-off analysis among environmental services in areas such as Mt Kilimanjaro, Lake Tanganyika
	DIVERSITAS	Provides access to global agrobiodiversity network and consequences of intensification and multifunctionality
	INBAR	Conducts ES analysis of bamboo- and rattan-based systems as part of broader landscapes
	Ecoagriculture partners	Identify criteria and indicators for eco-friendly agriculture in biodiversity-rich landscapes
	Katoomba group	Hold discussion forum on PES and its innovations
	IUCN	Develop innovative approaches to integrated natural resource management
	Conservation International	Function as hotspot alliance partner on innovative solutions for conservation in agriculturally used landscapes
	Universities of Alberta, Amsterdam (VU), Gottingen, Hohenheim, Utrecht, Wageningen, Leuven, Cambridge,	Analyze forest transition patterns in relation to drivers of change
	Macaulay Land Use Research Institute, SLU, ZEF	
	Sustainability Science Program at the Kennedy School of Environment at	Conducts analysis and synthesis of boundary organizations in natural resource management (NRM) negotiations and payments for ES

Type of research partner	Organization	Research partner contributions
	Harvard University	
	Tropenbos	Improves knowledge, and individual and institutional capacity for better governance and management of tropical forest resources
Regional level	CATIE	Coordinates research in Central America
	RECOFTC	Adopts research and disseminates through training
	WOCAN	Researches gender aspects of community-based NRM
	De la Salle University, Philippines	Researches gender aspects of emerging PES/RES institutions
	Heart of Borneo Initiative	Provides compensation scheme development, sustainable financing
Country or site level	FORDA (Indonesia)	Collaborates in research in specific sites
	NAFRI (Laos), MARD (Vietnam)	Researches land use planning processes
	Ministries of forestry (Guinea, Sierra Leone)	Conduct landscape management and restoration
	Embrapa (Brazil), LIPI (Indonesia)	Conduct land use monitoring
	FFI (Indonesia)	Develops environmental services compensation schemes
	FRIM (Malaysia)	Evaluates environmental services
	IRAD (Cameroon)	Conducts forest transition studies
Private sector	Bridgestone	Identifies criteria and indicators for eco-friendly rubber production
	Mars Inc.	Identifies criteria and indicators for eco-friendly cacao production

2.3.7 Research Theme 3: Enhancing responses and policy options to sustain and maximize environmental and social benefits from multifunctional landscapes

Rationale

Under what circumstances is it possible to reconcile conservation and development objectives in forested landscapes? What needs to be done to create appropriate conditions for this reconciliation? A new generation of integrated conservation and development initiatives, using approaches variously termed as the “landscape approach” and the “ecosystem approach”, are being implemented to address these problems.[100] Existing evidence suggests that such projects should: (1) be implemented at multiple scales; (2) address the problem of trade-offs by quantifying them, providing platforms for multi-stakeholder negotiations and using instruments such as PES; (3) pay greater attention to organizational and institutional aspects during implementation; (4) give greater weight to extra-sectoral and non-local drivers of change; (5) use adaptive management; and (6) mainstream participatory action approaches.

[100] Sayer, J. et al. 2007. Assessing environmental and development outcomes in conservation landscapes. Biodiversity and Conservation 16: 2677–2694.

The combination, sequence, timing, form and quality of interventions at the various scales are all important in influencing outcomes.

Adaptive management implies both "experimentation" and "learning" components of these conservation and development interventions, especially where the opportunity is taken to compare experiences and learn across sites. Research will target identifying and negotiating trade-offs between conservation and development,[101] as well as identifying and understanding the factors influencing implementation success and failure.

A specific interest in CRP6 at the interface of Components 2 and 3 is how forest ecosystems can be managed for conservation alongside production functions. Research aimed at developing guidelines, to be used at the "management unit" level in Component 2, will be viewed in a wider landscape context in Component 3. This will allow holistic models to emerge for the conservation of biological diversity, especially intraspecific diversity, including *ex situ*, *in situ* and *circa situ* (on-farm) approaches that do not undermine communities' ability to improve livelihoods.

Research under this theme includes examining ongoing negotiation mechanisms and land tenure reforms in fully or partially forested landscapes that can contribute to improved landscape management by recognizing the trade-offs between conservation and development, and by improving prioritization of land use. Research will illuminate ways to reform governance processes and institutions at local and landscape levels to make them more legitimate, to increase the security of rights and to balance customary norms and formal policy. The work will yield insights into what kinds of land use right lead to optimized situations for both conservation and development, and will produce tools and approaches for assessing trade-offs, mitigating conflicts and conducting multi-stakeholder negotiations.

Methods and research approach

The "learning landscapes" approach implies that key stakeholders in target landscapes are learning; at the same time, scientists are learning about what these stakeholders learn—this can remove bottlenecks elsewhere. Such "social learning" is used to frame logical but challenging requirements for evidence of (1) individual changes in understanding; (2) shifts in understanding in wider social units or communities of practice; and (3) attribution of (1) and (2) to social interaction processes. Methods will thus be a combination of quantitative and qualitative approaches that include focus group discussions and self-reflections as well as "hard" data, such as the use of remote sensing to determine changes at the landscape scale over time (c.f. CRP6.3.1). Methods used in this theme are a trade-off between "product" and "process" -oriented traditions. Product-oriented traditions emphasize quantitative approaches that scale across space and time and can feed into forecasting and scenario development. They are generally seen as good science and replicable, but may have a problematic outcome/impact pathway. The focus of process-oriented traditions is on multi-stakeholder learning; these approaches emphasize outcome and impact, but may be weaker on scientific content and replicability.

[101] Sunderland, T.C.H. et al. 2008. Conservation and development in tropical forest landscapes: a time to face the trade-offs? Environmental Conservation 34(4): 276–279.

An important consideration in selecting and managing “learning landscapes” for this component is to balance the level of engagement of researchers in support of change (including influencing local policy reform) with the continued opportunity to interpret the ongoing processes of change of relevance for a broader set of landscapes. While “sentinel landscapes” (see Annex 4) will serve more as “observatories”, the “active learning landscapes” described here will involve more direct researcher participation in local action. This approach opens opportunities to use sentinel landscapes for formal impact assessment of work undertaken in this theme; however, in practice, the line between *sentinel* and *learning* landscapes will not always be very distinct.

Landscape studies provide powerful tools to examine how society-wide changes, such as changing macroeconomic conditions, infrastructure development, land tenure and agrarian reforms, influence the development and sustainability of particular agricultural strategies or production systems, and thereby reveal the pressure they have on forest resources.

However, these approaches often provide no information about the implications for livelihoods and the social distribution of benefits of economic growth, or about the differentiated implications of emerging land uses for forest goods and services. Hence, the challenge is to link landscapes to livelihood approaches, and to interpret them within a broader context of factors shaping the interplay between economic development and landscape change. Although there has been a great deal of research on the causes of deforestation and forest degradation, much remains to be learned about viable solutions to emerging problems. For example, can policies be developed that can enhance people’s livelihoods by stimulating particular agricultural strategies and land use practices, while mitigating pressures on forest resources? NGOs, district officials and other key stakeholders need tools and appropriate information (such as scenario building, trade-offs assessment and opportunity costs analyses) to assist them in making decisions for the optimized management of multifunctional landscapes, allowing for integration of land use management, conservation and socioeconomic planning. These tools will further raise awareness among national and local decision makers about the pace, magnitude and location of landscape changes, and potential implications of such changes for forest goods and services.

Research questions

Broad research questions (Component 3, Theme 3)	Gender-specific aspects of the research question	Examples of science outputs
How can multi-stakeholder, multifunctional landscapes evolve from a conflict-dominated state to one that involves negotiation and use of opportunities for synergy—with positive environmental and social outcomes? How do the outcomes of negotiations between conservation and development trade-offs systematically vary in relation to such factors as negotiation capacity of various stakeholders, scientific input and	Do conserved and other forests have different values and accessibility for men and women? What kind of conflicts may occur within communities and how might their nature and intensity vary by gender? What options exist for conflict management and resolution that draw upon the relative strengths of men and women? How can different abilities to participate and negotiate, including bargaining power, between men and women be accounted for and addressed?	Identification of principles, methods and processes for optimizing conservation and livelihood values from the allocation of land use rights within forest landscapes Collaborative decision-making and monitoring tools for strengthening community involvement and meaningful participation in conservation and land use planning, especially by women and other disadvantaged stakeholders

Broad research questions (Component 3, Theme 3)	Gender-specific aspects of the research question	Examples of science outputs
inclusiveness of participation?	How to facilitate equitable land use rights allocation and women's ability to maintain rights? What kinds of safeguards are required in rights allocation processes to ensure equitable and effective rights and access?	
How can conservation and livelihood objectives be reconciled at the landscape scale?	How do species uses differ between user groups and how should these be taken into account in conservation and management? How to resolve conflicting uses between multiple users within and among communities? How to empower women by recognizing and strengthening their role in and livelihood benefits from resource management? What might be the unintended consequences of such empowerment and how can such consequences be mitigated and/or avoided? What suite of incentives, knowledge and resources is required to enhance reserve managers' gender sensitivity?	Identification of improved modalities and approaches to effectively support conservation in forest landscape mosaics Participatory models for reserve managers to identify how reserve dwellers use particular resources and threaten long-term sustainability of targeted species; monitor current uses; and develop guidelines for conservation and sustainable management of species and populations of value

Research partners

Type of research partner	Organization	Research partner contributions
Participating CGIAR Center	CIFOR/World Agroforestry Centre	Jointly convene and participate in research in a number of focused "learning landscapes", experimenting with new ways of balancing goods and service provision in multifunctional landscapes
International level	CIRAD	Contributes expertise on forestry/agroforestry interface
	IUCN/CEESP	Provide a framework for a "rights-based approach" to conservation
	IMFN	Implement sustainable management of forest-based landscapes through the Model Forest approach
	Diversitas	Assesses biodiversity in agricultural landscapes and the anthropogenic drivers of biodiversity change
	IUCN	Convenes global network of "learning landscapes" through LLS
	WWF, CARE	Lead a number of landscapes with PES experiments
	IFAD	Mainstreams RES approaches in regular agricultural development projects
	Tropenbos	Improves knowledge, personal capacity and institutional capacity for better governance and management of tropical forest resources

Type of research partner	Organization	Research partner contributions
Regional level	CATIE	Coordinates research in Central America
	ICIMOD	Conducts land use change analysis in greater Himalaya subregion
	RECOFTC	Engages in research uptake and dissemination through training
	Heart of Borneo Initiative	Engages in compensation scheme development, sustainable financing, long-term research
	CARPE	Engages in landscape-scale implementation in Congo Basin
	WWF Lower Mekong	Engages in landscape-scale conservation and development in Lower Mekong
	CARE	Works with livelihoods, tenure, rights and development
Country or site level	FORDA (Indonesia)	Collaborates in research in specific sites
	NAFRI (Laos)	Researches land use planning processes
	MARD (Vietnam)	Researches land use planning processes
	Ministries of Forestry (Guinea, Sierra Leone)	Conducts landscape management and restoration
	Embrapa (Brazil), LIPI (Indonesia)	Conducts land use monitoring
	FRIM (Malaysia)	Conducts environmental services evaluation
	IRAD (Cameroon)	Conducts forest transition studies
	CI (Indonesia)	Conducts West Papua landscape assessments
	WCS (Cambodia and Laos), WWF (Cameroon, CAR and Gabon), FFI Cambodia	Carry out landscape-scale conservation and development
	National RUPES committees and networks in Indonesia, Philippines, Vietnam and Nepal	Identify national-scale regulation and legislation bottlenecks linked to “focused learning” sites
	Many site-level partners such as WARSI in Indonesia	NGOs involved at site level and in scaling-out to province/national scale
Private sector + NGOs	RSPO (Roundtable on Sustainable Palm Oil)	Conduct analysis of forest transition data in relation to proposed industry self-regulation
Private sector	Various drinking water companies	Potentially invest in environmental service provision

2.3.8 Sentinel landscapes

Details of the rationale for establishing a CRP6 network of sentinel landscapes are provided in Annex 4. The particulars of how this network will be implemented will be resolved during the first year of this program’s implementation. Most or all of the individual sentinel landscapes within such a CRP6 network will likely be research sites for this landscape-oriented component. Given its focus on this scale, CRP6 Component 3 will work with other component research teams to integrate knowledge generated, for instance, at the scale of individual farmer plots (CRP6.1), timber stand harvesting by communities (CRP6.2), climate change mitigation and adaptation strategies (CRP6.4) and the impacts of global trade and investment (CRP6.5) and to build understanding of how these factors play out in individual landscapes.

We will benefit from this network to undertake long-term research to monitor the impacts of exogenous and endogenous change at the landscape scale, and test the durability of options to sustain livelihood and environmental resilience. Subsequently, we will develop and apply field-tested and standardized research protocols to allow global comparative studies of forest transition stages, economic and demographic conditions and climatic/biophysical determinants of environmental services and livelihood options, building on the learning landscapes approach of Theme 3 of this component. Finally, via the overall coordination with other CRPs that CRP6 will provide (see Section 4 on program support) we will link with researchers in other CRPs in exploring development questions at the scale of landscapes (see Annexes 3 and 4).

2.3.9 Impact pathways

We expect to produce impacts (see Figure 2.5) primarily by developing and disseminating methods and policy strategies under the auspices of international treaties and policy frameworks (e.g., CBD, IPBES) and by conducting capacity building with our partners for user groups including planning agencies (Theme 1), forest and land use governance agencies (Theme 2) and landscape management agencies and actors (Theme 3). (See Section 3.1 for gender-specific impact pathways.)

To achieve our desired results, we will apply a range of strategies. Our work, spanning a wide network of landscapes, will cover the primary dimensions of variation for longitudinal (long-term) research where existing data sets and partnerships can be used to monitor the impacts of exogenous and endogenous change at the landscape scale. This will provide key information and knowledge for policy and practice partners. To enable global comparative studies of forest transition stages, economic and demographic conditions and climatic/biophysical determinants of environmental services and livelihood options, we will develop and apply field-tested and standardized research protocols. Negotiation Support Systems[102] will be used to influence and facilitate change among multiple stakeholders at local scales. Finally, for scaling-out, diagnostic approaches will be packaged into replicable appraisal methods that will be used for train-the-trainer events. The initial stages of their application will typically be supported by universities, NGOs and government agencies.

Risks remain in the overselling of oversimplified approaches linked with quantitative impact indicators that are not broadly supported (voluntary) or not feasible (unrealistic) and that do not have operational indicators for achieving the conditionality necessary for PES and RES. This component is designed to deal with these key risks through its focus on quantifiable indicators and cause–effect relations, while documenting experience on the use of PES and RES for conditional, outcome-based forms of rewards.

[102] van Noordwijk, M. et al. 2001. Negotiation support models for integrated natural resource management in tropical forest margins. Conservation Ecology 5(2): 21 [online] http://www.consecol.org/vol5/iss2/art21.

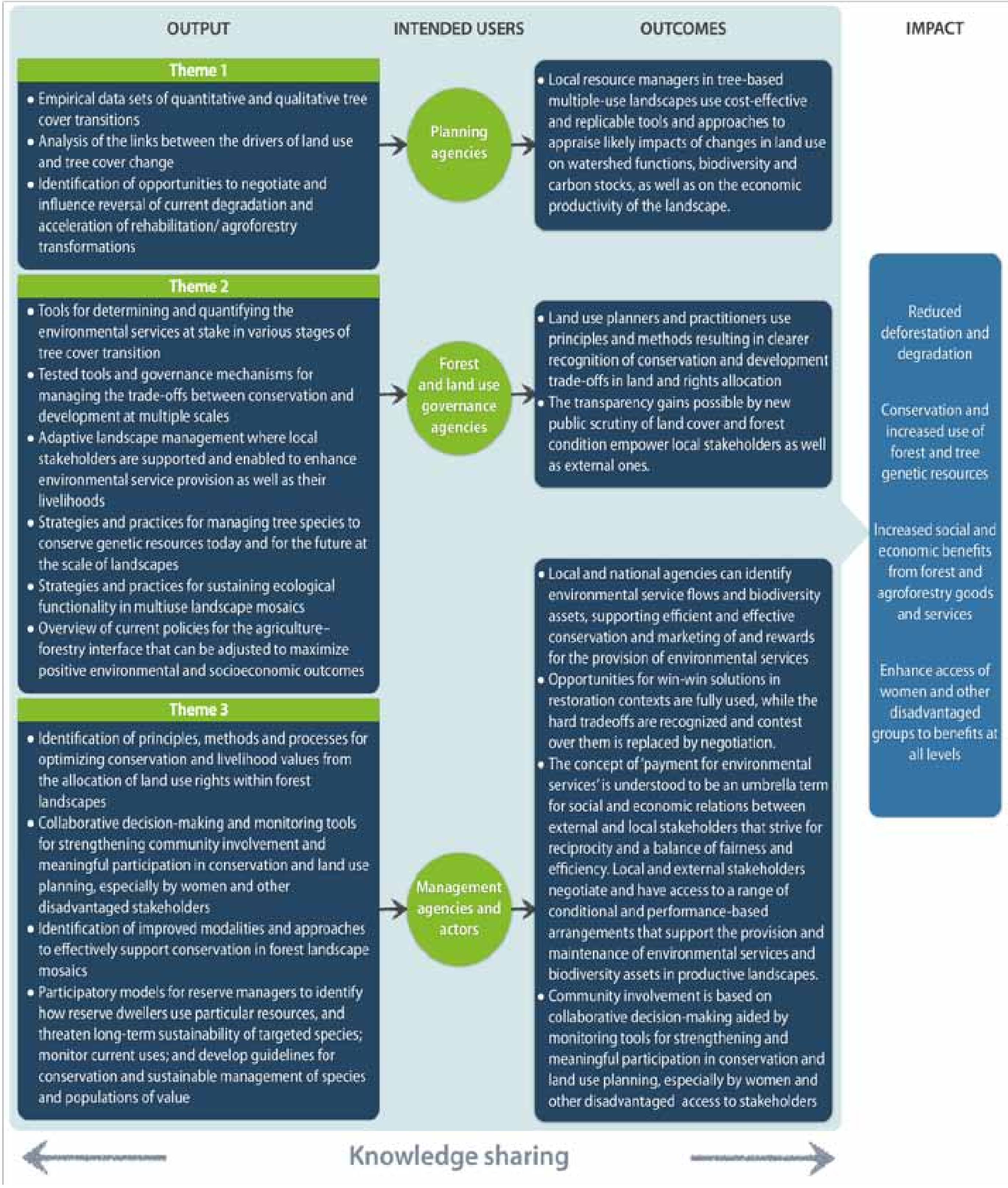


Figure 2.5 Impact pathways for Component 3

Box 2.6 Examples of potential impacts of Component 3

The benefits of improved and integrated landscape management can include maintenance and even increases in many different environmental goods and services, leading in turn to increased rural incomes, food security, biodiversity conservation and carbon storage. Following are some examples.

- *Forest-based pollination services for agricultural productivity.* As natural habitat for bees, bats and other critical taxonomic groups, forests, agroforests and other tree-based systems provide pollination services to adjacent agricultural areas. Studies suggest that forest-based pollinators can substantially increase coffee yields and quality. In one case from Costa Rica, coffee yields and the quality of beans on sites close to forests and forest edges were 20% and 27% higher, respectively, than on sites far from forests. This difference in productivity translated into an additional farm income of approximately US$60 per hectare.[1] Maintaining forests and viable forest fragments in landscape mosaics can thus increase agricultural productivity and rural incomes.
- *Co-management for improved incomes and biodiversity conservation.* The Landscape Management for Improved Livelihoods (LAMIL) project in Guinea supported co-management of forests between local forest committees and the Department of Forests and Fauna[2]. As a result of better management, the area affected by fire each year was reduced by around 80%, and wildlife populations were restored. Assistance to farmers in buffer zones in the form of improved farming and agroforestry practices and improved varieties of crops and trees contributed to increases in average household income of more than 25%, with many villagers able to increase their incomes by a factor of three or more. Co-management has also resulted in collective community benefits, as proceeds from forest harvests have gone into construction of community schools and wells.
- *Tenure clarity for REDD+ revenues and carbon storage.* One condition for payments for environmental services (PES) is the need for a clear “seller” of those services, requiring similarly clear land tenure rights. However, some 24% of all land in Brazil and more than 50% in Indonesia (the two countries with the highest rates of deforestation) are characterized by unclear or insufficient tenure rights. As a result, PES-related approaches to REDD+ mechanisms are hindered as a climate change mitigation strategy. Projections indicate that about 67% of all deforestation will occur in these areas, hence limiting the feasibility of PES to approximately one-third of its potential to reduce deforestation.[3] The development of policies and strategies to clarify tenure rights in Brazil and Indonesia would thus have a dual benefit: potentially millions of smallholders living in these areas would become eligible for a new source of income as environmental service providers, and REDD+ investments would reduce emissions from deforestation[4].
- *Wildlife management for increased food security.* In at least 62 countries worldwide, wildlife and fish together constitute at least 20% of the animal protein in rural diets. In some rural areas in Central Africa, bushmeat constitutes up to 80% of protein and fat in local diets. While the extinction of significant forest mammals is of concern from an ecological point of view, the impacts of wildlife depletion on food security can also be dramatic. Protein malnutrition would likely increase rapidly as many African countries do not produce sufficient quantities of non-bushmeat protein to feed their populations.[5] Improved strategies for sustainably managing these ecosystem goods at the landscape scale could significantly improve food security.
- *Clean and sustained sources of water.* The influence trees and forests have on the total water yield of a catchment is generally negative, but quality of surface and ground water and regularity of river flow are generally positively related to tree cover. The relationship between forest cover and flooding risk is an area of ongoing public debate and scientific analysis[6].

References:

[1] Ricketts, T. et al. 2004. Economic value of tropical forest to coffee production. Proceedings of the National Academy of Sciences USA 101(34): 12579–12582.
[2] Pye-Smith, C. 2009. Restoring lives and landscapes: how a partnership between local communities and the state is saving forests and improving livelihoods in Guinea. CIFOR, Bogor, Indonesia; World Agroforestry Centre, Nairobi.
[3] Börner, J. et al. 2009. Direct conservation payments in the Brazilian Amazon: scope and equity implications. Ecological Economics 69: 1272–1282.
[4] Akiefnawati, R. et al. 2010. Stewardship agreement to reduce emissions from deforestation and degradation (REDD): Lubuk Beringin’s Hutan Desa, Jambi Province, Sumatra as the first formal and operational “village forest” in Indonesia. International Forestry Review 12: 349–360.
[5] Nasi, R. et al. 2008. Conservation and use of wildlife-based resources: the bushmeat crisis. Technical Series No. 33. Secretariat of the Convention on Biological Diversity, Montreal; CIFOR, Bogor, Indonesia.
[6] van Dijk, A.I.J.M. et al. 2009. Forest–flood relation still tenuous—comment on “Global evidence that deforestation amplifies flood risk and severity in the developing world” by C.J.A. Bradshaw, N.S. Sodi, K. S-H. Peh and B.W. Brook. Global Change Biology 15: 110–115.

2.3.10 Milestones

Working milestones for Component 3 are as follows.

Year 1: Organizations key to achieving impact pathway are confirmed as partners. Partnerships are formalized through MoUs/subcontracts, etc. Platforms for negotiation are established to underpin the “feedback process”. Baseline data are collated (e.g., synthesis of current agent-based spatially explicit modeling frameworks in relation to forest and tree cover transitions); research methodologies are developed and tested. Long-term implementation research strategies are agreed. Ongoing research and other activities are aligned with CRP6.3 as appropriate. Research sites (including for sentinel landscapes) are selected in consort with other CRP6 components and key partners.

Years 2–4: Research activities are undertaken and results validated through peer-review publication. Multi-stakeholder analysis provides feedback on progress on achieving outcomes

Years 5–6: Research outcomes; for example: use of improved methods for evaluating environmental services leads to improved assessment and calculation of reward mechanisms; land use planners and practitioners adopt new approaches that result in clearer conservation and development trade-offs in land and rights allocations; improved modalities and approaches that effectively support conservation in forest landscapes are identified and implemented. Research outputs are adopted and further disseminated by lead CG-centers, partners and research targets (e.g., CBD, IPBES).

Years 7–9: Continued monitoring (including multi-stakeholder analysis) in both learning and sentinel landscapes provides evidence of improved land use practices, more equitable tenure and resource rights and improved livelihoods.

Year 10: Observable decrease in forest and tree loss and increase in forest cover (due to both restoration and agroforestry). Continued feedback informs future research efforts.

We emphasize that the milestones listed above are preliminary and subject to refinement during the initial project start-up, and as part of a rolling annual planning process over three years. In practice, a 3–4-year project cycle is frequently most appropriate as lessons are learned, new priorities emerge and situations change in individual landscapes and globally. We are targeting a 10-year project design, but suspect that delivery of the full potential impacts will likely require a longer time horizon (see also Annex 4 on sentinel landscapes).

2.3.11 Role of partners

This component will build on the solid foundation of partnerships developed in previous and ongoing research undertaken by the CGIAR centers involved in CRP6. The World Agroforestry Centre, and the ASB Partnership for Tropical Forest Margins that it convenes, has long-term research underway analyzing environmental service dynamics, incentives to influence agroforestry transformations and the links between the drivers of land use and tree cover change at global, national and local scales along with opportunities to influence agroforestry transformation.

Another example is CIFOR's landscape-scale research on conservation and development trade-offs (which includes the joint CIFOR/World Agroforestry Centre Landscape Mosaics initiative, as part of the joint Biodiversity Platform, collaboration with IUCN's Livelihoods and Landscapes Strategy (LLS) and the International Model Forest Network), sustainable forest management, and smallholder and community forestry. CIAT has also undertaken extensive research on forest–farmland margins.

Table 2.3 Illustrative list of policy and knowledge-sharing partners for Component 3.

Levels / types	Policy and practitioner partners*	Roles / contributions	Knowledge-sharing partners	Roles / contributions
International level	CBD	Key international instrument for sustainable development	Panos	Uses scientific content in training journalists
	FAO	State of the World's Forests: annual forest cover assessment	WOCAN	Promotes institutionalization of gender perspectives in NRM-related organizations
	FSC	Investigates the potential role of certification of environmental services	De la Salle University, Philippines	Gender aspects of emerging PES/RES institutions
	IPBES	Mechanism proposed to further strengthen the science–policy interface on biodiversity and environmental services		
	GEOSS	Links stand-alone biodiversity monitoring systems and connects them to other Earth observation networks, such as climate and pollution indicators		
	RRI	Analysis of options for tenure reform and "boundary organization" interface with advocacy organizations and national policymakers		
	IMFN	The sustainable management of forest-based landscapes through the Model Forest approach		
	Katoomba Group	Discussion forum on PES and its innovations		
Regional level	COMIFAC	Translates research results into policy guidance for Congo Basin governments	CATIE	Uses content in graduate curriculum
	OTCA	Translates research results into policy guidance in Amazon Basin countries.	RECOFTC	Capacity building for community forestry and devolved forest management
	Heart of Borneo Initiative	Compensation scheme development, sustainable financing		
Country or site level	Ministries in charge of forest, forest resources and environment e.g., FORDA (Indonesia), NAFRI (Laos), MINFOF (Cameroon)	Land use planning policy and implementation	IPB/LIPI	Science and policy links to education and curriculum development
	Ministries, agencies in charge of gender and community development e.g., MARD (Vietnam)	Sustainable rural development	Environmental education organizations e.g., Living Earth Cameroon	Community outreach of research outputs

2.3.12 Prioritization

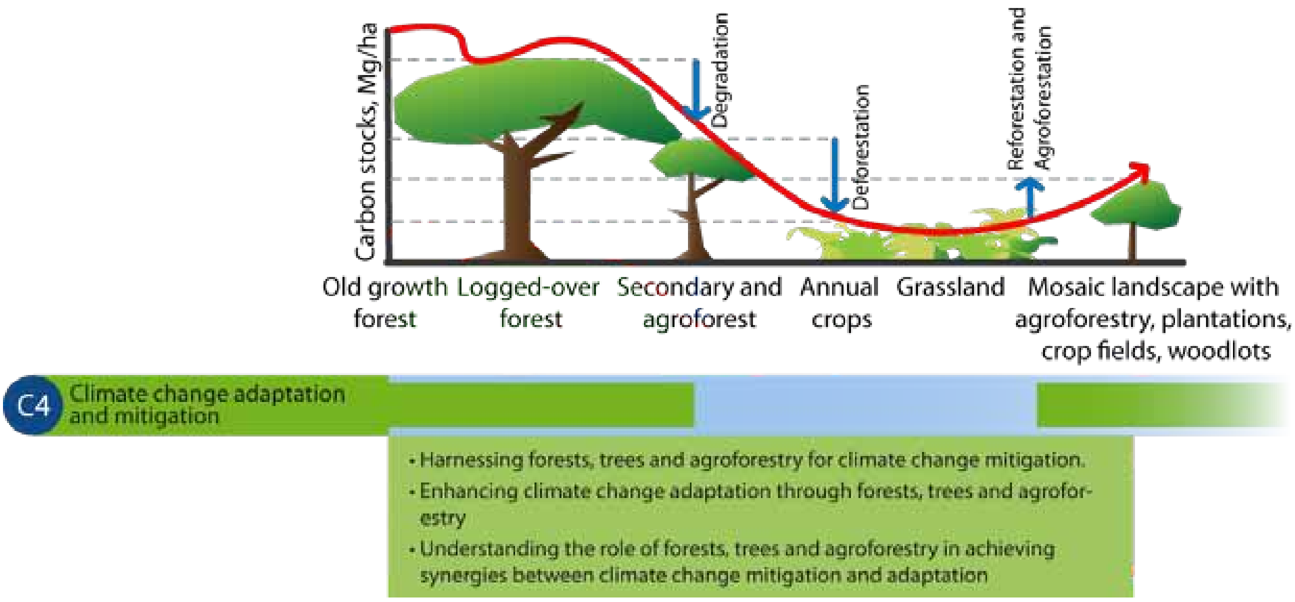
This component of CRP6 is pivotal to the program, not only for building understanding, but also for linking the landscape-scale impacts of drivers (CRP6.4, 6.5) to consequences and management options (CRP6.1, 6.2). The logic of drivers–state–response implies that priorities cannot be set easily at the thematic level in this component as all three themes are needed. A fully effective CRP6.3—that accomplishes all of its objectives—will require a suite of research landscapes across the global tropics to capture social and ecological variation. The scale and rate at which we will build this program will depend on the availability of funds, appropriate partners and other resources. Greater investment will enable a finer scale of research, whereas budgetary limitations will reduce it to more coarse-scale coverage, with less reliable conclusions. The stronger our financial support, the more rapidly we will be able to achieve our overall outputs targeting specific outcomes and impacts, as well as integrate better with other CRP6 components. Planning and prioritization will be undertaken through the rolling annual planning process over three years (continuing the CGIAR Medium Term Planning mechanism at center and CRP levels) with the engagement of the Component Implementation Team and broader CRP6-wide elements. We envisage the following two main strategies to prioritize the rollout of Component 3.

- The *scale of operations*: Work will need to start in all three themes from the initiation of CRP6 to ensure continuity of currently funded activities, enabling the effective and timely production of key outputs. However, if unavoidable budget restrictions prevail, it may be possible to delay the delivery of certain outputs as cost-saving measures over the first years of this program, pending more detailed analysis by the Component Implementation Team.

- The *number of landscapes* in which we conduct research: An ideal research design, from a global comparative study perspective, would require a number of replicates in each cell of a multidimensional matrix encompassing forest types (e.g., ecoregions), human population density, livelihood strategies and governance approaches. However, from a prioritization perspective, we would aim first to fill out the matrix with research underway in at least one landscape per cell in order to capture broad global variation. Subsequently, we would add research in replicate landscapes as more funds and other resources became available to enable us to produce more robust outputs. Rather than direct replication, additional sites would allow a finer resolution in a hierarchical typology of landscapes. In practice, the typology itself will be subject to review and revisions as more data become available. Further, selection of additional sites will depend on research design criteria, as well as partnerships opportunities and co-funding.

A full prioritization strategy will follow the initial Component Implementation Team meeting during the first semester of CRP6.

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.

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[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

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[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.

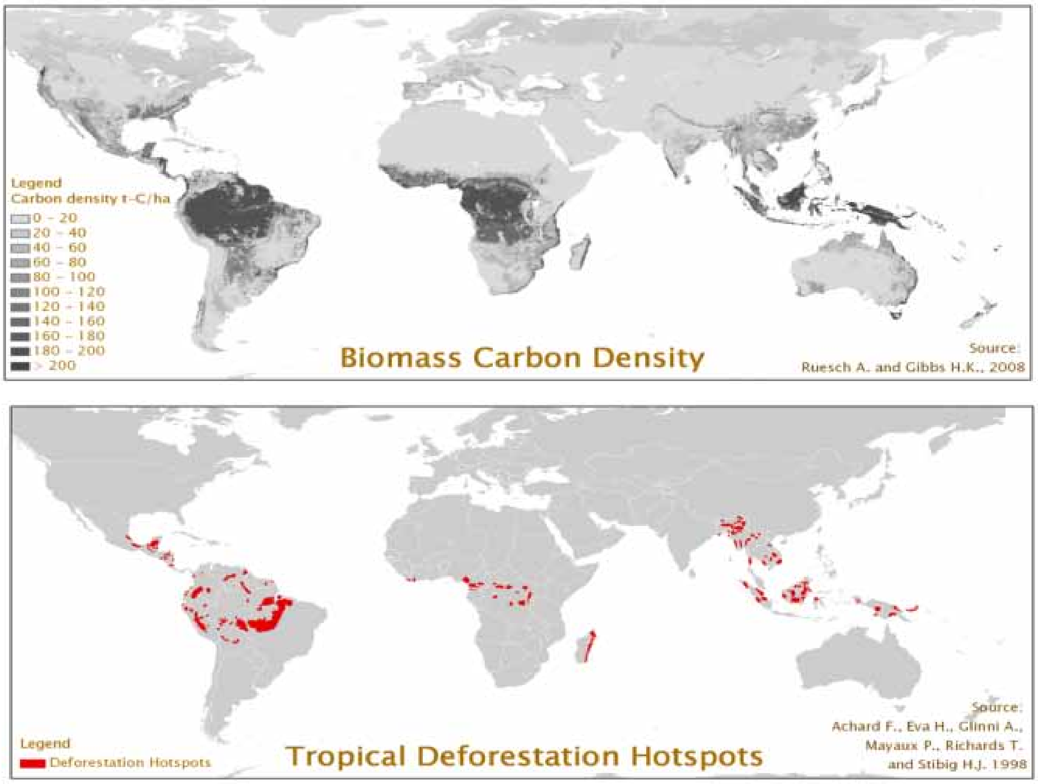

Figure 2.6. Ecosystem-based mitigation opportunities in terms of Carbon Biomass density and deforestation

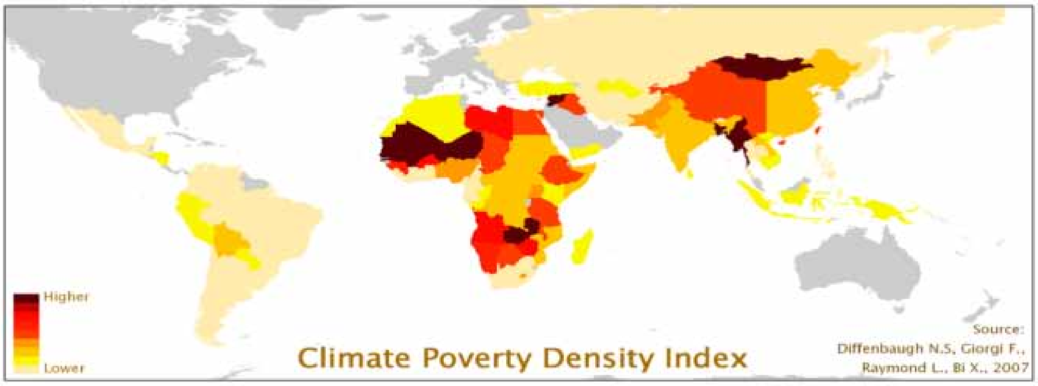

Figure 2.7 Adaptation needs: The climate poverty density index[122]

[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

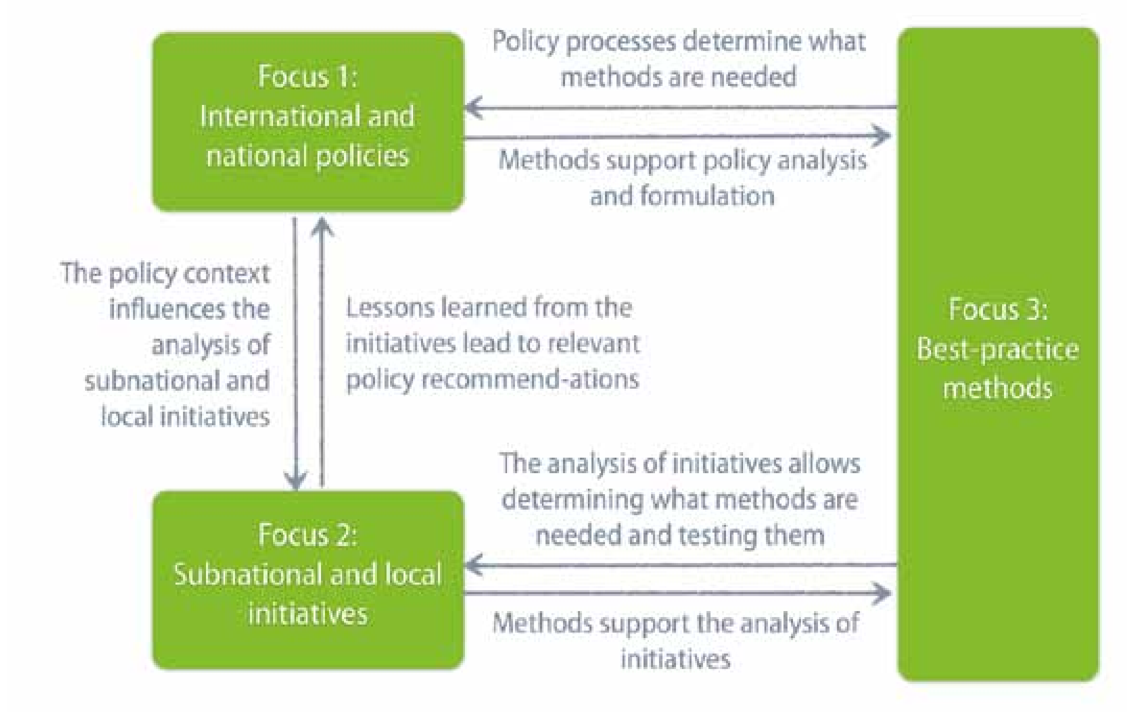

Figure 2.8 Articulation of the three foci in Component 4

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.

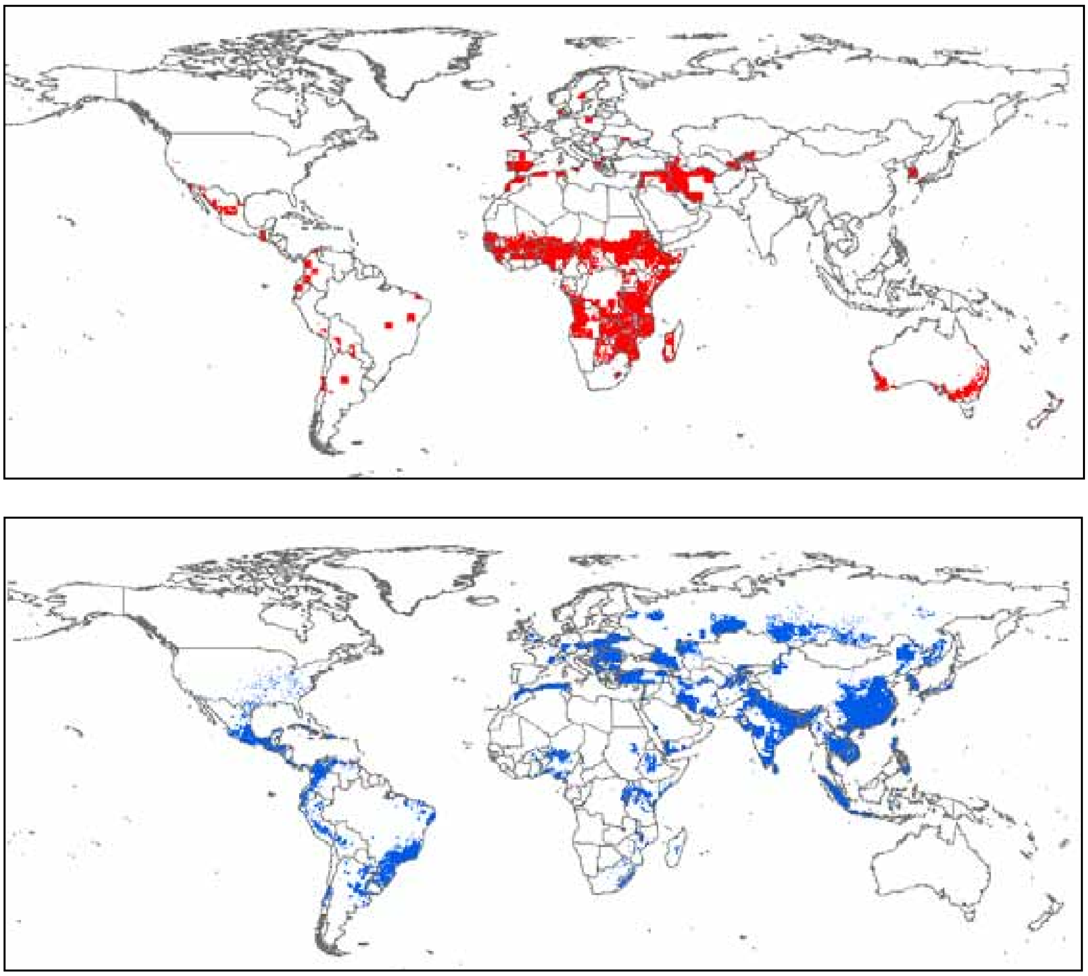

Figure 2.9 The areas most affected by drought (top) and flood (bottom), in terms of mortality or economic losses

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.

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[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).

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[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.

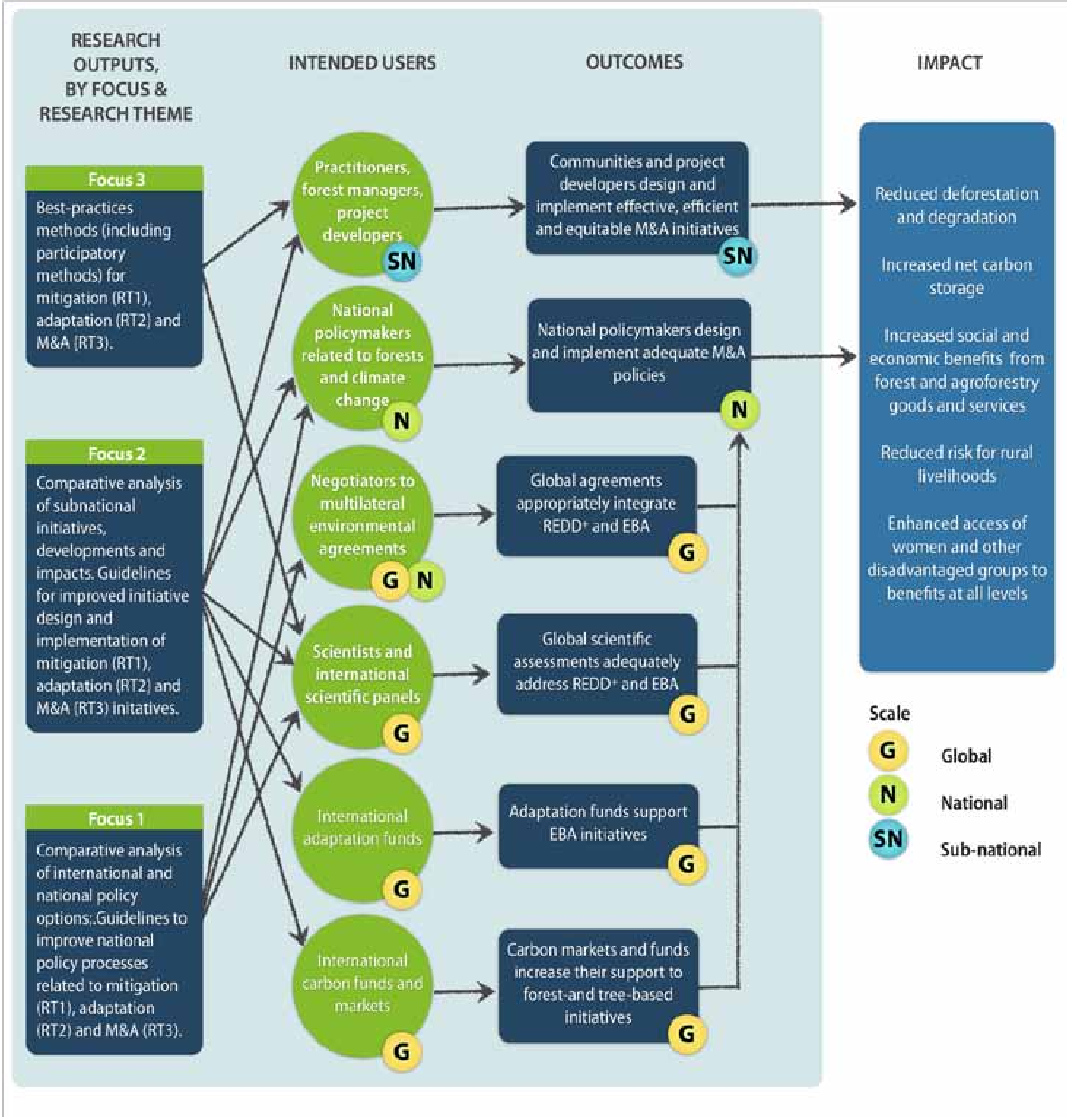

Figure 2.10 Impact pathways for Component 4

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 tCO_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.
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[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).

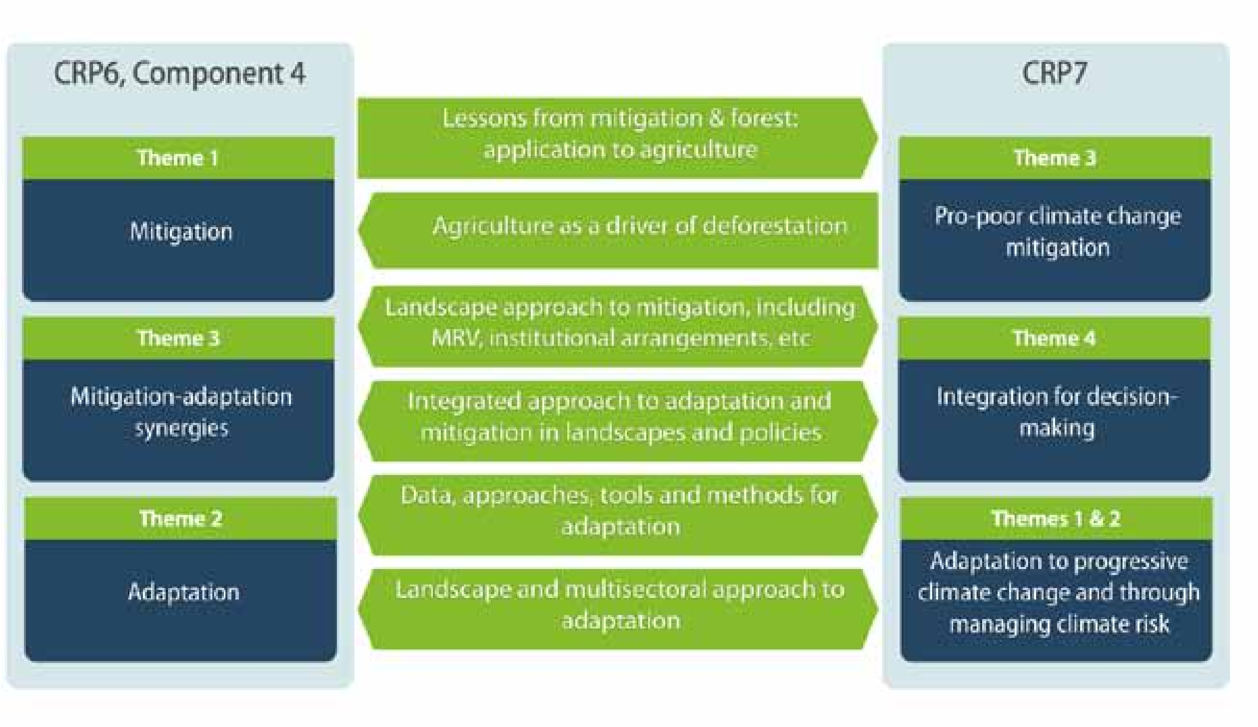


Figure 2.12 Links between Component 4 and CRP7

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

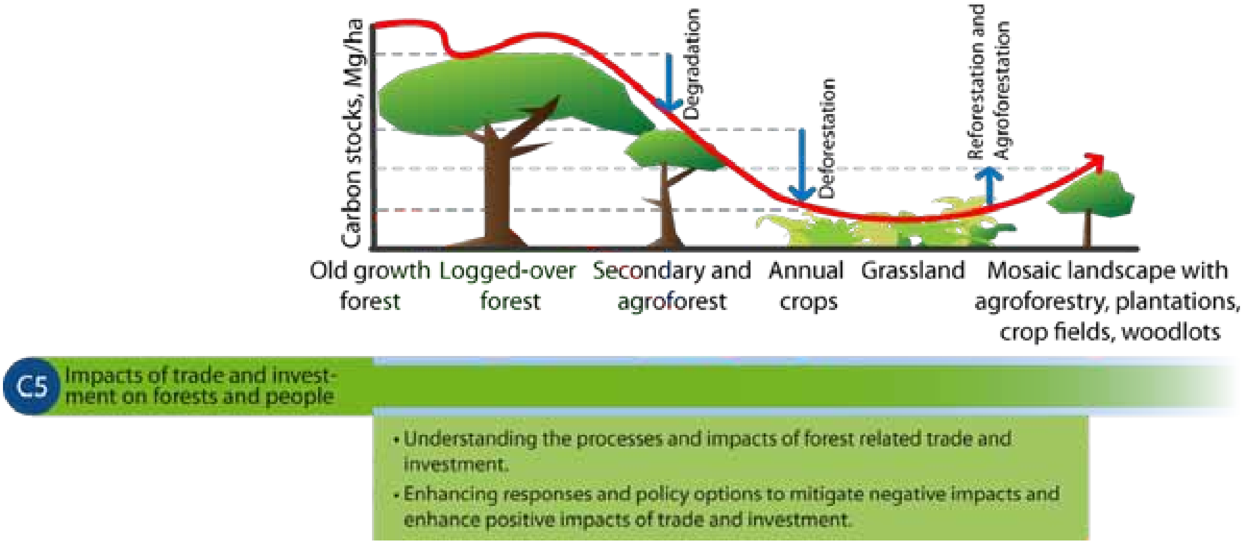
Work to be undertaken in Component 4 that is relevant to CRP7	Work to be undertaken in CRP7 that is relevant to Component 4	Work to be undertaken jointly
	Mitigation	
Evaluating global and national policies for REDD+ and subnational institutional arrangements	Analyzing agricultural drivers of deforestation 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.

2.5 Component 5: Impacts of trade and investment on forests and people



2.5.1 Introduction

The processes of commoditization and differentiation in land use systems have underpinned local livelihood strategies in developing countries for centuries. The patterns and geographies of trade, however, are increasingly shaped by growing globalization of trade and investment that are associated with the emergence of new commodities and processing technologies, the restructuring of commodity chains and the anticipated growth in global demand for edible oils, biofuels, fodder, food and beef. In this context, expanding trade and investment has become a major driver in shaping production trends, including agriculture and forestry. This has had significant implications for land-use change dynamics, and thus for forest transitions over large landscapes. Trade and investment present important socioeconomic and environmental consequences, which can be both negative and positive for economic development, local people's livelihoods and the environment. Substantial governance challenges are entailed to attenuate the negative effects of trade and investment on forests and people, and to enhance their contribution toward achieving sustainable development.

The expansion of global trade is often associated with growing foreign direct investment (FDI) flowing into forest-rich producer countries, leading to increased pressure on forested land. Some of the higher-impact activities include timber extraction, conversion of forest to agricultural land for the expansion of food, fodder and fuel crops (e.g., oil palm and soybeans) and to pastureland for beef production, and extraction of minerals in forestlands. In addition, the expansion of both internal markets and domestic investment, taking place in some forest-rich countries (e.g., Indonesia and Brazil) also places incremental pressures on forestlands, either for timber extraction or for conversion to agricultural land uses. Furthermore, the emergence of carbon as a "new commodity" will likely affect the financial flows targeting forest landscapes, and thus the land use dynamics associated to large-scale investments. It is noteworthy that patterns and processes of trade and investment, and their associated effects on forests, show some variations among Asian, sub-Saharan African and Latin American countries.

The coexistence of global and domestic markets and investments calls for increased articulation between national, regional and global regimes to govern the impacts on forests and people, because multiple solutions at multiple scales are needed to address the conditions shaping these impacts and their magnitudes. The aims of Component 5 of CRP6 are: (1) to reveal the processes and conditions shaping trade and investment dynamics and understand their associated impacts on, and trade-offs between, livelihoods and forest conditions; and (2) to contribute toward building effective multi-scale governance processes and architectures to mediate and manage the impacts for forest change. Our work will contribute toward more sustainable and equitable future development scenarios in forest-rich tropical countries.

The following three trends related to trade and investment influence changes in forest landscapes.

- *Growing demand for primary goods* (e.g., crop commodities, timber, minerals) from major emerging economies, notably the BRIC countries (Brazil, Russia, India, China), and increasingly from South Africa and the Middle East, is driven by industrialization, food consumption and increased income levels.[130] This leads to significant trade with and investment in forest-rich tropical producer countries with far-reaching impacts on land use transitions, forest conditions and people's livelihoods, particularly of the poor. Domestic demand is also growing in the producer countries, notably in Brazil and Indonesia, mainly as a result of urbanization, which increases demand for timber, food and energy.[131] Greater convergence of food, fuel and fiber markets is also affecting prices and market trends, causing shifts in the economic landscape.[132] Furthermore, the economic policy and trade agreements undertaken in large established markets, for example, in the EU and the USA, are also influencing changes in the geographies of trade.

- *Increasing investment in large-scale land and forest acquisition* is linked to a growing role played by transnational corporations in production.[133] Although this is not new, there are indications of a new wave of transnational land acquisition in tropical countries. Land is acquired for purposes such as development of commercial plantations for agricultural and tree crops, for food, fodder and biofuel, as well as for speculation arising from food and energy security concerns.[134] Most land acquisition for expansion of large-scale plantations tends to take place in sparsely populated areas with good agricultural potential, poorly defined land rights and low prices, which are common features of many forestlands.[135] The prospective delivery of large funds for

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[130] McDonald, S. et al. 2008. Asian growth and trade poles: India, China and East and Southeast Asia. World Development 36(2): 210–234; Athreye, S. and Kapur, S. 2009. The internationalization of Chinese and Indian firms: trends, motivations, and policy implications. Policy Brief 1. UN University, The Netherlands.
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[135] Deininger, K. 2010. Rising global interest in farmland: can it yield sustainable and equitable benefits? World Bank, Washington, DC.

REDD+ is likely to result in additional large-scale acquisition of forestlands, which could take place through different ways, mainly by allocating public forest in concessions for carbon or by reshaping current forest concession systems in association with carbon as an emerging global commodity.[136]

- *Persistent illegal timber harvesting and trade is a lucrative global business.* Significant trade flows take place from tropical forest-rich countries to intermediate and final consumer countries, mainly in Europe and China (see Figure 2.13). Global timber trade has significant impacts on forest conditions because it often leads to pressures on forest degradation—but it also contributes to important income generation for forest-rich producer countries. While expanding demand from emergent consumer countries stimulates illegal logging, the latter is also driven by increased demand in the domestic markets in the producer countries, often involving a large number of stakeholders—in the rural areas and cities—that derive some income originated in these informal economies. Efforts to address illegality in logging and trade are confounded by flawed national forest regulations, weak law enforcement and leakage between informal domestic markets and transnational trade.[137] Illegal logging, and other forest crime, is often further fueled by corruption, which frequently leads to the mismanagement of financial resources generated from forest-related activities.[138]

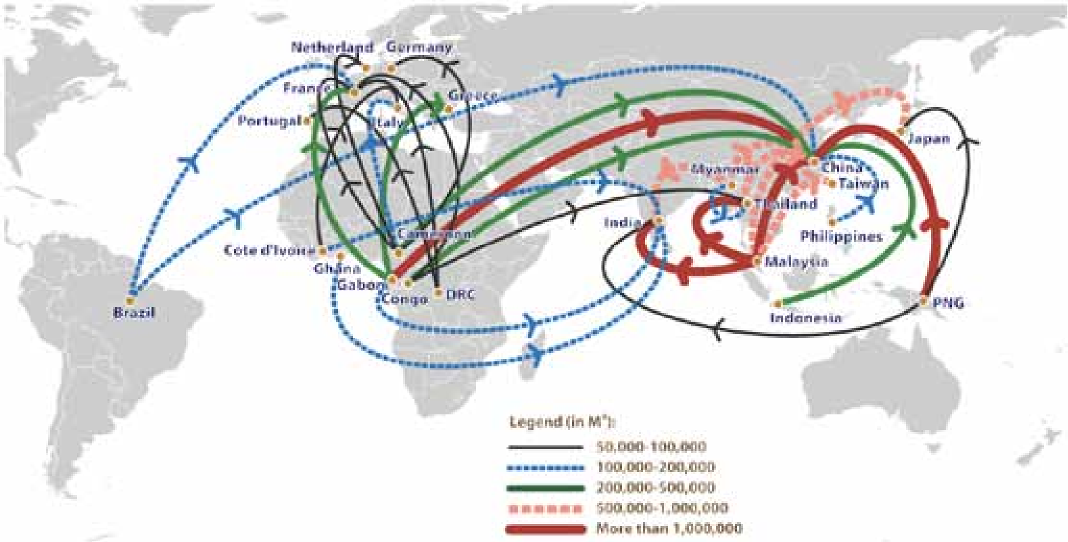

Figure 2.13 International trade in tropical wood (2008)

Source: Based on data from COMTRAD (2008). Diagram by CIFOR.
Note: Includes only bilateral trade flows that exceed 50,000 m^3, originating from tropical forest-rich countries. The trade volumes of rough- and sawnwood have been aggregated for the purpose of this illustration.

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136 Myers, E.M. et al. 2010. What is a REDD+ pilot? Building a typology for Indonesia. Infobrief No. 26. CIFOR, Bogor, Indonesia.
137 Brown, D. et al. 2008. Legal timber: verification and governance in the forest sector. ODI, London; Lawson, S. and MacFaul, L. 2010. Illegal logging and related trade: indicators of the global response. Chatham House, London; Cerrutti, P. et al. 2010. The challenges of redistributing forest-related monetary benefits to local governments: a decade of logging area fees in Cameroon. International Forestry Review 12(2): 130–138.
138 Smith, J. et al. 2003. Illegal logging, collusive corruption and fragmented governments in Kalimantan, Indonesia. International Forestry Review 5(3): 293–302; Barr C. et al. 2010. Reforestation Fund during the Soeharto and post-Soeharto periods, 1989–2009: a political economic analysis of lessons for REDD+. CIFOR, Bogor, Indonesia.

The trends mentioned above interact with each other in complex ways on different scales, with different implications and trade-offs for forests and people. Impacts on forests are primarily a result of shifting land use competition dynamics. Impacts on people result from the distribution of costs and benefits associated with the land use dynamics among the diverse stakeholders, involved in production but also in processing and trade. For example, the development of intensive crop and tree plantations may help to alleviate some pressures on primary forest cover when they are established in non-forestlands. In contrast, growing demand for food and biofuel crops may lead to large-scale deforestation, reducing the provision of forest goods and services, but, at the same time, generating significant earnings for producer countries. In addition, large-scale acquisition of forestlands to maintain carbon stocks could contribute to reducing greenhouse gas (GHG) emissions, but can also harm local people whose livelihoods depend on forest resources or conversion of forestlands to agricultural uses, with either subsistence or cash-income goals.

Impacts of trade and investment on people depend on changing levels of development and living conditions, as well as access to resources. On the positive side, trade and investment may generate new opportunities for producer countries to enhance their capital base, expand sources of employment, increase foreign exchange earnings due to improved terms of trade in primary goods, bring about important occupational shifts and incite (agro-) industrial upgrading through technological spillovers.[139] On the negative side, trade and investment may also stimulate short-term economic interests leading to negative environmental externalities, and to the concentration of large tracts of land in the hands of a few large corporations. Under weak governance systems, such factors are likely to cause the erosion of local people's rights and may impose greater costs on the most vulnerable groups, such as women and indigenous peoples.[140] Such conditions engender inequitable benefit sharing and exclusive business models because large-scale corporations capture most of the profits. In addition, expanding global trade for timber may exacerbate illegal practices—in logging and forest clearing—limiting the appropriation of economic rents by states and encouraging corrupt behaviors.

Trade and investment trends are influenced by broader economic shifts, as well as by policy changes such as those brought about by environmental concerns. The rapid increase in oil prices in the mid-2000s and the definition of carbon reduction targets by UNFCCC Annex I countries prompted some governments to incentivize biofuel production and/or mandate fuel blending. The resulting increase in demand for biofuel feedstocks prompted growing competition with food crops for agricultural land, leading to food price increases and greater large-scale land acquisition for biofuel feedstock production.[141] The expansion of biofuels, in turn, placed both direct and indirect pressures on forests.[142] The global economic downturn in the latter part of the decade then depressed the commodity and timber markets. Nonetheless, aside from financial and economic cycles, agricultural production is predicted to grow rapidly

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[139] Borensztein, E. et al. 1998. How does foreign direct investment affect economic growth? Journal of International Economics 45(1): 115–135.
[140] De Schutter, O. 2009. Agribusiness and the right to food: report of the special Rapporteur on the right to food. United Nations General Assembly, New York; Deininger, K. 2010. Rising global interest in farmland: can it yield sustainable and equitable benefits? World Bank, Washington, DC.
[141] Cotula, L. et al. 2009. Land grab or development opportunity? Agricultural investment and international land deals in Africa. IIED/FAO/IFAD, London and Rome.
[142] Havlík, P. et al. 2010. Global land-use implications of first and second generation biofuel targets. *Energy Policy* doi:10.1016/j.enpol.2010.03.030

to keep pace with demographic growth.[143] In this context, developing countries will provide the main source of production lands to fulfill the consumption needs from BRIC and Middle East countries, whose demand for all resources and consumption are rapidly catching up to European and North American levels. In addition, food prices will probably not return to their average levels, but will keep increasing.[144] Timber demand remained low in 2009 as a result of the economic crisis; however, demand for tropical timber in both China and India is expected to be sustained by their strong domestic markets and high economic growth.[145]

Governments, in both consumer and producer countries, with the active involvement of corporate actors, international financial institutions and civil society organizations, are developing diverse responses to mitigate the adverse social and environmental impacts of globalized trade and investment. A number of initiatives have already emerged at different levels and involving different actors; some of these initiatives, such as forest certification and labeling for regulating timber trade, are relatively complex. Governments in consumer countries are increasingly concerned about the negative implications that their consumption might have for producer countries and many are issuing regulations prohibiting imports of timber from illegal sources (e.g., Forest Law Enforcement, Governance and Trade (FLEGT), US Lacey Act) or are imposing limits on the import of biofuels that do not comply with certain production standards, including net GHG savings on fossil fuels (e.g., European Union Renewable Energy Directive (EU–RED)).

Simultaneously, diverse measures have emerged in producer countries to influence production dynamics, mainly by affecting markets; these include certification of forestry operations, standards for sustainable production linked to specific commodities (e.g., roundtables for palm oil and soybean) and moratoriums. Other market mechanisms are also emerging to address the negative impacts of large-scale investment on biodiversity (e.g., business biodiversity offsets). At the global level, international financial institutions are active in developing strategies and guidelines for achieving responsible investment (e.g., International Finance Corporation in oil palm).

Thus, responses from both state and non-state actors are adopting more complex institutional architectures, working at different scales, but they face many environmental, social and political challenges. These diverse initiatives have the potential to facilitate rapid change; however, significant research is needed to help improve their effectiveness, not only to reduce the negative impacts of trade and investment on forests and people, but also to find ways to increase their benefits. Numerous issues have to be addressed at different scales in order to improve governance of the social and environmental impacts of trade and investment. At the global level, more effective normative frameworks and mechanisms are needed.

At the national level, there is a need for more effective governance systems pertaining to land and forest management, which should be backed up by incentives for the adoption of responsible forest and agroforestry-related investments, and innovative mechanisms to reduce illegal practices with the contribution of due diligence in financial institutions (see Box 2.14). At the local level, more inclusive entrepreneurial business models and better safeguards for vulnerable groups are needed. Also required at the local level are better national and

[143] World Bank. 2010. Global economic prospects: crisis, finance and growth. World Bank, Washington, DC.
[144] OECD, FAO. 2010. Agricultural outlook 2010–2019. OECD/FAO, Paris.
[145] ITTO. 2009. Annual review and assessment of the world timber situation. Yokohama, Japan.

international policy coordination across sectors, concerted law enforcement and more effective risk assessment, as well as improved information sharing and joint action among key stakeholders.

Box 2.14 Financial sector reform to reduce forest crime

Losses associated with illegal logging and trade in Indonesia have been estimated at US$2 billion[1] to US$3.3 billion annually,[2] seriously threatening the country's economy and environment. In 2003, Indonesia was the first country in the world to explicitly include forest crime as a predicate offense in national anti-money laundering legislation. The legislation enables law enforcement agencies to trace the proceeds of illegal logging, including funds held in bank accounts, not just shipments of logs. In 2009, the Indonesian Central Bank promulgated a Circular[3] to the Indonesian banking industry that provides guidelines for conducting customer due diligence and detecting suspicious transactions related to forestry sector clients. The guidelines were informed by CIFOR research on how to integrate forest and financial sector law enforcement processes. Now, police and prosecutors have the tools they need to go after the "big guys with bank accounts" rather than just the "little guys with chain saws".

References:
[1] Human Rights Watch stated that Indonesia lost US$2 billion during 2003–2006 (Human Rights Watch. 2009. Wild money: the human rights consequences of illegal logging and corruption in Indonesia's forestry sector. Human Rights Watch, New York.)
[2] In 2006, the Indonesian Ministry of Forestry stated that state losses due to illegal logging were equal to US$3.3 billion (Tempointeraktif, Akibat illegal logging negara rugi 30 trilliun, 14 November 2006) http://www.tempointeraktif.com/hg/ekbis/2004/11/14/brk,20041114-05,id.html.
[3] Central Bank of Indonesia. 2009. Circulation Letter Number 11/3/DPNP on standard guidelines on implementation of anti-money laundering program and terrorism funding prevention for banks.

This component of CRP6 will support these efforts through relevant and innovative research on the impacts of trade and investment and responses to address the negative effects of trade and investment and enhance their contributions toward sustainable futures, targeting outcomes simultaneously at the local, national and global levels. There are currently no other overarching, comparative research programs that use empirical data from forest-rich landscapes to assess the nature and magnitude of trade and investment impacts (i.e., social, economic and environmental) across diverse spatial and temporal scales, and with a multi-commodity perspective. Under Component 5, we will assess the processes and mediating factors shaping trade and investment impacts across several agricultural commodities (e.g., oil crops, beef), timber, mining and carbon[146] across specific landscapes in major tropical eco-regions in sub-Saharan Africa, the Asia-Pacific and Latin America to allow for meaningful global comparisons. In addition, research under this component will assess the effectiveness of current and emerging state and non-state initiatives, processes and architectures, as part of broader governance systems and regimes, and provide options to enhance these responses. Component 5 will use innovative research approaches that link social and natural sciences disciplinary perspectives and methods with explicit attention to impacts on women and other vulnerable groups. This component also explicitly attempts to achieve impacts by working simultaneously at different scales and interacting with multiple actors.

We seek to contribute toward reducing the negative impacts of trade and investment and enhancing their positive impacts. Contributions might include, for example, providing information to financial institutions on how to improve their due diligence and investment

[146] Research on "carbon" as a new commodity in global trade with likely implications for land use competition and livelihoods will be explored in conjunction with Component 4 during implementation of CRP6.

decisions in sectors affecting forests and agroforest-tree cover systems. We expect to strengthen the capacities of key stakeholders to make informed decisions on forest-related trade and investment, and to support the adoption of more effective governance regimes through the development of transparent finance, improved sustainable production standards, and guidelines to promote responsible investment practices that stimulate the development of more inclusive business models. Ultimately, this should lead to equitable outcomes for local populations while ensuring biodiversity conservation and the maintenance of forest environmental services. We will primarily accomplish these outcomes through the provision of analysis and tools for identifying and assessing policy options, and practical tools and approaches for taking appropriate action.

2.5.2 Thematic focus

This component is organized according to two themes.

1. Understanding the processes and impacts of forest-related trade and investment

   This theme will focus on analyzing the processes under which trade and investment affect forest and agroforestry landscapes, and determining the nature and magnitude of their impacts and consequences for both forests and agroforestry landscapes—in terms of deforestation, forest degradation and intensification of agroforestry systems—and the livelihoods of forest-dependent communities, including their effects at broader national scales. Emphasis will be given to assessing trade-offs between economic and ecological outcomes and to determining the effects on some marginalized groups of the benefits accruing to different types of actors.

2. Enhancing responses and policy options to mitigate the negative impacts and to enhance the positive impacts of trade and investment

   Research in this theme aims to identify options to (1) avoid or mitigate the negative impacts of trade and investment on forests and people; and (2) enhance the opportunities from trade and investment for sustainable and equitable development, with increased benefits for the most marginalized forest-dependent groups, including women. The theme will focus on assessing responses from state and non-state actors operating at different scales—from local to global—in the form of policy regulations and economic incentives, and other broadly defined market-based instruments and regimes (including those governing production, consumption and finance) that are being implemented in both consumer countries and forest-rich producer countries. It will also examine the effectiveness of these different responses in dealing with the forest-related trade and investment impacts defined under Theme 1.

This component will prioritize five subject areas that transcend the two themes.

1. The impacts of emerging economies (e.g., BRIC countries), in relation to growing demand for timber, agricultural commodities and minerals from forest-rich countries, with respect to other already established regional markets (e.g., EU and USA).

2. The impacts associated with bioenergy development, including first-generation and second-generation biofuels, and other traditional sources of energy (e.g., fuelwood and charcoal), and options for moving toward sustainable bioenergy production.

3. The drivers and impacts associated with diverse types of large-scale agribusiness investments, with specific emphasis on processes of large-scale land acquisition and the processing and trade of food crops, biofuel feedstock and beef and their impacts on economic development, the distribution of benefits and forest conditions.

4. The dynamics of illegal logging and timber trade linked to domestic and global timber markets, the effectiveness of policy processes to support legality (e.g., FLEGT, use of forest carbon standards) and their implications for the distribution of benefits and costs among the different actors involved, and for forest conditions.

5. The financial flows affecting forests, the conditions and loopholes in the systems regulating the financial sector and transactions that enable the persistence of corruption and money laundering associated with forest crime and large-scale investments.

Component 5 is organized to address each of these five subject areas, which constitute the most relevant forest-related trade and investment issues, as discussed in Section 2.5.1. Therefore, the research questions, outputs, outcomes and impact pathways are organized to achieve progress and outcomes in each of these five areas of enquiry and action.

Two decision rules will distinguish research activities implicating smallholders and communities in Component 5 with respect to Components 1 and 3. These are as follows.

1. Research addressing investments associated with landscape transformations linked to *global* market dynamics should be included in Component 5. This may encompass historical analyses of regional and global value chains, and changes in local/national value chains with a new global dimension (e.g., charcoal trade).
2. Similarly, all research related to efforts to promote smallholder production systems (e.g., outgrower schemes, contract farming) as integral parts of broader trends of FDI and/or domestic large-scale land-based investments associated with land use/land cover changes will be addressed as part of Component 5.

2.5.3 Objectives and expected outcomes (10 years)

The overall objective of Component 5 is to contribute toward major shifts in the trade and investment trends taking place in forested landscapes, with the aim of reducing their negative impacts and enhancing their positive effects on forests and forest-dependent communities. The research aims to achieve this objective through informing policy options and responses that can enable more effective governance options and architectures that involve both state actors and non-state actors at multiple scales. In this way, it will enhance how trade and investment contribute toward more sustainable and equitable development, with special attention to women and other marginalized groups.

Over 10 years, we expect that Component 5 of CRP6 will contribute toward a significant shift in how trade and investment affect tropical forests and the livelihoods of people who depend on them. The ecological areas of impact are: (1) reduction of deforestation and degradation related to trade and investment to maintain the provision of forest goods and services, and reduction of GHG emissions; and (2) increase in forest cover and quality of landscapes through trade and investment. The social areas of impact are: (3) reduction in displacement of local people due to large-scale investments; and (4) increase in and equitable distribution of incomes from trade and investment in forest landscapes originating from forest conversion for food, fodder and biofuels, timber forest management and carbon, or mining.

We expect to contribute toward the following specific outcomes.

- Multilateral and regional banks favor investments in non-forestlands and reduce investments driving conversion of primary forests in selected forest-rich countries. This will encompass, for example, shifting investments away from peatlands to degraded mineral soils in Indonesia to reduce GHG emissions.
- International multi-stakeholder processes build effective forest governance regimes by defining standards, procedures and safeguards that are inclusive of small-scale producers, and are economically and politically feasible and environmentally sound.
- Multilateral and regional banks increase their investments in selected forest-rich countries, favoring inclusive business models that specifically address the needs of women, indigenous peoples and other disadvantaged groups.
- Regional investment and economic development institutions in Central, East and Southern Africa, Southeast Asia and the Mekong region in Asia, and the Amazon and the *Cerrado/Chaco* region in Latin America adopt guidelines that promote trade and investment incentives that are ecologically sound and socially inclusive.
- Private corporations with significant forest-related investment adopt sustainable standards that ensure respect of local people's rights and facilitate equitable benefit sharing and continued provision of forest goods and services.
- Governments in consumer countries, especially in North America, member states of the EU and China, advance policy and legislation aimed at improving procurement guidelines seeking to reduce deforestation from food, fodder and fuel crop production, and forest degradation associated with illegal timber trade.
- National governments in forest-rich countries in each selected region design and enforce effective policies, laws and regulatory frameworks on resource extraction while ensuring legal trade, protection of local people's rights and provision of forest goods and services.

2.5.4 Geographic priorities

Much of our research is global in nature, but some specific dimensions to be addressed require a focus on specific producer and consumer countries. With regard to research on global trends, some global processes (e.g., the influence of China-related trade, large-scale land acquisition, biofuel development from agricultural feedstocks) have their own "signature" in terms of how they influence specific countries and landscapes. Thus, the prioritization of geographic areas will reconcile the need for work in specific countries in which to achieve impacts with the need to capture global processes that affect forest landscapes across a range of commodities and that have substantial effects on forest landscape change. In addition, given that some established and emerging countries tend to dominate global consumption, there is a need to focus on those countries. In this regard, Component 5 will analyze impacts and responses from global trade and investment trends across a number of producer and consumer countries.

In producer countries, research will be conducted in landscapes where pressure from trade and investment is greatest at different stages of the forest transition curve. We will focus our attention in regions and countries in which significant pressure from trade and investment is taking place under different variants of investments in oil crops, biofuels, timber, beef and mining. We will embrace both tropical humid and dry forest ecosystems, as well as diverse geographic ecoregions in sub-Saharan Africa, Asia and Latin America, given their social, institutional and economic specificities.

Based on the criteria above, Component 5 of CRP6 will privilege some specific countries across regions and forest ecosystems. Table 2.6 lists those regions and countries where we expect to be able to demonstrate outcomes and impacts at local, national and regional levels. Additional countries will be considered depending on funding availability.

Table 2.6 List of selected countries by region

Sub-Saharan Africa	Asia-Pacific	Latin America
Congo Basin	*Southeast Asia*	*Amazon basin*
Cameroon	Indonesia	Brazil
DRC	Malaysia	Peru
Gabon	Papua New Guinea	Bolivia
		Colombia
		Ecuador
East and Southern Africa	*Mekong region*	*Cerrado/Chaco*
Tanzania	Vietnam	Brazil
Zambia	Laos	Bolivia
Mozambique	Cambodia	Argentina
		Paraguay

In addition, the consumer countries in which we will prioritize our attention in an initial phase are China, the member states of the EU and the USA. We will also explore the increasing role of India, Brazil and South Africa as consumer economies.

2.5.5 Research Theme 1: Understanding the processes and impacts of forest-related trade and investment

Rationale

This research theme aims to improve understanding of the processes and impacts of forest-related trade and investment, especially those involving large-scale investments—originated in foreign or domestic capitals. The main types of trade and investment are: (1) operations based on the management of forest resources for timber and carbon, (2) agribusiness and logging operations based on land conversion, and (3) agribusiness or extractive industries operating on already converted lands.

Research in Theme 1 will examine the main forest-related trade and investment trends at global and regional levels, and the conditions shaping them linked to the global trends discussed in Section 2.5.1. Greater attention will be given to the implications of changes in trade regimes as a result of macroeconomic environment and business conditions, in part influenced by multilateral and bilateral trade agreements, and regional policy decisions regulating imports based on sustainability (e.g., EU-RED) or legality criteria (e.g., FLEGT, US Lacey Act) adopted by some of the main consumer countries of the EU and the USA.

Theme 1 will assess the impacts of forest-related trade and investment associated with the five subject areas described in Section 2.5.2. It will assess the impacts of trade and investment on forest (e.g., deforestation, forest degradation, biodiversity conservation and other environmental services) and agroforestry landscapes (e.g., afforestation, intensification and diversification of agroforestry systems), people's livelihoods and broader macroeconomic effects. The research will also explore how changes in global demand and investment trends affect smallholder production systems in forest landscapes and people's well-being. Analyzing these effects will require examining several mediating factors that shape specific outcomes, such as national regulatory and policy frameworks, tenure regimes, governance systems and market conditions in producer countries. While many of the impacts from trade and investment are local on forests and people livelihoods, some others affect the provision of global forest environmental functions as well as macroeconomic conditions. In addition, some of the effects directly drive land use and livelihoods change, whereas others indirectly stimulate deforestation through land use displacement or through broader effects on macroeconomic conditions and business environment. Our research will address, whenever feasible, direct and indirect impacts.

In forest-rich producer countries, we will focus our attention on assessing the social, economic and environmental impacts and trade-offs between different forest-related commodities (e.g., timber, food, minerals, fuel, fiber) as influenced by specific policy and governance conditions (e.g., regulatory and legal frameworks, political systems, rule of law, property rights regimes and others), market conditions (e.g., incentive systems, value chains, market powers), production systems and business models (e.g., smallholder production, large-scale plantations, outgrower schemes) and ecological conditions (e.g., moist and dry forest landscapes). Analysis of the distribution of costs and benefits from trade and investment among different stakeholders will be conducted whenever feasible with particular emphasis on determining effects on marginalized groups, including women and indigenous peoples. Furthermore, attention will be given to determining the emissions embedded in trade as one significant issue in the context of climate change associated to trade and investment. The ultimate aims of our research are to identify the business models of trade and investment that will achieve better outcomes for society, and to determine the feasibility of achieving better trade-offs under various institutional, economic and ecological conditions.

Methods and research approach

Our research will draw on broader analyses of global and regional trends in trade (flows of goods) and investment (financial flows) to identify major processes and trends of importance to the equitable and sustainable management of forests and forest landscape change; we will use these to refine our analytical frameworks and working hypothesis. Then, we will adopt a complementary approach focused, on the one hand, on landscapes/territories that are experiencing significant land use changes driven by trade and investment and linked to global processes and, on the other hand, on specific commodities associated to such changes. Research related to selected commodities across prioritized landscapes will be conducted to assess the social, economic and ecological impacts of those commodities, as well as their trade-offs. The focus on specific landscapes/territories will contribute toward understanding how competition driven by trade and investment affects commodity production across different land uses and stakeholders in specific spatial and institutional settings. This area of research will also consider aspects of the political economy underlying such competition, such as social institutions, market conditions, tenure rights and power relationships. We will also adopt a historical perspective to generate lessons from similar past processes.

The research will be organized around questions linked to the five subject areas mentioned in Section 2.5.2.

Common methodologies will be applied across landscapes in order to enable comparison and synthesis of the impacts related to specific global trade and investment processes. The analysis of the economic, social and ecological impacts of trade and investment on forests and people's livelihoods will be based fundamentally on primary information, which will be generated from case studies using integrated social and ecological approaches that rely on a combination of qualitative and quantitative methods.

Qualitative approaches for data collection and analysis to determine the social and economic impacts of trade and investment will encompass participatory research methods such as semi-structured key informant interviews, focus group discussions, matrix ranking and social network analysis to identify locally relevant types of social and environmental impacts. These methods are critical in developing hypotheses, to triangulate different sources of information and to determine local perceptions of the social and environmental costs and benefits associated with different types of commodities and investment trends. In turn, quantitative methods for generating primary information will rely on surveys of different stakeholders (e.g., companies, employees, land-losing households, outgrower producers, independent smallholders) that are differentially affected by disparate models of commodity production/extraction (e.g., industrial scale plantations, outgrower schemes, independent farmers). Data collected will be disaggregated by gender and, wherever feasible, gender-specific subgroups will be analyzed to ascertain differences in socioeconomic benefits that have accrued from investments to male- and female-headed households. Formal statistical methods (e.g., multivariate analysis) will be used to analyze variable interactions.

A range of methods will be adopted to determine ecological impacts, such as diachronic analyses using different types of remotely sensed data (e.g., to monitor land use and land cover trends over time), field methods in sample plots (e.g., to monitor biodiversity change or changes in forest integrity before and after investments) and synchronic approaches using snapshot censuses of various components of diversity, floristic and vegetation structure, contrasting impacted and non-impacted sites that present similar conditions.

In addition, analysis at the firm or household level will be linked to broader territorial dynamics of land use change shaped by domestic and global markets, and governance factors. Value chain analysis will be used through participatory workshops and interviews with key informants in order to assess the configuration of markets and the factors shaping investments processes. Spatial analysis using geographic information systems (GIS) linked to market and investment processes will be used to assess land use competition and displacement, thus identifying which trade and investments exacerbate deforestation versus those that do not. In addition, we will link the previous analysis to specific regulatory and institutional contexts and to policy incentives by using landscape modeling to explain diverse outcomes on forest change. Finally, inspired by the global commodity chain approach,[147] innovative research

[147] Gereffi, G. and Korzeniewicz, M. (eds). 1994. Commodity chains and global capitalism. Westport, Greenwood Press; Gibbon, P. 2001. Upgrading primary production: a global commodity chain approach. World Development 29 (2): 345–362.

methods will include historical analyses to complement issues concerning chain governance, quality regulation, restructuring processes and upgrading, and linking with spatially explicit approaches in specific landscapes.

Research questions

The main illustrative questions for Research Theme 1, listed in the following table, are organized around the five subject areas defined earlier.

Broad research question (Component 5, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
How do shifts in trade and investment associated with emerging economies (e.g., BRIC countries) and established markets differentially affect forests (e.g., area, ecological goods and services?) and local people's livelihoods? What is the magnitude of these impacts and associated trade-offs?	Do impacts differ across gender groups? What factors explain differential impacts on men and women and their main variations? Do trade and investment intensify existing inequalities?	Assessment of processes, conditions and mediating factors through which trade and investment influence forest landscapes change and the livelihoods of forest-dependent people Analysis of the impacts associated with trade and investment trends on forests (including deforestation, forest degradation, biodiversity conservation, and provision of environmental services), people's livelihoods (men and women) and economic development Methods and analysis of ecological, social and economic trade-offs associated with trade and investment at different scales of impact (local, subnational and national) Comparative assessment of impacts on forests and people from global and domestic trade and investment trends across selected commodities and forest landscapes
How do demand for and investment in food, fuel and fiber change the type, location and degree of pressures on forest landscapes, thus shaping forest transitions? What are the impacts on forest and local people's livelihoods related to specific global–local interactions? What is the magnitude of these impacts and associated trade-offs?	What conditions associated with trade and investment in different resources differentially affect men and women? What options and processes exist for gender-sensitizing codes of conduct for investors?	
How do land acquisition and tenure regimes evolve under the influence of growing pressure on lands? What are the impacts of land allocation deals and tenure regimes (e.g., concessions) linked to the extraction of timber and other forest resources and/or the provision of environmental services? How do they influence and change resource rights and the distribution of benefits?	What are the gender-differentiated impacts of business models or conservation schemes associated with large-scale land investments?	
What interactions between domestic and global timber value chains are shaping forest cover and forest livelihoods in different forest landscapes? What is the scale of illegal logging associated with both domestic and global timber markets in specific landscapes, and with what implications for local livelihoods and forest condition? What are the modes of operation used by different stakeholders in the domestic and global value chains? What are their impacts on forests (including goods and services) and the distribution of benefits in specific landscapes and across gender groups?	How are benefits of (formal and informal) access and use of forest resources linked to global trade differentially distributed between men and women? What institutional arrangements, including policies, can serve to narrow observed inequalities?	

Broad research question (Component 5, Theme 1)	Gender-specific aspects of the research question	Examples of science outputs
What conditions and loopholes in financial systems and corporate governance allow forest-related fraud and corruption and socially detrimental “high-stakes” deals to continue? What are the interactions between illegal logging and other forest crime practices such as money laundering? What is the scale of and who are the actors in financial fraud and corruption associated with forest crime and large-scale land and resource transactions in select countries and landscapes?	Who benefits and who loses from forest-related corruption, fraud and money laundering and large-scale land and resource transactions? How does the performance of forest-related financial governance systems affect vulnerable groups, including women?	

Research partners

We aim to implement Theme 1 in collaboration with a diverse range of research partners, which will contribute to research design and implementation. These include universities, research centers and NGOs that are conducting research at different levels (i.e., global, regional, national and local). We expect that during the implementation of this research process we will be able to explore and identify new partnerships and opportunities for collaboration. These research partners, in order to achieve concrete outcomes of research into policy actions, will relate to the broader group of policy and knowledge-sharing partners detailed below.

Type of research partner	Organization	Research partner contributions
Participating CGIAR centers	CIFOR	Leads the design, implementation and coordination of collaborative research for Component 5 ensuring the delivery of outputs and the achievement of outcomes
	World Agroforestry Centre	Manages research issues linked to agoforestry landscapes and systems
	CIAT	Contributes to research on impacts of trade and investment on land use transitions
	IFPRI	Manages links to research in CRP2
International level	CIRAD	Collaborates in developing methodologies and analysis across the whole range of issues addressed in Theme 1
	Tropenbos International	Provides inputs to research on illegal logging and timber trade and domestic markets
	Profundo	Contributes to the analysis of finance and investment trends in select commodities
	JRC	Provides inputs for the analysis on the implications of land use change in carbon accounting
	SEI	Collaborates in the development of methodologies for analysis of impacts, policy options and future scenarios
	ETH Zurich	Contributes to the analysis of ecological impacts of trade and investment
Regional, country or site level (sub-Saharan Africa)	University of Leipzig	Collaborates in research on China-in-Africa relations and their impacts in specific sites
	Utrecht University	Collaborates in research on the implications of large-scale land acquisition in sub-Saharan Africa
	Université de Kisangani, IRET/CENAREST, ERAIFT, CSIR, Shanduko, PLAAS, Eduardo Mondlane University	Participate in collaborative research processes including fieldwork for data collection, processing and analysis of information in select sites, and outreach activities

Type of research partner	Organization	Research partner contributions
Regional, country or site level (Latin America)	Tufts University	Contributes to the analysis of global and regional trends in trade of select commodities
	CSF – Latin America	Provides inputs to the analysis on the implications of large-scale investments in forest landscape change
	University of Sao Paolo, IPEA, UNAM, Embrapa, CEDLA, University of Cordillera, FLACSO, SFA, INIAP, SPDA, IIAP	Participate in collaborative research processes including fieldwork for data collection, processing and analysis of information in select sites, and outreach activities
Regional, country or site level (Asia)	IPB, University of Papua, TBI (Tropen Bos Indonesia)	Participate in collaborative research processes including fieldwork for data collection, processing and analysis of information in select sites, and outreach activities
	Telapak	Collaborate in feeding carefully designed messages based on research findings for environmental campaigns

2.5.6 Research Theme 2: Enhancing responses and policy options to mitigate negative impacts and enhance positive impacts of trade and investment

Rationale

Public policies in the form of regulations and market-based instruments have the potential to influence how trade, FDI and domestic investments affect forest and agroforestry landscape change, livelihoods and other macroeconomic impacts associated with them. Nonetheless, regulations are often violated or weakly implemented and, in many cases, narrow and exclusively profit-seeking behaviors are widespread—such as those fostering illegal logging or illegal forest conversion to establishing large-scale crop plantations—which often lead to negative social, economic and environmental outcomes. In addition, in many cases, for historical reasons, regulatory frameworks and policy incentives are often skewed in favor of foreign investors and large-scale companies, thus largely excluding smallholders. Furthermore, policies have tended to favor activities articulated to external markets, and little attention has been paid to domestic markets. The latter has contributed to incentivizing commodities and corporate actors that are more competitive in international markets, often leading to less sustainable and equitable outcomes. However, growing awareness about the impacts of trade and investment is stimulating the emergence of many policy responses designed to address these impacts.

The multi-scale nature of the factors shaping trade and investment impacts on local economies and environments, however, means that more complex governance systems are required, supported by nested multi-scale and multi-actor institutional architectures embracing state and non-state actors.[148] Nevertheless, currently, many governance responses are focused on specific commodities, landscapes or actors (some of these are introduced in Section 2.5.1).

Current responses designed to govern trade and investment dynamics vary widely. They include: (1) voluntary multi-stakeholder global processes to promote sustainable production in specific commodities (e.g., forest certification, roundtables for sustainable palm oil

[148] Rayner, J. et al. 2010. Embracing complexity: meeting the challenges of international forest governance. A global assessment report. IUFRO World Series Volume 28. IUFRO, Vienna.

production, sustainable soybean production); (2) moratoriums on deforestation in producer countries promoted by industry and governments (e.g., soybean in Brazil, deforestation and conversion of peatlands in Indonesia); (3) market regulations introduced by governments in consumer countries (e.g., FLEGT-VPA, EU-RED, US Lacey Act); (4) financial industry benchmarks adopted by financial institutions (e.g., Equator Principles) and guidelines developed by multilateral banks to promote responsible investments (e.g., performance standards of the IFC); (5) public incentives targeting smallholders to promote more inclusive business models linked to large-scale land-based investments (e.g., outgrower schemes, contract farming); and (6) local social responses from specific groups affected by large-scale investments. These instruments and initiatives embody different approaches to regulating and governing trade and investment, and it is unlikely that any single instrument alone will be able to reverse the adverse social and environmental impacts associated with global trade and investment.

Theme 2 is aimed at identifying improved governance regimes and architectures to avoid or mitigate the negative impacts, and to enhance the positive impacts of trade and investment on forests and people. Thus, this theme will focus on assessing the effectiveness, efficiency and equity outcomes of responses, from state and non-state actors, in achieving these goals as they apply to forest condition and people's well-being, and their trade-offs.

Methods and research approach

Theme 2 will examine the governance and institutional options for reducing the negative effects of trade and investment, for promoting opportunities for vulnerable groups such as women and indigenous people, and for harnessing the national economic development benefits. Lessons will be drawn from policies and market-based instruments for regulating large-scale agricultural expansion (e.g., conditions tied to investment by host country governments or financial regulators, deforestation moratoriums, adoption of sustainability standards), smallholder-based agricultural production (e.g., organic certification and fair trade, support services to smallholders, minimum smallholder sourcing requirements) and sustainable forest management (e.g., forest certification, FLEGT, anti-money laundering).

From these different initiatives, "real" examples will be selected and analyzed, representing efforts undertaken at diverse scales (e.g., local, landscape, country level) or embracing a diverse array of stakeholders, to identify the gaps and loopholes in their design. This will include an analysis of the strategies used by corporate actors and the financial sector to adopt or circumvent governance instruments intended to hold corporate actors accountable to social and environmental outcomes. In addition, we will analyze the main weaknesses and strengths in their implementation, in order to design better instruments for the management of trade-offs from global trade and investment. We will also use participatory policy and scenario-building analyses to help stakeholders assess significant risk factors and critical uncertainties, and to identify potential regulatory and market-based mechanisms and support services that could improve the sustainability and equity of trade and investment.

As in Theme 1, research in Theme 2 will be organized according to the five subject areas identified in Section 2.5.2, as a way to provide targeted policy analysis and recommendations to inform actors, processes and initiatives related to the following issues: (1) the mechanisms that need to be in place to mitigate the impacts of investments from emerging economies; (2) the national and global governance systems required to regulate and promote the expansion of biofuel feedstocks on degraded lands as a way to reduce the pressures on primary forestlands; (3) the local collective action and national state responses required to avoid the negative implications of large-scale land acquisition and to take advantage of their associated benefits; (4) the effectiveness of regional processes to promote legality in the forestry sector in terms of their links to national policy frameworks designed to reverse illegal logging and preserve the livelihoods of local forest users; and (5) identification of the most effective integrated law enforcement approaches to combat corruption and fraud related to forest crime.

This research theme will combine several methods to assess the effectiveness, efficiency and equity outcomes of policy regulations and market-based instruments, depending on the policies and instruments under evaluation. For assessing the implications of policy and market-based instruments, and other voluntary processes and initiatives shaping production and consumption, we will conduct case studies aimed at undertaking in-depth analysis of outcomes linked to selected initiatives and processes (e.g., certification, moratorium, industry bans) and responses (e.g., different forms of collective resistance) against a predefined set of criteria. Interviews with key informants, focus groups and expert consultations will be used to gather information in the field. The latter will be complemented by surveys of corporate groups, firms and individuals to collect existing quantitative information as well as to relate firm behavior to different governance conditions and market and policy factors.

The adoption of common methods to conduct case studies, using similar variables and indicators, will allow for systematic and meaningful comparison not only across different set of policies and instruments, but also across landscapes, countries and regions. The latter will provide reliable information for robust global comparisons and will make it possible to distill lessons on what are the most effective policy responses and voluntary mechanisms (e.g., involving industry and financial institutions), and under which policy, institutional, financial and market conditions such mechanisms might achieve their promised outcomes. These lessons can then be applied beyond the specific landscapes and countries studied. Finally, formal modeling exercises will also be used to assess the implications of adopting certain regulatory, policy instruments and market-based instruments at landscape, national and global levels.

Research questions

The main illustrative questions for Research Theme 2, listed below, reflect the five subject areas defined above, as well as some others leading to cross-cutting analysis among instruments and global comparative analysis within each issue addressed.

Broad research questions (Component 5, Theme 2)	Gender-specific aspects of the research question	Examples of science outputs
How do various models of non-state market-driven governance systems and corporate social responsibility (e.g., timber certification, biodiversity offsets, sustainability standards, financial due diligence) differentially reduce deforestation and forest resource degradation, increase cover of biodiverse forest and fulfill poverty-reduction objectives? What are the scope and scale of effectiveness of the different governance systems, and what institutional architectures are needed to support durable forest governance?	How to ensure that market-driven models and instruments "do no harm" to the most vulnerable groups, and increase equity between social groups in the pursuit of improved social outcomes?	Guidelines, based on comparative analysis, of lessons learned on the effectiveness of market-based instruments and non-state processes, for managing the impacts on forests and people, increasing biodiverse and socially beneficial forest and agroforestry cover, and enhancing the social and economic benefits from non-forestlands and forest management
What policies, regulations and governance systems should be in place involving, on the one side, forest-rich producer countries (of timber, biofuel feedstocks, food and other commodities), and on the other, consumer countries, to: • reduce the pressures and impacts on forests and people associated with trade and investment in emerging economies? • mitigate the negative and enhance the positive social, economic and environmental impacts of trade and investment linked to food and biofuel markets, and promote more responsible investments? • support improved governance, especially for securing the land and resource rights of local people, and promote more equitable distribution of benefits in the context of large-scale land-based investment? • shift from illegal to legal forest practices that ensure sustainable forest management while securing the livelihoods of local forest users and other stakeholders? • reduce the risks of corruption and fraud associated with forest crime, and forest-related money laundering in public funds and payments (including REDD+ transfers)?	What measures can be designed to safeguard the livelihoods of vulnerable groups (including women) under threat from trade and investment-driven pressures leading to deforestation and forest degradation? How can policy frameworks link the need for sustainable forest-based resource management with greater gender equity? What measures are needed to protect the rights of the most vulnerable groups from large-scale land acquisition? What is the role of women in shaping the social and local responses to commercial pressures on land linked to trade and investment? What kinds of arrangements (including information and resources) are required to link such local responses to national and transnational networks focused on making international trade and investment more accountable to local actors?	Identification of improved principles, sustainability standards and safeguards to promote responsible trade and investment and more effective institutional systems for enhancing legality linked to forest management and trade, and combat fraud and corruption associated with forest Identified improved policy frameworks and institutional options for regulating and managing the impacts on forests and people associated with trade and investment, strengthening forest and land governance systems, integrated law enforcement approaches, and equitable benefit sharing Enhancement of instruments and platforms for policy analysis and dialogue in producer countries on best policies, regulatory frameworks and improved practices for managing social, economic and environmental impacts linked to trade and investment
What combinations of factors and governance instruments produce positive gains for sustainability and equity goals?		Synthesis of comparative analysis with recommendations on policies options

Research partners

Research under Theme 2 will be conducted through collaborative research processes for design and implementation with partners working across global, regional or country-specific levels, many of which are common to both themes. We will also identify new opportunities for building research partnerships at global, regional and country levels during the process of research implementation. These research partners will link to a distinct group of policy and knowledge-sharing partners in our aims for achieving impacts, listed in Table 2.7.

Type of research partner	Organization	Research partner contributions
Participating CGIAR centers	CIFOR	Leads the design, implementation and coordination of collaborative research for Component 5 ensuring the delivery of outputs and the achievement of outcomes
	World Agroforestry Centre	Manages research on responses and policy options linked to agroforestry landscapes and systems
	CIAT	Contributes to research on policy responses to address impacts of trade and investment on land-use change
	IFPRI	Manages links to research in CRP2
International level	CIRAD	Collaborates in developing methodologies and analysis across the whole range of issues addressed in Theme 2
	Tropenbos International	Provides inputs to analysis on governance mechanisms to address illegal logging linked to timber trade
	Profundo	Contributes to the analysis of finance and investment policy frameworks and voluntary mechanisms
	Yale University, University of Oxford	Provide inputs for the analysis on the implications, effectiveness and policy options with respect to multi-stakeholder processes of forest governance
	SEI	Collaborates in the development of methodologies for analysis of impacts, policy options and future scenarios
Regional, country or site level (sub-Saharan Africa)	University of Leipzig	Collaborates in research in China-in-Africa relations and their impacts in specific sites
	Utrecht University	Collaborates in research on the options for adoption of responsible investment in sub-Saharan Africa
	Université de Kisangani, IRET/CENAREST, ERAIFT, CSIR, Shanduko, PLAAS, Eduardo Mondlane University	Participate in collaborative research processes including fieldwork for data collection, processing and analysis of information in select sites, and outreach activities
Regional, country or site level (Latin America)	Tufts University	Contributes to the analysis of policy frameworks and trade agreements and instruments to govern global and regional trade and investment
	University of Sao Paolo, Embrapa, CEDLA, University of Cordillera, FLACSO, SFA, INIAP, SPDA, IIAP, IPEA	Participate in collaborative research processes including fieldwork for data collection, processing and analysis of information in select sites, and outreach activities
Regional, country or site level (Asia)	IPB, University of Papua, TBI (Tropen Bos Indonesia)	Participate in collaborative research processes including fieldwork for data collection, processing and analysis of information in select sites, and outreach activities

2.5.7 Sentinel landscapes

Concerns about global environmental change have galvanized interest in moving toward interdisciplinary research designed to produce knowledge that can guide state and non-state actors as they move progressively toward sustainable development. The reconstruction of landscape histories that recognize hierarchical scales of analysis in both time and space can help to highlight the complexity of specific local geographic and historical settings. The impacts of successive waves of investment and disinvestment in land use, for example, can be observed only through historical examination. These can provide the basis for redefining baseline social and ecological conditions, to reinterpret the impact of demographic growth and both long-term and new patterns of trade, and to build in perspectives from political economy when shaping landscape change. Furthermore, historical data and present-day monitoring can be used as an empirical basis for scenario building. A *longue durée* analysis provides a solid empirical basis and an opportunity for scenario or model validation.[149]

From the perspective of Theme 1, conducting research on sentinel landscapes will facilitate diachronic analysis of the socioeconomic and ecological impacts of large-scale investments associated to global trade, and contribute toward understanding the processes of change and interactions between differentiated institutional, economic and ecological local conditions over time. From the perspective of Theme 2, research on sentinel landscapes will contribute not only toward assessing the effectiveness of responses to trade and investment adopted by state and non-state actors with a diachronic perspective, but also toward influencing specific decision-making processes related to those landscapes. It will also contribute toward developing participatory processes for building future scenarios of land use and forest cover and livelihoods changes under different trade and investment conditions linked to the selected sentinel landscapes. Use of these scenarios will enhance our opportunities to influence policy dialogues and to propose meaningful policy innovations with a higher likelihood of promoting change.

The overarching research question—How effective are public policy and attendant regulatory frameworks, as well as other voluntary processes for governing trade and investment, in terms of achieving equitable and sustainable development?—will be assessed by:

- exploring the gaps between formal and actual governance systems;
- identifying and mapping the complex networks of actors involved in resource use or governance processes influencing resource use;
- understanding local actions by resource users in terms of their internal value systems, interests and strategies, and their encounters with external conditionalities and interests; and

[149] Leemans, R. and Costanza, R. 2005. Integrated history and future of people on earth (IHOPE) Newsletter of the International Human Dimensions Program (IHDP) 2/2005: 4–5; Wardell, D.A. and Reenberg, R. 2006. Framing field expansion strategies in the savanna biome: land use and land cover dynamics in and around the Tiogo Forest Reserve, Burkina Faso. In: Mistry, J. and Berardi, A. (eds) Savannas and dry forests: linking people with nature, 19–52. Ashgate, Aldershot, UK.

- understanding how underlying value systems and perceptions in their interactions with domestic and global markets influence actions and strategies adopted by different resource users.[150]

2.5.8 Impact pathways

We expect to achieve the impacts targeted in this Component through four distinct impact pathways, via which we will provide information and scientific knowledge to and interact with the four types of actors detailed below across global, regional and national levels. Component 5 will engage with multi-stakeholder and multi-scale governance systems and architectures. This will increase the complexity of some efforts to achieve impact at the various levels because, although synergies can be built across scales in some cases, they are not always possible in practice. We aim to accomplish the targeted impacts mainly by influencing specific intermediary processes that are put in place by intermediary actors. Thereby, for each of the four impact pathways identified here, we will seek to influence the policy frameworks and processes that are being led or stimulated by these different actors and their respective organizations.

The four groups of actors are: (1) global bodies and institutions including development banks and international financial institutions, global processes, international NGOs and others; (2) global and regional corporations and industry associations, and third-party institutions supporting the development of production and investment standards to regulate the social and environmental impacts of these corporate actors at different levels; (3) national governments and regional bodies in main consumer countries (e.g., EU, USA, BRICs) through state agencies with significant decision-making influence on trade and investment in producer countries; (4) national governments in selected producer countries through their departments and ministries charged with regulating access to forest, land and resources and responding to economic, social and environmental impacts.

In addition to these four specific impact pathways, we will target the global scientific community and the general public by disseminating information through the media, civil society organizations and networks.

Impact pathway 1: Global and regional trade and investment actors

Our outputs will inform the guidelines, standards and other instruments developed by global and regional trade and investment institutions, so that they incorporate safeguards to reduce negative impacts on forests and livelihoods, and improve regulations to promote more sustainable trade and investment. The end users of our findings, lessons and recommendations will be multilateral institutions (e.g., World Bank, FAO, UNCTAD),[151] financial institutions (e.g., IFC) and regional (e.g., EIB, IADB, ADB, CEB, AfDB, CAF) and national development banks (e.g., BNDES, China Exim Bank).The intermediate users of our outputs will include some non-state forest governance mechanisms such as forest certification bodies (e.g., FSC), global initiatives seeking to promote sustainable production and processing of select commodities (e.g., RSPO, RSB, RTRS) and global processes (e.g., FAO guidelines on land governance). We will also seek to influence global bodies related to the

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[150] See, for example, Haberl, H. et al, 2006. From LTER to LTSER: conceptualizing the socioeconomic dimension of long-term socioecological research. Ecology and Society 11(2): 13 [online] http://www.ecologyandsociety.org/vol11/iss2/art13/

[151] See the list of abbreviations at the beginning of this proposal.

links between climate change and trade (e.g., UNFCCC, IPCC). We will collaborate with regional economic communities (RECs) in Africa, and regional treaties and agreements such as OTCA, CAN and MERCOSUR in the Andean–Amazon countries. We will also share analysis and information with civil society organizations and networks (e.g., BIC, ILC, RRI), and harness opportunities provided by global events and the global media.

Impact pathway 2: Global and regional corporations and industry associations

The ultimate users of our research will include global and regional corporations and industry associations because these actors have significant influence on shaping investments, and thus production and land use trends in producer countries. Our analyses and outputs will inform industry associations and their initiatives, with the aim of encouraging the adoption of good practices by their members investing in forest-rich tropical countries, in order to promote improved social and environmental outcomes. We will also aim to influence multi-stakeholder processes and the development and refinement of standards, such as certification criteria and green investment guidelines, applied to govern impacts of these actors. We will provide inputs to some intermediary processes such as sustainability initiatives (e.g., RSPO, RSB, RTRS), certification organizations and processes (e.g., FSC, PEFC) and others (e.g., Extractive Industries Transparency Initiative). When necessary, we will target national and local associations affected by trade and investment. To achieve these impacts, we will provide policy analysis to environmental and community advocacy groups that are direct actors shaping these processes (e.g., CI, WWF, Transparency International, FPP).

Impact pathway 3: Governments in consumer countries

With our research and civil society partners, we will target the ministerial bodies that create guidelines regulating the activities of overseas companies (e.g., China's Ministry of Commerce), and regional (e.g., the EC and its EU-RED policy and timber legislation) and national legislative bodies responsible for establishing and ratifying trade agreements (e.g., US Congress). The knowledge products tailored for these bodies will detail the social and environmental impacts of trade and investment as well as analysis of the potential outcomes of different forms of legislation on national economies and local livelihoods. This will include various voluntary mechanisms, such as third-party certification, or emerging initiatives (e.g., FLEGT) to fulfill the legal requirements associated with international trade and investment. Specifically, our outputs will aim to influence policies promoting trade and investment in certain commodities (such as biofuel feedstocks or timber) while curbing illegal logging and trade, and securing local economic and social benefits.

Impact pathway 4: Governments and actors in producer countries

Impacts will be achieved through the design and enforcement of national policies governing resource use, extraction and trade, and laws and regulations protecting local land rights and equitable distribution of benefits from forests and forested land. Research partners will include universities in target countries, state agencies and civil society groups. Research outputs will inform decision making and policy debate in governments of producer countries on the appropriate conditions for trade and investment in specific commodities (e.g., timber, biofuel feedstocks), and their implications for land use and forest resource management.

Linkages will be established with key government agencies playing a role in promoting or regulating international trade and investment to identify key policy aims associated with different sectors; this will enable us to focus our research on variables of interest to key decision makers and to produce a more nuanced and politically relevant account of trade-offs. Effort will also be invested in adopting integrated law enforcement approaches to reduce corruption and fraud associated with illegal logging and the mismanagement of funds from forests and investments in other commodities that stimulate widespread forest conversion. The ultimate users of these research outputs are national government agencies, such as investment promotion agencies; ministries of land, finance, commerce and trade; forestry departments; environmental protection agencies; and key sectoral ministries (e.g., energy, agriculture, mining). We will also collaborate with civil society and NGO networks (e.g., RECOFTC) and national and regional offices from environmental NGOs (e.g., CI, TNC, WWF, IUCN), which are currently working along these lines with different state agencies and actors.

Box 2.15 Advocacy influences on pulp and paper industry practices

Research carried out by CIFOR scientists a decade ago indicated that the installed capacity of pulp and paper mills exceeded sustainable fiber supply from plantations, thus increasing pressure on natural forests. Advocacy by NGOs that cited CIFOR's findings led pulp and paper companies to increase conservation set-asides and accelerate plantation development. Further, in response to pressure from export markets and investors, the Indonesian government adopted a ministerial decree on the "acceleration of plantation development and pulp and paper industry raw material supply" requiring improvements in fiber sourcing. An impact assessment of CIFOR's research on the political economy of the Indonesian pulp and paper sector estimated that the research had averted the loss of 135,000 hectares of natural tropical rainforest, saving some US$133 million in carbon emissions.

Reference:

Raitzer, D.A. 2008. Assessing the impact of CIFOR's influence on policy and practice in the Indonesian pulp and paper sector. CIFOR, Bogor, Indonesia; Raitzer, D.A. 2010. Assessing the impact of policy-oriented research: the case of CIFOR's influence on the Indonesian pulp and paper sector. World Development 38(10): 1506–1518.

A simplified overview of the four identified impact pathways for this component is presented in Figure 2.14. (See Section 3.1 for gender-specific impact pathways.) These relationships are linked to the broad research questions we intend to answer to produce the required outputs, as per the above tables for each research theme. The pathways detailed above will be tailored to each of the five prioritized subject areas introduced in Section 2.5.2, each of which involves a different set of intermediated organizations at different scales. Box 2.16 illustrates the pathways for achieving impacts, with a quantification of expected outcomes related to one of the five subject areas, viz., curbing illegal logging associated with domestic and international timber markets.

Several risks and challenges are linked to achieving these impacts in practice. Our capacity to achieve impact through each of the identified pathways will depend on our ability to build and sustain effective networks with our partners and to influence change in policies and practices of governments, corporate actors and governance processes. Furthermore, achieving impact will depend on our capacity to build processes and platforms for knowledge sharing; use of such processes and platforms will foster the timely and targeted delivery of key messages to each user group, and will provide opportunities to generate feedback to the Component 5 implementation team.

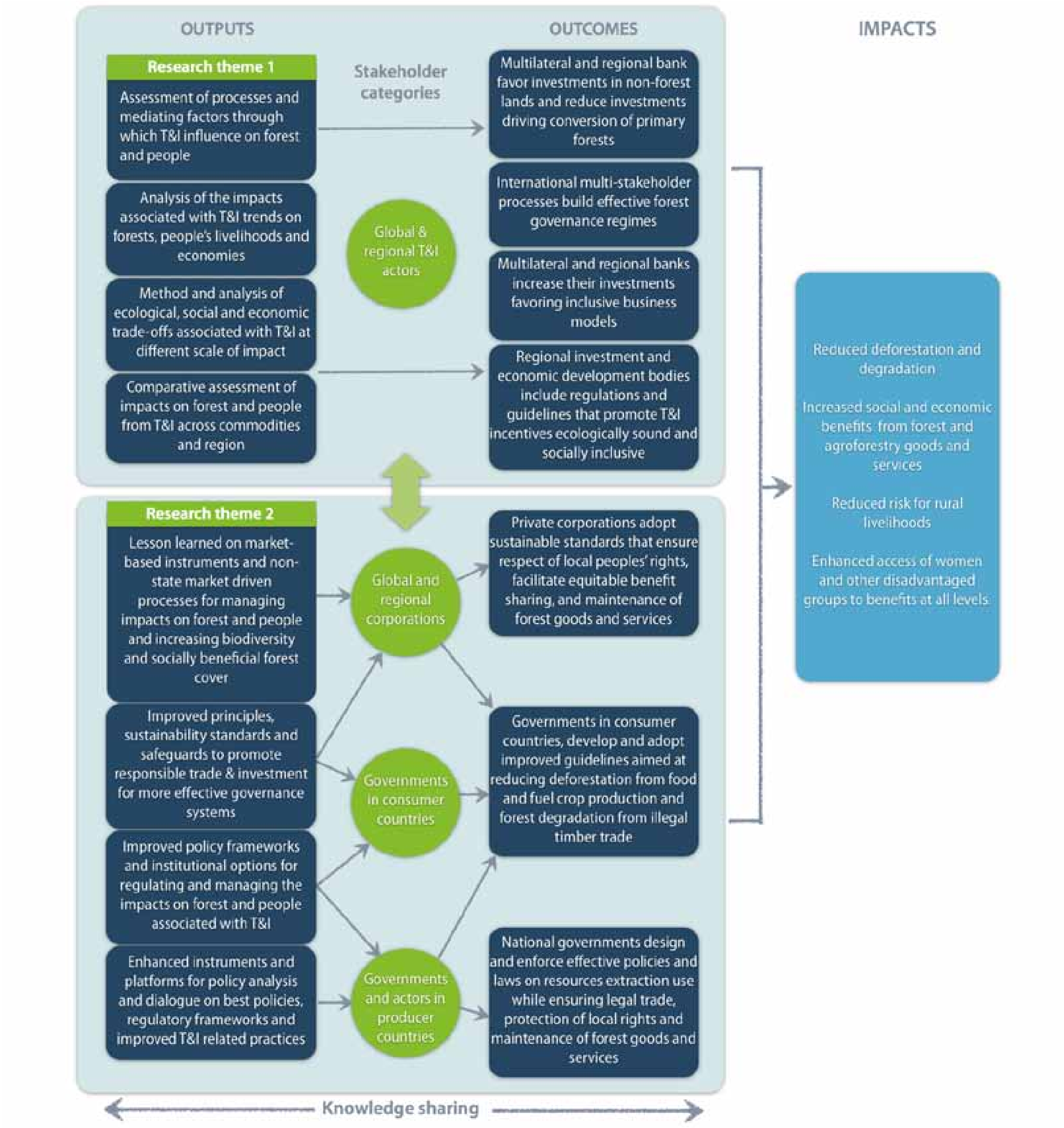

Figure 2.14 Impact pathways for Component 5

Box 2.16 Illustrative expected outcomes related to illegal logging and timber markets

Rationale

Sustained domestic and international demand for tropical timber, coupled with flawed regulations and weak enforcement of forestry regulations in several producing countries, have often resulted in increased illegal forest activities with consequences on forest degradation. Three main approaches are being adopted to improve forest governance related to timber trade:

1. forest certification (e.g., FSC, PEFC);
2. processes and policy decisions made by some consumer countries to decrease imports of illegal timber (e.g., FLEGT-VPA, US Lacey Act); and
3. changes made to forestry regulation and forestry agencies in some producer countries to stimulate the adoption of sustainable forest management (SFM), increase participation of local people living in or around forested areas and improve livelihoods.

There are many opportunities to improve synergies among these different approaches to improve impacts. One is to take advantage of the emerging interest in consumer countries in verifying the legality of timber imports; this will also lead to the verification of legality being embraced in domestic markets. CRP6 proponents will draw on lessons from CIFOR's work in Cameroon and Indonesia. Cameroon agreed to include all the timber produced in the country in its traceability system. However, CIFOR research indicated that the domestic timber sector—which mostly operates informally and beyond the law—equates in size to the export sector, generates about three times as many jobs as the formal sector and provides significant income for rural people (including bribes to forestry officials). In Indonesia, CIFOR research showed that at least 3000 small-scale wood-processing units are not monitored and only partially enter the national calculations of supply–demand dynamics in the forestry sector.

These two cases suggest a need to reform regulatory frameworks to address the needs of small-scale loggers and other local forestry operators. However, this should be done in the context of building more innovative business models and transparent markets linked to the formal forestry sector.

Planned impact pathways

We will adopt a three-pronged strategy to achieve impacts in collaboration with national and international partners, with the aim of improving synergies between global and national processes in at least five countries in three regions. Our impact pathways are as follows.

- We will work with national state agencies in producer countries to remove institutional barriers that work against informal local forest users and impede their operation in formal markets (e.g., cumbersome institutional procedures, lack of incentives) and implement systems to monitor progress. We will also explore more innovative business models to enhance the benefits of the different agents in the formal markets.
- We will inform governments in consumer countries about considering more nuanced criteria in VPAs, paying explicit attention to domestic timber markets. The aim is to address leakage between domestic and international timber markets and avoid greater inequalities in the distribution of benefits for forest users engaged in these markets.
- We will support the FSC's attempts to make certification an attractive option for forest users, especially those efforts aimed at simplifying procedures and expanding the adoption of SFM by a wide range of forest users, including local users, and contribute to finding more efficient ways to introduce formal operations into innovative business arrangements.

Main assumptions

It is assumed that promoting more flexible logging regulations adapted to different local forest users, and adopting simplified and less costly certification systems, will significantly improve the adoption of SFM practices by small-local loggers, smallholders and communities, thereby making timber markets fairer and more transparent. This will also contribute to strengthening alliances between small-scale loggers and communities with enterprises under more innovative business models. Reducing bribes in informal markets, making these markets more transparent and socializing proper tax systems will increase the net income of small-scale loggers and the formal forestry sector contributions to the national earnings.

Quantifiable indicators

- *No. of small-scale loggers that have formalized their forestry operations*
  No. of people directly involved in informal timber operations:
  Cameroon: 50,000; Gabon: 5000; DRC: 20,000; Indonesia: >50,000; Ecuador: 10,000
  We will contribute to formalizing at least 30% of the total informal small-scale loggers
- *Percentage of increased forest-based income of formalized small-scale loggers*
  Average income obtained from informal small-scale loggers (in USD/year):
  Cameroon: 4500; Gabon: 8000; DRC: 3700; Indonesia: 2800; Ecuador: 400–1200

2.5.9 Milestones

Below is an illustrative example of milestones during a 10-year period regarding the implementation of activities corresponding to Research Themes 1 and 2. The timeframes are indicative only and deliverables will be developed across years. Milestones are shaped strongly by an interactive process of collaborative research to be implemented with a relatively large number of policy, practitioner and knowledge-sharing partners. Component 5 will need to retain flexibility to adapt to changing contexts and trade flows to maintain its relevance.

Year 1: Methodologies for data collections defined, including definition of landscapes in select countries. MoUs established with research partner organizations in relevant countries and work plans defined. Interactions initiated with national and regional networks, and practitioner and knowledge-sharing partners at appropriate levels.

Years 2–3: Case studies conducted as part of global comparative research processes on global trends (linked to emerging markets, biofuel development, large-scale land acquisition, timber trade, finance), and findings analyzed at different levels of aggregation (case study, country, regional). Global synthesis produced by commodity and landscape types. Research findings disseminated for academic community (e.g., published in peer-reviewed journals) and for development practitioners and policymakers (e.g., policy briefs, reports available online). Engagement with governments and policy and practitioner and knowledge-sharing partners initiated to devise more specific impact pathways for research topic.

Years 3–4: Global comparative studies on impacts completed. Research underway on improved policy regulations, market-based instruments and voluntary mechanisms. Findings obtained support more active engagement with financial institutions, regional economic bodies, national development banks and multi-stakeholder processes, inform outcomes from trade and investment, and provide clear messages for improving best practices in production, finance and trade.

Years 4–5: Recommendations from research effectively adopted by policy and practitioner partners. Collaborative communication strategies established with knowledge-sharing partners to distill main findings and lessons from research applied across contexts and scales. Scientists actively engaged in policy debates in prioritized countries, in regional bodies, and in global processes through networks and investment forums that provide guidance on recommended practices, and innovations and policies and market-based mechanisms.

Years 5–6: Research conducted on linkages between past and emerging global trends related to global market and policy shifts, and on local, national and global responses. Global processes informed by research findings. Inputs provided to specific local and national initiatives aimed at governing production, finance and markets to enhance the positive impacts of trade and investment in sustainable development.

Years 6–7: Case studies revisited to identify changes in the impacts of trade and investment over time, and to assess the effects of policy responses on land use transitions, economic development and livelihoods. Research disseminated through policy and practitioner partners and knowledge-sharing partners.

Years 7–8: New global comparative synthesis completed, pulling together analysis across commodities and landscapes, and comparing historical trends with comparative studies. Analysis provided on refined options, instruments and institutional architectures for governing forest-related production, finance and trade. Analytical frameworks reassessed. A new generation of questions and hypotheses to move research forward proposed.

Years 8–9: Global process involving global, regional and national actors initiated to rethink the causes and consequences of globalized trade and investment for development and conservation, and related governance systems. Options proposed for securing benefits for forest and people from responsible finance and investment, and for emerging trade agreements embracing environmental and social concerns.

Year 10: Impact assessment conducted of the research outcomes from Component 5 on observable trends, mainly with regard to forest cover change, displacement of investments to non-forestlands and establishment of more inclusive business models. Assumptions on impact pathways revisited. Improved research approaches and strategies proposed.

2.5.10 Role of partners

Partners are fundamental for the implementation of this research component, which is based on collaborative processes and knowledge sharing. Different partners will bring different perspectives and diverse skills that are fundamental to achieving the desired outcomes. However, partners not only contribute to the process of knowledge generation; they also participate through advocacy and dissemination of findings, and through their engagement in policymaking processes that are fundamental to achieving the outcomes. Table 2.7 provides examples of policy and practitioner partners and knowledge-sharing partners at the global level, regional level in sub-Saharan Africa, Asia and Latin America, and country level in selected countries by region.

Table 2.7 Illustrative list of policy and knowledge-sharing partners for Component 5

Levels/types	Policy and practitioner partners	Roles/ contributions	Knowledge-sharing partners	Roles/ contributions
International level	FAO, UNCTAD	Include research findings in the development of voluntary guidelines and programs	ILC	Disseminate research findings in network debates
	FSC, PEFC	Translate research results into standards and guidelines for producers	RRI	Disseminate research findings among member institutions and policy forums
	WB, IFC	Acknowledge research findings in investment decisions	Oxfam	Share findings across institutional platforms

Levels/types	Policy and practitioner partners	Roles/ contributions	Knowledge-sharing partners	Roles/ contributions
	BIC	Acknowledge research findings in their campaigns	Ecole Polytechnique Federale de Lausanne	Incorporate inputs on the development of tools for global processes
	TRAFFIC	Acknowledge research outcomes in their efforts to shape policies on natural resources governance		
	NGOs (CI, WWF, TNC, IUCN)	Acknowledge research outcomes in development of programs		
	RSB, RSPO	Use research findings to refine criteria and indicators and implementation guidelines		
Regional level	Regional bodies (COMESA, SADC, OTCA, CAN)	Use research findings to raise awareness on the need for policy change either regionally or within member states; inform member states decisions through research findings; encourage regional trade and economic cooperation	CATIE, UNAMAZ, FLACSO	Introduce research findings into regional courses and training programs
	Regional banks (EIB, IADB, ADB, CEB, AfDB, CAF)	Translate research results into policy guidance for Congo Basin governments	RECOFTC	Introduce research findings into training and dissemination programs
Country or site level	Ministries of agriculture, energy, industry, mining; state agencies of forestry, lands and investment	Use research findings to inform their decisions on promotion, regulation and service provision	National media organizations	Disseminate research findings, lessons and recommendations
	In Sub Saharan Africa: African Forest Forum	Acknowledge research outcomes in development of programs and actions		
	In Latin America: Amazon Initiative	Acknowledge research outcomes in development of programs and actions		
	In Asia: Forest Watch Indonesia, Sawit Watch Indonesia, TBI, Telapak, IWGFF, WALHI, IHSA	Acknowledge research outcomes in development of programs and actions		

2.5.11 Prioritization

Component 5 will prioritize conducting research simultaneously across the five subject areas introduced in Section 2.5.2. These areas are related to impacts from: (1) emerging economies, notably BRIC countries; (2) bioenergy development including biofuels and charcoal; (3) large-scale investments and land allocation in agribusiness, timber and carbon, and mining; (4) illegal logging and timber trade; and (5) forest-related corruption and money laundering.

Depending on the availability of financial and human resources, we will have to make critical decisions in terms of “phases” and “scope and scales”. With regard to phases, the main priorities will be to conduct research under Theme 1 on (1) collecting and analyzing data on the impacts of trade and large-scale investment in prioritized countries and landscapes linked to the development of biofuel feedstocks and large-scale investments from China in forest-rich producer countries, and (2) assessing the dynamics of illegal logging and timber trade linked to domestic and global timber markets and the effectiveness of policy processes to support legality and reverse corruption and money laundering. Theme 2 priorities will be to assess state and non-state responses related to these same topics of interest.

If additional resources are available we will expand our research to more systematic analysis on the implications of large-scale land acquisition, explore more deeply issues of corruption and forest finance (including carbon), and assess the challenges for building improved governance regimes and architectures.

3. Cross-cutting Themes

3.1 Gender

Social attributes such as gender, wealth, age, ethnicity, migration status and religion can confer a systematic disadvantage by making it difficult for some groups and individuals to access public and private mechanisms of resource allocation or decision making. Although we set out research possibilities for addressing gender concerns in this section, we recognize that gender-based disadvantages may not always be the most urgent in all settings. As outlined below, the careful use of participatory methodologies, including in problem framing, provides good scope for locating the most salient features of disadvantage in each setting and for ensuring their inclusion in the research and action process.

3.1.1 Role of women in managing forest and tree resources

Despite a wealth of studies demonstrating the critically important roles women play in managing forests, agroforestry and tree genetic resources, women's contributions remain underappreciated. Women are traditionally the main collectors of fuelwood, medicinal and aromatic plants and other non-timber forest products (NTFPs) from forest and agroforestry landscapes.[1] Their participation in decision making at household and community levels, although limited, has been demonstrated to improve forest regeneration,[2] increase crop yields, improve financial management[3] and prioritize funding for pro-poor and empowerment programs.[4] Women in forest communities can generate more than 50% of their income from forests, compared with about a third for men.[5]

Although the policy environment for addressing gender inequity has improved over the past decade, women continue to be disadvantaged by insecure access and property rights to forest, tree and land resources,[6] by discrimination and male bias in the provision of services

[1] Colfer, C. (ed). 2005. The equitable forests: diversity, community and resource management. Resources for the Future, Washington, DC; Shanley, S. and Gaia, G.R. 2001. Equitable ecology: collaborative learning for local benefit in Amazonia. Agriculture Systems 73: 83–97.
[2] Agarwal, B. 2007. Gender inequality, cooperation, and environmental sustainability. In: Baland, J.M. et al. (eds) Inequality, cooperation, and environmental sustainability, 274–313. Russell Sage, New York; Princeton University Press, Princeton; Agarwal, B. 2009. Rule making in community forestry institutions: the difference women make. Ecological Economics 68: 2296–2308.
[3] Acharya, K.P. and Gentle, P. 2006. Improving the effectiveness of collective action: sharing experiences from community forestry in Nepal. CAPRi Working Paper No. 54. International Food Policy Research Institute, Washington, DC.
[4] Komarudin, H. et al. 2008. Collective action to secure property rights for the poor: a case study in Jambi Province, Indonesia. CAPRi Working Paper No. 90. International Food Policy Research Institute, Washington, DC.
[5] World Bank, FAO and IFAD. 2009. Gender in agriculture sourcebook. The International Bank for Reconstruction and Development, The World Bank, Washington, DC.
[6] Quisumbing, A.R. et al. 2001. Women's land rights in the transition to individualized ownership: implications for tree-resource management in Western Ghana. Economic Development and Cultural Change 50: 157–181; Meinzen-Dick R. et al. 2010. Engendering agricultural research. Paper prepared for the Global Conference on Agriculture and Rural Development. Montpellier, France, 28–31 March.

including credit and technology,[7] and by exclusion from decision making at household, community and national levels. Women disproportionately bear the costs of tree and forest management, realize only a fraction of the benefits and tend to be enlisted for decision making only when forest and tree resources are degraded.[8] Moreover, women's lack of formal education, employment and personal networks makes them poorly placed to influence resource allocation or research.[9]

3.1.2 Addressing gender inequity

Changes in tree cover and loss of community access to forests can have a disproportionately adverse impact on women, with indirect impacts on households and, consequently, on the livelihoods of 5–10 times as many people. Gender equity in the forestry and agroforestry sector can thus contribute to the achievement of broader social and economic goals, including the Millennium Development Goals. However, it is important to contextualize the constraints facing women in tree and forest management and conservation. Gender inequality is relational. Any focus on women must examine the interplay of power, institutions and practices that animate disparities between men and women in tree and forest management if such disparities are to be reduced or eliminated. Focusing on gendered relationships (and not on women alone) has a higher probability of providing guidance for changes to institutions, policies and practices that are relevant for transforming unequal gender relationships. Such a focus must, however, avoid a zero-sum struggle between men and women.

3.1.3 Gender in CRP6

Gender analysis and research are integral to each of the CRP6 research components, as demonstrated in the following sections of this proposal. Gender-sensitive research will generate an understanding of key institutional, cultural and attitudinal contexts that entrench inequity across a relevant set of issue areas. It will identify policies, technologies and practices that will enhance gender equity in access, use and management of forests and trees, and the distribution of associated benefits. Gender-sensitive research will also offer guidance on how to avoid or mitigate negative impacts associated with relevant processes. Table 3.1 illustrates how gender-related issues cut across the five components. Following are some aspects of gender-relevant research that capture recent trends.

1. Research into the potential for expanding women's opportunities to own land and gain access to business and development support services for environmentally friendly enterprises.
2. Research to inform ongoing tenure reforms and formalization processes in order to ensure consultative, transparent processes that are cognizant of the uses, needs and priorities of women and other marginalized groups.

[7] Place, F. 1995. The role of land and tree tenure on the adoption of agroforestry technologies in Zambia, Burundi, Uganda, and Malawi: a summary and synthesis. Land Tenure Center, University of Wisconsin, Madison, USA; German, L. et al. 2008. Enabling equitable collective action and policy change for poverty reduction and improved natural resource management in the eastern African highlands. CAPRi Working Paper 86. International Food Policy Research Institute, Washington, DC.

[8] Agrawal, A. and Chhatre, A. 2006. Explaining success on the commons: community forest governance in the Indian Himalaya. World Development 3(1): 149–166.

[9] Crewe, E. and Harrison, E. 1998. Whose development? An ethnography of aid. Zed Books, UK; Ferrier, S. 2002. Mapping spatial pattern in biodiversity for regional conservation planning: where to from here? Systematic Biology 51: 331–363.

3. Research on how to better inform policy by enhancing linkages among environment and women's/gender ministries and specialized bodies/treaties such as the UNFCCC, National Adaptation Programme of Action, Climate Investment Funds, etc.
4. Research on ensuring gender-equitable access to REDD+ benefits and carbon market incentives, as well as incorporating gender analysis into vulnerability assessment tools.

As achieving gender equity (or more feasibly narrowing the gender gap) is premised on change, gendered research in this CRP will systematically analyze and reflect on strategies and pathways of influence for both policy and practice. Systematic reflection and learning will allow the program to leverage the most effective linkage methods and good practices.

Table 3.1 Consideration of gender differentials and equality across the research components. For descriptions of components, see Section 2

Theme	Issues across research components	Key research strategies
Knowledge, preferences and priorities reflected in identification of research topics	• Priorities for tree and forest species, traits, land uses and products (C1–C5) • Value chains and enterprise opportunities for tree and forest products (C1, C2) • Priority resources and mitigated impacts in climate change adaptation (C4) • Specific priorities of women: postharvest processing (C1, C2), bioenergy for household consumption (C4), fruit trees (C2)	• Participatory research and identification of topics • Sex-disaggregated data • Gender analysis for understanding the underlying factors
Negative impacts identified and avoided / mitigated	• Trade-offs between land uses and livelihoods, and displacement of user groups during forest transitions (C3), market integration (C5), payments for environmental services (PES) (C3) and REDD+ projects (C4) and conservation actions (C2) • Policies and strategies on tenure rights (C1–C5), ecosystem management (C2, C3), REDD+ (C4), trade and investment flows (C5) and conservation (C2) • Impacts of climate change (C4), loss of ecosystem services (C3) and biodiversity (C2) on priority systems, products and services	• Participatory research and identification of topics • Sex-disaggregated data • Gender analysis for understanding the underlying factors • Knowledge sharing and tools development
Differential access and ability to adopt materials, methods and knowledge accounted for in activities	• Access to and control of land and tree resources during changing land uses, policies and markets (C1–C5) • Approaches and tools in ecosystem and tree management (C1–C3) • Approaches and tools in climate change adaptation and mitigation projects (C3) • Targeted extension and training approaches (C1–C4) • Access to inputs, markets and market information on forest and tree products (C1, C5), PES (C3) and REDD+ (C4)	• Participatory research and identification of topics • Sex-disaggregated data • Gender analysis for understanding the underlying factors • Participatory scenario building and planning • Knowledge sharing and tools development • Outcome mapping
Equitable participation in and ability to influence decision-making processes enhanced	• Obtaining and securing tenure rights during intensification (C1), forest transitions (C3), market integration (C5), development of markets for ecosystem services (C3) and REDD+ (C4), and conservation actions (C2) • Negotiation power on land uses and trade-offs with external actors: local and national authorities (C1–C5), market actors and industries (C1–C5), international climate policies (C4) and conservation NGOs (C2, C3) • Design of policies and strategies for tree and ecosystem management (C1–C3), PES (C3), climate change mitigation and adaptation (C4), trade, investment and land acquisition (C5) and conservation (C2) • Distribution of incomes from tree and forest products (C1, C2, C5), PES (C3) and REDD+ projects (C4) • Reconciling needs and managing conflicts in resource use within households and communities (C1–C5)	• Participatory research and identification of topics • Gender analysis for understanding the underlying factors • Alliances built with policy and advocacy communities • Knowledge sharing and tools development • Sex-disaggregated data

3.1.4 Strategies for gender-responsive research

To build the implementation of gender-responsive research into CRP6, a four-step interactive process will be employed.

Collection of gender-disaggregated data

As a first step, the regular and consistent gathering of gender-disaggregated data on various aspects of the forest, tree and people interface will be mandated under CRP6. Data collected will include: (1) the implications of new policies/laws/technologies; (2) effects of emerging global issues such as climate change and biofuels expansion on the welfare of men and women; (3) household and community use and management of forests and trees; and (4) tree biodiversity and germplasm. Such data will help in identifying men's and women's differentiated perceptions, experiences, contributions and priorities. It will ultimately help in defining interventions that will enhance gender equity.

Researchers will consistently employ gender analysis as a tool to provide in-depth information on gender differentiation and, in particular, to identify institutional, cultural and attitudinal factors underpinning differentiation. Gender analysis will identify options and priorities for transforming inequality, and will identify the roles and responsibilities of relevant stakeholders in realizing these options and priorities. Although gender differentiation is inherently a localized experience, the analysis of conditioning factors will spotlight features of institutions (including markets, policies and legal regimes) at multiple governance levels that influence local-level outcomes.

Participatory approaches are well suited for enhancing inclusiveness, especially of disadvantaged groups, to allow better representation of multiple views to improve people's capacity to act on their own behalf and to promote learning. We will pursue multiple methodologies to generate insights into the gender-relevant policy problems and core research questions identified in each component of CRP6. Quantitative household surveys will be used to establish household-level effects and responses. Intra-household surveys will be encouraged in line with recent advances in gender research that demonstrate that preferences, resources and overall access can differ between men and women within households. Experimental games may be used to facilitate the isolation and analysis of specific variables of interest. However, we will place a premium on the application of participatory techniques that hold great promise for inclusion, learning and empowerment (see Box 3.1).

Adaptive Collaborative Management, which combines a series of participatory techniques for problem identification and resolution such as participatory action research, focused group discussions, transect walks, participatory mapping and outcome mapping, will form a methodological pillar for gender analysis in CRP6. We will add a historical dimension to our analysis in order to illustrate the dynamic nature of how women may gain or lose authority in the use, management and control over forest and trees and their products and services.[10]

[10] For a historical analysis of gendered access to markets, see: Wardell, D.A. and Fold, N. (forthcoming). Globalizations in a nutshell: the shea trade in Northern Ghana.

Box 3.1 Gender-responsive participatory research

Gender-responsive participatory research (GRPR) is research that involves the participation of end users, and responds to the differential needs of the genders represented in the end-user community. GRPR recognizes that smallholder farmers play key roles in food production and nutrition improvement, have specialized knowledge regarding the management of natural resources in their specific environments and are conscious of the value of biodiversity and a healthy environment. GRPR further recognizes that differences in access, interests and needs along gender, ethnic, age and socioeconomic lines have an impact on innovation in natural resources management.

GRPR has the potential to generate multiple options for heterogeneous rural communities because it fosters multi-stakeholder collaboration, bringing all elements of a community “on board”, especially those frequently marginalized by either research or society generally. Participants at the workshop on Repositioning Gender-Responsive Participatory Research in Times of Change concluded that GRPR offers some of the most powerful and useful approaches for alleviating poverty, improving well-being, achieving sustainable development and sustainable levels of natural-resource use while protecting the environment.1

Reference:

1 CIAT. 2010. A global strategy and action plan for gender-responsive participatory research in international agricultural research. Workshop on Repositioning Gender-Responsive Participatory Research in Times of Change, Cali, Colombia, 16–18 June 2010. International Center for Tropical Agriculture, Cali, Colombia (CIAT). http://grprinitiative.blogspot.com/2010/08/gender-responsive-participatory.html.

Because the nature and magnitude of gendered outcomes may vary depending on cultural and social norms, research will be conducted in different settings. Each CRP6 component has not only identified specific gender-related research questions, but has also identified geographic priorities, spanning Africa, Asia and Latin America, where culture and social norms can differ. Moreover, sentinel sites, which will be established in diverse settings, provide an opportunity for monitoring change and assessing impacts of specific policy interventions and/or practices. Data collection methodologies will be both qualitative and quantitative and data analysis will accordingly range from statistical techniques (including regressions) to interpretation of norms, conventions and practices to identify the underlying mechanisms that lead to visible actions and outcomes. Relevant theories and approaches in behavioral sciences and psychology will be employed to enhance understanding and explanation; however, new theories may be generated via grounded approaches. Component and project leaders will encourage multidisciplinary research teams—comprising both male and female researchers—to work with both men and women. Training programs and workshops will enable CGIAR center researchers and their partners to shift from collecting sex-disaggregated data to comprehending the dynamics of gender relations. Moreover, measures for ensuring that women (and other marginalized individuals, including poorer or younger men) are included in participatory techniques will be emphasized, for example through timing of research or group separation.

Researchers will also be encouraged to assess and adopt measures (e.g., conflict resolution) that safeguard women against backlash and other adverse consequences throughout the course of the research. Researchers will be advised to further disaggregate the generalized categories of “men” and “women”, as differences among women can be as great as differences between men and women. This process of disaggregation will capture other salient attributes such as wealth, ethnicity, age, religion, marital status, inheritance system and so on, depending on the social and political setting.

Partnerships and alliances

Gender inequality is rooted in societal relationships and broad changes are necessary for achieving gender equity. As a second step, research teams will build alliances with both policy and advocacy communities, within and across sectors and across governance levels. Such alliances, including with women's farming/forest organizations that have links to male-led farming/forest organizations, will provide an avenue for uptake and adoption. Strengthening links to advocacy networks and platforms (including media and women-focused civil organizations) is critical for raising awareness of gender-related issues and for mobilizing action toward gender inclusion. Moreover, these links will increase the likelihood that problem identification and prioritization are gender sensitized (see Box 3.2).

Box 3.2 Anatomy of a gender-based research and action partnership in Uganda

The final impact pathway identified in Figure 3.1 below relates to improving women's influence in decision making—specifically, increasing their control over forest and tree resources, their capabilities to claim their rights and an overall (re)negotiation of inequitable arrangements in the management and distribution of the benefits and burdens of forest and tree management. The achievement of this impact pathway is conditioned on a careful mix of research, advocacy, training and capacity building, as well as innovations in policy and practice.

A series of partnerships and carefully crafted iterative processes are envisaged. Problem identification and research priorities will be established jointly with national-level partners, such as ministries of forestry (e.g., Uganda's Forestry Commission and National Forestry Authority), university departments (e.g., Makerere University's Faculty of Forestry and the Department of Women and Gender Studies), forestry-relevant NGOs (e.g., CARE-Uganda) and gender-relevant NGOs (e.g., Association of Uganda Professional Women in Agriculture and Environment) at national and subnational levels. Representatives from each of these organizations will form a Project Advisory Committee that will oversee the research and action process, and will meet quarterly to review the research findings and to identify leverage points for policy and practice and to begin to implement them.

Each organization in this partnership will have a specific task and bear responsibility for its implementation. For example, Makerere University will bear responsibility for methodology development, data collection, analysis and reporting as well as for convening the Project Advisory Committee. Forestry and gender-relevant NGOs will be responsible for initiating and sustaining local community engagement in the research, providing training for both men and women and jointly identifying (and putting into action) relevant and appropriate local-level practices and commitments for improving women's decision making and control over forests and trees. The NGOs will also have responsibility for helping men and women identify indicators of “progress” and in assisting them to periodically evaluate actions against these indicators. Government officials, informed of research (and action) findings through regular Project Advisory Committee meetings, will be encouraged to indicate ways in which these findings can/will be used to modify their projects, internal processes, strategies (including monitoring and evaluation) and overall policies.

While CRP6 research teams will undertake global dissemination and outreach, all national-level partners will undertake the same among their networks and constituents at national level through workshops and advocacy campaigns.

At international level, cooperation will be strengthened with FAO's Gender Program, IFAD, the International Land Coalition (ILC), Women Organizing for Change in Agriculture and NRM (WOCAN) and IUCN. These organizations have strong links with regional and national networks that provide advocacy for gender equity in resource use planning, policy formulation, access to resources and information, and distribution of benefits and costs. We will also seek to build partnerships with the newly mandated UN WOMEN. On the research front, we will seek to partner with the International Center for Research on Women (ICRW).

At national and supranational levels, current partnerships will be strengthened and new ones sought with women's organizations, forest users' federations, women-focused civil society organizations and local media. Partnerships with IFAD and ILC will provide further opportunities for creating and strengthening contacts with local organizations. The governments of many developing countries have established gender/women's ministries and departments; we will seek to partner with them in addition to gender divisions in forestry and agriculture ministries. Similarly, national universities are increasingly establishing departments of gender and/or women's studies. Specific attention will be paid to creating opportunities and encouraging partnerships between the various partners of the CRP6 and gender-specific organizations. Such networks will strengthen the women's organizations (especially at national and local levels), allow identification of complementarities and enhance the uptake and adoption of research outputs.

Researchers will also explore opportunities for learning among peers in the CGIAR network. Gender units (with clear authority and budgets) in each participating center will create a forum that will convene and ensure cross-institutional interaction to provide further continuous, constructive and collaborative guidance among participating institutions. The forum of gender units will also encourage and monitor self-study and reporting of achievements and impacts. This effort will be linked to other similar efforts, especially those identified under CRP2 where gendered rights and access to natural resources, gendered resource management and gendered access to markets are prominent themes. Research design, methodologies for impact assessment, policy dissemination and outreach are areas of joint action.

Knowledge sharing

The third step, closely related to the second, will include systematic documentation and dissemination of knowledge generated through gendered research. Such documentation will include good practice guides, training guides, policy briefings and scientific articles covering the critical aspects of gender in forest, tree and agroforestry management. Such aspects would include essential elements that facilitate successful implementation of gender/women-targeted projects: gender-differentiated policy impacts, needs, perceptions and priorities of multiple stakeholders and/or leadership development of women. Documentation will articulate the interconnections between new behaviors and success and will provide insights into how changes can be embedded into ongoing structures and practices. Research teams will regularly share findings among communities, practitioners and policymakers to remain informed of the status of gender equity. Such dissemination will continuously clarify the value addition of gender and reinforce attention to gender perspectives.

Adaptive learning

The fourth step relates to adaptive learning. Researchers will develop and track indicators to capture inclusion, to improve gender equity, to evaluate the effectiveness of programs, projects and interventions, and to improve data collection and analysis systems. These indicators will span the breadth of forestry and agroforestry concerns, including representation in planning and decision-making processes, property rights, access to technologies and services, income distribution, market access and innovation systems. We will select and apply appropriate quantitative and qualitative indicators to assess and communicate the true magnitude of impacts. Such assessments will allow for a critical analysis of activities and outputs and for the incorporation of new knowledge into existing and anticipated phases of research.

3.1.5 Impact pathways

Social and political change can occur through multiple avenues (see Box 3.3), such as through improved knowledge and technology, collective organization and mobilization, or contestation. Our four steps toward strengthening gender research for impact generally reflect our expectations regarding how change will happen. Figure 3.1 provides further details on how we expect to achieve impact. For example, to ensure that women's (and men's) knowledge and priorities are reflected in a priority setting or that the operational strategies of forestry agencies are gender-sensitized, we will build partnerships with relevant organizations. We will work with state agencies, NGOs and National Agricultural Research Systems (NARS) and private sector actors (e.g., timber companies, project financiers) to ensure that the needs and priorities of women are jointly identified by women, by implementing agencies and by advocacy organizations at local, national and global levels. We anticipate that bringing in implementing actors at such an early stage will foster joint ownership, coproduction and joint responsibility for outcomes and learning. Private sector actors, in particular, will mainstream gender concerns into contracts in order to ensure compliance.

Box 3.3 Impact pathways: An illustration from Uganda

Between 1990 and 2005, deforestation occurred in Uganda at a rate of about 2% per year. Studies in India and Nepal have shown that increasing the number of women in forest management committees and other executive bodies positively impacts forest regeneration and lowers the incidence of illegal extraction. Moreover, where women make up 33% or more of committee officials, a critical mass is reached and women's overall participation, including attending meetings and voicing needs and demands, is increased by about 28%.[1] Although Uganda's Local Government Act mandates that local council committees (which are also involved in environmental decision making at village, sub-county and district levels) include at least three women out of a total of nine, the practice has not lived up to legal expectation. Most councils include only one woman.

Recent studies by Uganda's National Forestry Authority found that in local village councils with at least three women, forest degradation levels were lower and biomass higher than in local village councils with only one female representative or with none. NFA thus predicted that if village councils countrywide were to have at least three women representatives, then annual deforestation rates would be reduced to 1.5–1.8% per year over the following 10 years. According to NFA, women committee members are less tolerant of encroachment, especially of livestock grazing, which has been shown to impede regeneration and to pave the way for further degradation. Increasing women's numbers in committees provides them with more voice and influence. Increasing the number of women council members to at least four at other governance levels (such as sub-county and district) in addition to the village council may push deforestation rates to well below the forecast 1.5–1.8% per year by 2020. Moreover, women's subgroups in some forest associations (such as the Zida forest association in Mpigi District) are now participating and drawing benefits under the Sawlog Plantation Grants Program, which supports plantation establishment on degraded/deforested government land or individual land, but which has mostly been captured by influential private entrepreneurs.

The transition from one (or none) woman to three to four women in formal environmental management structures is, however, dependent on the extent to which the National Forestry Authority and local government are willing and able to enforce legal requirements for gender equity. It will also depend on the level of men's and women's awareness of the value addition of women's participation, their support for narrowing the gender gap and their subsequent capacity to influence politicians. The latter actors will then allocate resources and align the bureaucrats with the legal intent. Our research in CRP6 will provide evidence of the benefits of women's participation, while partnerships built with governments, civil society and media houses will stimulate the advocacy, awareness and commitment for moving knowledge to action.

Reference:

[1] Agarwal, B. 2010. Does women's proportional strength affect their participation? Governing local forests in South Asia. World Development 38(1): 98–112.

Figure 3.1 illustrates that the transitions from research output to outcome and from outcomes to research impact are underwritten by carefully coordinated processes. For instance, transitioning from output to outcome will include: collaboration with government ministries, NGOs and women's organizations; gender-differentiated cost–benefit analyses of impacts; awareness raising and capacity building for women and men; and the use of pilot projects to demonstrate the value addition of increased attention to gender. Transforming outcomes to impacts will include the following processes: awareness campaigns; strategic communication of success stories from pilot testing; advocacy for equitable resource allocation and for the acquisition and securitization of land/forest rights; and the strengthening of women's forums. To increase the likelihood of learning at each phase of the research cycle, the effectiveness of these interlinked processes will be monitored and evaluated. However, we emphasize that the seeming linearity of the impact pathway as illustrated can fail to reflect that single outcomes can have multiple impacts; that partnerships developed across multiple channels and governance levels can amplify impacts; or even that learning and feedback can prompt a rethinking of methodologies, problem analysis, etc. The linear representation is thus intended to be illustrative only.

Transformational change is fraught with risk and challenge. For example, cultural embeddedness may constrain the change of attitude necessary to achieve a gender-responsive forest management planning and implementation process. Empowerment can overburden women, or increase men's resentment and opportunism (e.g., shirking responsibility or appropriating women's increased assets to their own ends). Similarly, collective action among actors in partnership can be weakened by multiple factors, from competition to unforeseen changes in thematic priorities, resources or even geographic focus. Thus, cautious optimism is called for and careful thought will be given to creating preemptive safeguards.

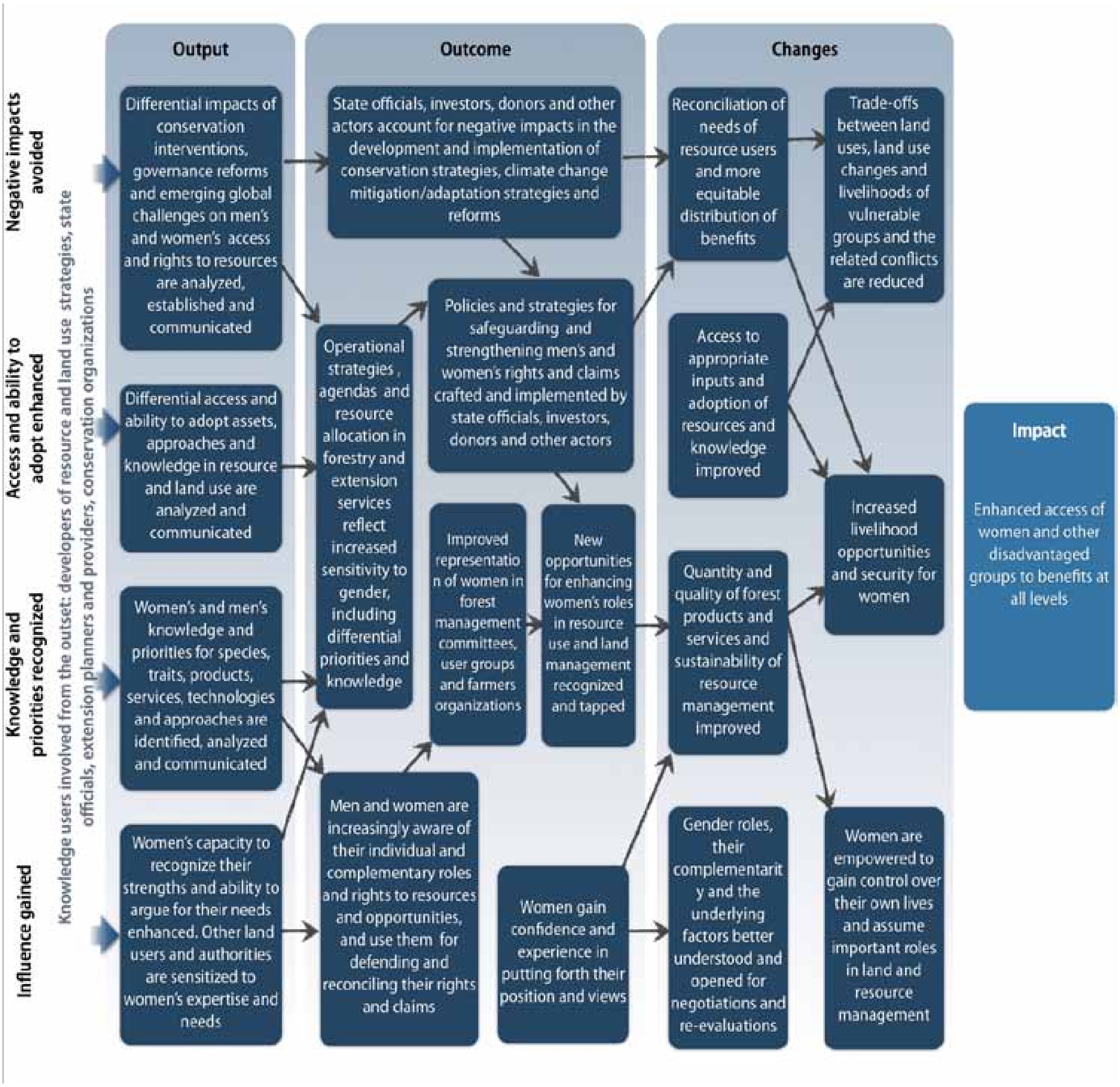

Figure 3.1 Illustrative impact pathways for addressing gender issues through research and action

3.2 Partnerships

During the Partnership Consultation for CRP6 in Nairobi (9–11 August 2010), a broad cross-section of partners articulated their goals in partnering with the CGIAR, and with CRP6 in particular, and what they felt they could contribute to a highly integrated and participatory effort. Potential partners from 20 countries, representing national research institutes (agriculture and forestry), community groups, advanced research institutes (ARIs), international NGOs, UN agencies and donors reaffirmed the legitimacy of the CGIAR mandate in this domain, and their interest in taking part in CRP6.

3.2.1 Roles of partners

The proponents of CRP6 have high ambitions to use research on forest and tree systems as a means to achieve large-scale improvements in the livelihoods and food security of the poor as well as in environmental quality. We recognize that this cannot be done alone. A key point of the report commissioned by GFAR and prepared by the Global Author Team (led by Uma Lele) for the first GCARD is that:

> [a] global transformation will require recognition of the substantially broader multi-institutional architecture of scientific research and development that must now span and evolve worldwide creating a market place for ideas, technologies and approaches.[11]

Research is one small part of the large complex of interacting processes and actors that determine how natural and social systems function. Multiple local stakeholders, national governments, NGOs and other civil society organizations (CSOs), development banks, private sector companies and international conservation and development agencies all play their roles. Moreover, CGIAR research is just one part of the larger research universe. Universities, government research agencies, NGOs, private researchers and a range of other international research organizations address related issues. The success of CRP6 therefore requires a careful assessment of our role within this larger universe and the creation of effective partnerships that will ensure impact and maximize scarce resources.

CRP6 has identified a set of priority challenges related to the management, use and governance of forests and trees. CRP proponents will further develop the research agendas and associated impact pathways presented in this proposal for each of these challenges, with the intent to catalyze positive change. The basic impact logic is that our efforts will:

- increase attention to key opportunities and constraints related to forests and trees in the broader research-for-development community;
- develop new ways of analyzing priority problems that are efficient and effective and give due attention to the needs of all stakeholders, including women;
- develop appropriate means of overcoming constraints and realizing opportunities that can be applied in the systems where we work, that can be adapted for application in analogous systems and that can be modeled and replicated in a wider range of systems; and

[11] Lele, U. et al. 2010. Transforming agricultural research for development. Global Author Team. The Global Forum for Agricultural Research (GFAR). Report for the Global Conference on Agricultural Research (GCARD). Montpellier, France. 28–31 March.

- develop and test impact assessment approaches—including the measurement of changes in livelihoods and conservation status—as a way to inform our own learning, to validate the approaches and to provide measurement tools as additional output for others to use.

This basic schematic implies the need for multiple interactions between, and different roles for, various types of partners. For ease of discussion, we have grouped these partners according to the typology presented in Box 3.4, with further elaboration below.

Box 3.4 Types of partners

Research partners are science-oriented organizations that participate directly in the formulation and implementation of the CRP6 research agenda.

Policy and practitioner partners are development-oriented organizations that are the immediate and intermediate clients for research results in impact pathways.

Knowledge-sharing partners are organizations oriented to communications and/or capacity building that can help translate research results into accessible knowledge and extend it to larger-scale target audiences. All partners form and contribute to the knowledge-sharing community.

For example, consider the research process on a particular problem in a certain field site or policy area. Upstream in research design, it will be important to engage with relevant stakeholders to contribute to problem definition and to ensure the relevance of the research issues identified and the approaches to addressing them. At a particular field site, these would include forest resource users and managers, as well as relevant practitioners such as conservation organizations and development agencies. When the target of the research is a larger institution or policy arena, engagement with relevant policy actors such as government officials, public interest advocates and financiers might be most appropriate. In addition to validating problem identification, early engagement with policy and practitioner partners can build ownership over eventual research results.

Because contemporary resource management problems tend to be complex at all scales, their diagnosis and solution require interdisciplinary approaches. Therefore, the research itself will rely on contributions from various research partners and directly from local stakeholders through participatory research. CRP6 research teams will work together with their partners to analyze the systems under study, to identify specific problems and constraints in those systems and to devise strategies and interventions to address them.

Research results are only useful if they are applied in practice. Ideally, we will engage with organizations that have the mandates and capacity to implement recommended interventions in the study locations and more broadly. Moreover, when changes are initiated, it is vital to learn from them. We will work with policy and practitioner partners to monitor outcomes and impacts, to adapt and improve impact pathways, and to generate more general lessons about conservation and development and impact assessment. We will extend our reach and broadly disseminate the lessons through engagement with knowledge-sharing partners.

CRP6 will conduct multidisciplinary, empirical research in a range of representative sites, institutions and policy contexts. Individual research activities will aim to have positive impacts on a particular site or policy arena and thereby provide value to local partners and stakeholders. These activities will then become the building blocks of the larger impact pathways of the program. Large-scale change will be achieved by:

- influencing the research and development agenda to increase attention to livelihoods and conservation issues, whether in particular forested environments or global institutions;
- extending the research and knowledge sharing by building capacity and facilitating others' work; and
- realizing widespread application of knowledge generated by the program.

These are the "international public goods" that the research program will deliver. CRP6 will have significant impact if (1) research partners accept and apply jointly developed methods in other sites and contexts and (2) our research recommendations influence how civil society and our partner agencies understand and respond to problems and opportunities in other locations and systems.

3.2.2 Types of partners

CRP6 is organized as a series of components, subdivided into themes, each of which will address key problems and opportunities in forest- and tree-based systems. Research activities will range from field-based empirical work, methodology development and testing, and policy analyses and recommendations. As discussed above, the program will work with different types of partners at different scales. Many organizations, such as many members of the Collaborative Partnership on Forests (CPF), are expected to play more than one type of partnership role.

Research partners

Research partners are the individuals and organizations that do the work to identify, analyze and generate options for solving priority problems. Centers participating in CRP6 specifically have strong core research capacity, but this represents a fraction of the total research capacity needed to address forest- and tree-related challenges. Research partners will bring complementary skills and additional resources that can be directed to priority issues. Engaging research partners will also expand the impact of CRP6 by influencing the agenda of a larger set of researchers and research organizations. Individuals and teams from government institutions, independent organizations, universities (ARIs and NARS) and private organizations will participate in research design, methods development, data collection and analysis, and communications and knowledge mobilization.

In the context of research at particular sites and country-specific policy arenas, local research partners often have essential skills (language, familiarity with local context, research history) to contribute to data collection and analysis. (Indeed, in many cases, direct stakeholders in research outcomes will be research partners, through participatory research methods.) In return, local research partners will benefit from capacity strengthening and gain new perspectives through interdisciplinary approaches and comparative studies. At national and international scales, research partners can contribute to the pool of skills required to execute the work of the Component Implementation Teams. They also help to generate and communicate policy-relevant research findings, and/or to bring additional resources to bear on priority problems. National and international partners can benefit from collective learning, especially in the context of the global comparative analytical approach of CRP6.

Table 3.2 demonstrates the synergies between CRP6 components and research themes and the Integrated Research Plan of Indonesia's Forestry Research and Development Agency (FORDA).

Table 3.2 Synergies between CRP6 components and themes and FORDA's RPI

	CRP6 components and key research themes	FORDA'S Integrated Research Plan (RPI)
1	**Enhance the contribution of forests, trees and agroforestry to production and incomes of forest-dependent communities and smallholders** Key research themes: 1. Enhancing management and production of forest, tree and agroforestry products by smallholders 2. Increasing income generation and market integration for smallholders through forest and agroforestry products 3. Improving policy and institutions to enhance assets and to secure rights for forest-, tree- and agroforestry-dependent communities	**RPI 6**. Management of construction wood plantation forest **RPI 7**. Management of pulpwood plantation forest; and **RPI 8**. Management of fuelwood plantation forest—particularly for research aspects related to agroforestry development in human-made forests. **RPI 12**. Management of non-timber forest products for food, energy and medicine (FEM NTFP) **RPI 13**. Management of non-FEM NTFP
2	**Conserve biodiversity, including tree genetic diversity, through sustainable management and conservation of forests and trees** Key research themes: 1. Understanding threats to tree species and their genetic resources (inter- and intraspecific) 2. Formulating effective and efficient conservation strategies for forest and tree resources 3. Improving access to high-quality germplasm and facilitating use of tree genetic resources 4. Conservation through sustainable management and use of forest and tree resources	**RPI 10**. Conservation of forest flora, fauna and microorganisms **RPI 11.** Model of ecosystem-based management of conservation areas
3	**Maintain or enhance environmental services from forests, trees and agroforestry in multifunctional and dynamic landscapes** Key research themes: 1. Understanding drivers of forest transition as a prerequisite for their management 2. Securing environmental services and conservation outcomes while addressing livelihood deficits 3. Response options for adaptive management and governance of landscape mosaics with sustainable forests	**RPI 1**. Management of watershed-based forest landscapes **RPI 14**. Management of upstream, cross-district and cross-province watersheds **RPI 15**. Management of land and water resources within a water catchment area **RPI 2**. Urban forest development
4	**Reduce emissions of greenhouse gases and enhance carbon stocks through better management of forest- and tree-based sources and increase local and societal resilience through forest-, tree- and agroforestry-based adaptation measures** Key research themes:	**RPI 16**. Economy and policy of REDD **RPI 17.** Inventory of forestry greenhouse gas emissions **RPI 18**. Bio-ecology and socioeconomic and cultural adaptation to climate change

	CRP6 components and key research themes	FORDA'S Integrated Research Plan (RPI)
	1. Harnessing forests, trees and agroforestry for climate change mitigation 2. Enhancing climate change adaptation through forests, trees and agroforestry 3. Understanding the role of forests, trees and agroforestry in achieving synergies between climate change mitigation and adaptation	
5	**Promote the positive impacts and reduce the negative impacts of global trade and investment as drivers of landscape change affecting forestlands, agroforestry areas, trees and the well-being of local people.** Key research themes: 1. Understanding the impacts and consequences of trade and investment 2. Enhancing responses and policy options to mitigate negative and enhance positive impacts	**RPI 25.** Strengthening the governance of the forest-product industry and trade

Policy and practitioner partners

Policy and practitioner partners are decision-makers engaged in global negotiations, formation of policies and regulations, administration of funding at the government or organization level and oversight of staff managing projects on the ground. They work in government agencies, civil society groups, donor agencies and international conservation and development organizations, as well as in private sector companies. These people, and the organizations they represent, are the primary clients for CRP6 research. The program needs to engage these partners early in research design, produce findings that are relevant to their interests and concerns, and ensure that results and recommendations are formulated so that they can apply them easily and practically.

O'Neil[12] identifies two key characteristics of influential research: (1) explicit and specific intent to influence policy and practice, and (2) direct engagement with the people and organizations with the power and resources to effect change. These result in more immediate and longer-lasting policy influence. Criteria for selecting partners in these areas include their ability to influence or make decisions about policy, development planning and financing.

Knowledge-sharing partners

We also need partners who can facilitate communications to key target audiences, and to students, the media and the general public. Any organization or network that can help disseminate CRP6 research findings can be a knowledge-sharing partner; knowledge-sharing partners thus span a broad range of public and private organizations and development media companies. International research networks (e.g., IUFRO), conservation organizations (e.g., IUCN) and development agencies (e.g., the World Bank) can all mobilize their networks to reach key policy and practitioner communities. Some partners, such as Panos and Inter Press Service, can help us reach the mainstream media. Others, such as RECOFTC, can ensure that research results are incorporated into training curricula for forest-related practitioner communities. Still others, such as CATIE and the University of British Columbia, can

[12] O'Neil, M. 2005. What determines the influence that research has on policy-making? Journal of International Development 17(6): 761–764.

incorporate relevant perspectives and experiences into graduate training in forest-related disciplines. At national and local levels, knowledge-sharing partners (e.g., PILI) can disseminate research results in formats and languages most accessible to local users.

In Table 3.3, we present a matrix of current and prospective partners, sorted by their functional roles and scale of operation. In practice, many organizations may have more than one type of role at more than one scale.

Table 3.3 Illustrative list of potential partners for CRP6

Partner types	Research partners*	Policy and practitioner partners	Knowledge-sharing partners
International partners	CIRAD, IRD, INBAR, CSIRO, IIED, ODI, RRI, Forest Landscape Denmark, Norwegian University of Life Sciences, BOKU (Austria) and other advanced research institutes, University of British Columbia, Bangor University, ASB Partnership for the Tropical Forest Margins, EUFORGEN	FAO, UNEP, RRI, World Bank, UN-REDD, IPCC, FSC, UNFF, UNCCD, UNFCCC, IUCN Forest Landscape Restoration, World Bank Rainforest Alliance, private sector (e.g., Mars, Unilever)	BBC World Service Trust, Panos, Inter Press Service, UN-REDD, IUCN, IUFRO, CTA
Regional level	CATIE, Amazon Initiative, AFORNET, FORNESSA, FARA, ASARECA, PRESA, CORAF, SAARD, STCP, SAFORGEN, APFORGEN, LAFORGEN	AU, COMESA, ADB, AfDB, IADB, ECA, AFF, IFAD, COMIFAC, Asia Forest Partnership, ECOWAS, SADC, EAC, NEPAD-AU, Asia Forest Partnership, WFP	RECOFTC, STCP, CATIE, ANAFE, SAFORGEN, SEANAFE; APFORGEN, LAFORGEN, RIFFEAC, Forum for African Women Educationalists (FAWE), Women Development and Environmental Organization (RWEDO), Friends of Women and Alliance for African Women Initiative (AFAWI)
Country or site level	NARIs, ARIs (where available); relevant local/national research organizations (e.g., CNRA Ivory Coast, IRAD Cameroon, MARD Vietnam, FRIM Malawi, FBD Tanzania, CAAS China, Kunming Institute of Botany, ICAR India, Bogor Agricultural University (Indonesia), IIAM (Mozambique), FRIM (Malaysia), NGOs FORIG (Ghana) IWOKRAMA (Guyana), KEFRI/KARI (Kenya) and Indonesia's Forestry Research and Development Agency (FORDA)	Ministries (environment, forestry, agriculture, energy, water), NARS, FORDA, IFAD, forest- and landscape-dependent community-based organizations, development and environmental NGOs, private sector companies	Colleges and universities, CARE, WorldVision, TechnoServe, local NGOs (e.g., PILI in Indonesia), forest and environmental ministries, Greenbelt Movement (Kenya), Amazon Livelihoods and Environment Network, forestry associations e.g., TAF (Tanzania)

* See the full list of abbreviations at the beginning of the proposal.

3.2.3 Partnership strategy

The impact orientation of CRP6 will guide the strategy for identifying and engaging with partners. The CRP6 strategy has been developed from the evolving strategies of the proponent CGIAR centers, several rounds of consultation with current and potential partners and other experts, and the collective experience of the writing team. The next step will be to engage with relevant partners at the level of components and themes. We will canvass national and international organizations relevant to the issues identified by each component to inform them about the intended program and to learn about their complementary interests, activities and resources, as well as potential benefits from strengthened collaboration with CRP6.

In the past, CGIAR research programs have been effective at engaging research partners, but have been less effective with other types of partners. Special effort will therefore be needed to engage knowledge-sharing, policy and practitioner partners in the early stages of problem definition and research design. The research itself will need to address issues relevant to each of the three partner types at multiple levels. To some extent, this will depend on where a particular research issue falls on the "issues cycle". Some well-established issues will have wide currency, whereas cutting-edge topics will be less popular but potentially important. The program should be open to investigating issues raised by partner organizations that are well placed to spot emerging problems or opportunities.

There will be a number of modalities for engaging partners throughout the CRP6 impact pathways.

- A few partners' contributions to realizing the objectives of CRP6 could grow to be sufficiently large that they will be invited to join in the governance of the overall program, through representation on the Steering Committee. We would expect such partners to bring significant resources to the collaboration.
- A larger group of partners—drawn from across all three types—will participate directly in the conceptualization, design and implementation of CRP6 work, in the context of particular components and/or of cross-cutting themes. These partners will share responsibility for outputs and/or outcomes and will contribute resources, in cash or in kind, to the program. Some of these partners will receive funding through CRP6, and others may bring resources from external sources to the collaboration.
- Additional partners that have shared interests and work in line with the objectives of CRP6 may have considerable influence over the orientation and design of the program. Indeed, research may be oriented specifically to answer questions or address issues raised by these partners, and research sites/contexts may be selected precisely due to the potential for impact embodied in their presence. However, while they may be instrumental in achieving outcomes, they will not share responsibility for outputs. We would expect such partners to be represented on the Science and Stakeholder Advisory Committee.

There are many possible partnership arrangements for conducting the research and outreach. Partners will contribute to: (1) research implementation (design, experimentation, assessments, knowledge generation, testing, validation); (2) scaling-up (extension, collective action, input provision); (3) communications (advocacy, translation, promotion, content production); (4) policy development (policy analysis, policy options, policy reform, policy support); and (5) proof of application (learning by doing research on development processes). Component Implementation Teams may allocate responsibilities by geography, with one partner or one team of partners responsible for all research in a location or country, or by discipline, by type of system, or by any other way that leverages partner strengths. The important point is that partners will be fully engaged in jointly determining objectives early in the research process, and the process will be characterized by open communication, multiple impact pathways and adaptive learning.

3.2.4 Managing partnerships

The proponents have substantial accumulated experience, both positive and negative, with various partnerships and have many lessons to build on. We will follow best-practice principles for good partnerships: effective communication, shared expectations, transparent decision making, due recognition and mutual benefits. Where the partnership includes capacity-building activities, it is crucial that the process of selecting beneficiaries is transparent and competitive. Special attention should be given to partnerships that include organizations from developing countries and that may lack the resources to finance their own participation.

In addition, there is a need and opportunity to consider new kinds of collaboration, such as open access models, and other ways to organize learning and action to make it more attractive for other individuals and organizations (of any of the partner types) to link with CRP6 even without funding. There should be incentives for CRP6 engagement, such as access to information and data, the prestige of involvement in the knowledge-sharing community, capacity-building opportunities and other benefits. With this program, we will take a learning approach to partnerships and investigate successes and constraints in differing partnership models.

3.3 Capacity strengthening

3.3.1 The global capacity gap

Achieving the impacts targeted by CRP6 requires that people and practitioners in research, government, the private sector and civil society are able to work with the multidisciplinary nature of contemporary forestry issues. No longer can forestry issues be handled within a closed “forestry sector”. Many of the most important drivers of deforestation and degradation, including agricultural expansion and infrastructure development, originate outside the forestry sector. Furthermore, global and national forest policymaking is increasingly taking place in climate-related forums, following the recognition of forests as a significant source of global emissions.

In addition, forest management can no longer be restricted within the boundaries of concessions, plantations and protected areas.

Recent estimates suggest that 46% of agricultural land has more than 10% tree cover.[13] This, combined with the importance of biodiversity conservation outside of protected areas, points to the need for new and innovative capacities to manage forests, trees and agroforestry across a range of multifunctional landscapes. Supply chains for timber and non-timber forest products (NTFPs) stretch from remote villages to globalized commodity markets, with potential to enhance or to threaten the livelihoods of vulnerable groups. Conflict among stakeholders over forest land use and benefit-sharing requires that forestry professionals understand governance issues, be sensitive to gender and other equity implications of forest management and have the skills to facilitate negotiated outcomes.

The need for research, policy and management capacity in the forest sciences broadly defined has never been greater. The world needs skilled people and capable institutions to address the complex interactions of policies and markets that influence forest-related resource conservation and livelihoods.

Added to this, there is a massive capacity gap in most developing countries where CRP6 will operate. There are too few trained foresters and agroforestry specialists, much less those with multidisciplinary expertise spanning the biophysical, social, economic and political sciences. There has been a marked reduction in training, education and capacity strengthening in forestry, with declining enrolments, dwindling resources and the closure of some schools.[14] Technical training in forestry in Africa, where the problem is most acute, has almost disappeared since 1999.[15] The existing forestry-related human resource base in some countries has been further eroded by natural attrition and, in some countries, by high rates of morbidity and mortality due to HIV/AIDS and civil conflict.

Some studies point to a global crisis in the professional education of foresters. There has been a general reduction in the number of colleges offering forestry training and a decline in

[13] Zomer, R.J. et al. 2009. Trees on farm: analysis of global extent and geographical patterns of agroforestry. ICRAF Working Paper No. 89. World Agroforestry Centre, Nairobi.

[14] Kleine, M. et al. 2004. Capacity development for sustainable forest management. In: Mery, G. et al. (eds) Forests in the global balance – changing paradigms, 161–172. IUFRO, Vienna; Temu, A. et al. 2005. Forestry education in sub-Saharan Africa and Southeast Asia: trends, myths and realities. FAO Working Paper No. 3. FAO, Rome.

[15] Temu, A.B. et al. 2006. Forestry education, training and professional development. International Forestry Review 8(1): 118–125.

enrolment globally. Capacity is deficient in the biophysical aspects of forest management—tree taxonomy, botany, quantitative or population genetics, ecology and resource inventory—as well as in the social and policy aspects. The renewed appreciation of the global importance of forestry issues now presents an opportunity and a challenge to develop a new generation of forest-related professionals, and build a new type of forestry competence among a much wider target group.

In addition to the erosion of the human resource base, recent studies[16] have shown that forestry institutions are also in need of investment. They are generally far too small and have limited capacity and power to undertake planning and decision making for forest-led development. At the same time, agriculture, energy, water, livestock, wildlife management and other sectors that influence, and are influenced by, the forestry and tree sector have little or no capacity to incorporate forest issues into their research and development agendas. Thus, capacity strengthening at the institutional level will be a special focus of CRP6.

3.3.2 Capacity-strengthening activities in CRP6

Capacity strengthening is a crucial ingredient of the impact orientation of CRP6. Achieving the program's impact goals requires the inclusion of capable individuals and organizations as partners and effective networks of complementary organizations to work with and to multiply efforts. CRP6 will have five primary kinds of activities to achieve its capacity-strengthening objectives.

Capacity assessment. Our first task will be to undertake a survey of capacity needs in the targeted countries and institutions associated with each research component to understand the gaps and to develop appropriate responses. This assessment will be done through a systems perspective, taking into account the broad, interdisciplinary needs of contemporary forest and tree management, and considering the great potential for knowledge sharing and collaboration offered by new communications and information management technologies.

Individual capacity building. Our work in this area will build on the experience of the participating centers and partners in strengthening the capacity of individuals as an integral part of our collaborative research work (see Box 3.5). Hands-on experience, mentoring, graduate student supervision, postdoctoral and visiting-scientist placements, on-the-job training and short courses help build a core of competent and experienced individuals who can then take scientific and leadership roles to advance the livelihoods and environmental conservation agenda (Box 3.6). These people, working together in an organized fashion, create a strong base for effective, well-functioning institutions.

Box 3.5 Forestry research capacity building in the DRC

In 2007, FAO, CIFOR and IITA launched an EC-funded project to rehabilitate the forestry and agricultural research capacity of the Democratic Republic of the Congo (DRC), a nation deeply constrained by the lack of trained local scientists and technicians. CIFOR, which is responsible for the forestry component of this project, is focusing on building capacity in the DRC through formal university training. This has included supporting a master's program on biodiversity and forest management with 37 students already graduated as of 2010, and a further 40 participating in the program during 2010–2013. CIFOR is also supporting a competitive grant program for young PhD students (14 grantees to date, with another 15 planned for 2010–2013). Finally, it is providing specific hands-on training exercises for current scientific and technical staff (four delivered in 2009).

[16] AFF. 2008. Forestry research institutions in Africa. Monograph. A survey report of the African Forest Forum.

Box 3.6 Filling capacity gaps in the management of forest genetic resources

There is a great need for increased capacity in forest resource management in many of the world's poorest countries, but the problem is particularly acute with respect to genetic resources. Most students studying forest management do not receive training in genetics, even though managers and practitioners need basic knowledge of genetic principles, as well as of conservation and management approaches, to maintain and improve the value of forest and tree resources. To alleviate the problem, Bioversity International has developed and tested a series of training modules to be made available online. The modules include case studies based on scientific papers that describe real-life scenarios and pose questions that are encountered in management situations. Data are provided and methods described for solving the problems. The modules include teacher guides and PowerPoint presentations. Each standalone module focuses on a different topic, such as conservation strategies, seed supply chains and trees outside forests. One or more of the modules can be used in short courses, to apply to particular situations and needs. This initiative constitutes a practical method of information transfer from the scientific literature to field application.

Institutional capacity building. For research organizations, the greatest needs are in research planning and management, institutional development, resource mobilization and scientific writing. Many forest research institutions are isolated and have limited facilities. Supporting them to network will enable them to pool human and physical resources with others and achieve more collectively. Working with them as partners to develop and implement joint projects will ensure systematic mentoring at the institutional level.[17] Such support will be complemented by well-targeted training of senior management and scientists. The CRP6 agenda also depends on the capacity of intermediary organizations to engage in the research process and to extend and utilize research results. Intermediary institutions include, *inter alia*, government ministries, civil society organizations (CSOs), NGOs, community-based organizations (CBOs) and a range of private organizations. CRP6 teams will engage with intermediary organizations with the aim of strengthening their capacity to define, manage and use research for development and conservation aims.

Supporting teaching and training organizations. The recruitment and formation of new scientists, technicians and managers depends on a wide range of teaching and training organizations internationally. These include technical schools, universities and training centers, as well as education networks such as ANAFE, SEANAFE, SEARCA and RUFORUM (Box 3.7). There is also a clear need for more and better long-term technical and degree training in forest management and other relevant disciplines (ecology, sociology, socioeconomics and political science). CRP6 participants will also engage with relevant universities and training organizations, which they will support and encourage to collate and incorporate new knowledge into training and education curricula and the development of learning resources. We will also work with other international organizations, such as the FAO, which has previously played a major role in establishing and supporting forestry education in developing countries, and is preparing to re-engage in this role.

[17] Temu, A.B. and Kiyiapi, J. 2008. Restructuring Africa's forestry education. In: Temu, A.B. et al. (eds) New perspectives in forestry education, 47–64. Peer-reviewed papers presented at the First Global Workshop on Forestry Education, September 2007. World Agroforestry Centre, Nairobi.

Box 3.7 Mainstreaming agroforestry into agriculture and natural resources training

In the 1990s, the World Agroforestry Centre initiated an innovative partnership with African and Southeast Asian academia to assist more than 130 colleges and universities in Africa and 85 in Southeast Asia to mainstream agroforestry into their learning systems. The universities established the ANAFE and SEANAFE networks for Africa and Southeast Asia, respectively. Among other activities, the networks used research results generated by the World Agroforestry Centre and its partners to develop learning resources, primarily to build the capacity of trainers and educators. More than 50 manuals were produced in several languages and more than 500 educators were trained. Following this, between 2000 and 2010, more than 100 colleges and universities reviewed their curricula to incorporate agroforestry or establish new agroforestry education programs. In 2007, ANAFE was formally registered as an independent international NGO; SEANAFE followed suit in 2009. Having these networks as partners will greatly enhance the results of capacity building in forestry, tree and agroforestry sciences.

Building and supporting networks among research and intermediary organizations. CRP6 will have a large network of partners playing a variety of roles in the impact pathways associated with each component described below. This dimension is related more to the capacity mobilization aspect. Networking will be facilitated by the common research sites and by the use of modern information technology, knowledge-sharing platforms and active efforts to encourage engagement among various partners at project, component and program levels. This approach will leverage the complementarities between organizations, encourage shared learning and capacity development and increase attention to the forest, tree and agroforestry systems agenda.

Important considerations:

- Special attention will be paid to create opportunities for women and members of youth and marginalized groups to help strengthen the capacity of individuals and their organizations in knowledge generation and utilization.
- Use of sentinel landscapes that represent different geographic, physical and socioeconomic conditions will provide platforms to engage local and international graduate students on comparable research questions and contribute to enhancing research capacity, following the model of CIFOR’s Poverty Environment Network (PEN) project.

3.3.3 Targets for capacity strengthening

Targets for capacity strengthening will include three main groups: forest/agroforestry research communities (e.g., forestry research institutes (FORIs), National Agricultural Research Systems (NARS), universities, colleges, NGOs and private sector); intermediary institutions that seek to capture and implement or communicate research results (e.g., government ministries undertaking extension, development NGOs, religious-based organizations, farmers’ cooperatives, CSOs and networks); and teaching and training institutions. The communications teams of all of these groups will be invited to join and expand the knowledge-sharing community and thereby improve their capacity to communicate research and outcomes to their internal and external audiences.

3.3.4 Impact pathways for capacity-strengthening strategies

Table 3.4 sets out the outputs, outcomes and impacts of capacity-strengthening strategies.

Table 3.4 CRP6 capacity-strengthening outputs, outcomes and impacts

Capacity-strengthening strategies	**Outputs** (direct result of Consortium Board efforts)	**Outcomes** (change in behavior)	**Impact** (long-term effects)
1. Capacity assessment	• Review of capacity formation in selected countries and institutions • Identification of gaps and needs • Strategy to respond through direct CRP6 activities a through partnerships	• Well-focused CRP6 capacity-strengthening activities • More attention and more appropriate focus on capacity needs among other organizations	• Improved capacity to generate and use knowledge for effective use and management of forest and tree systems
2. Individual capacity building	• Increased number of skilled and experienced researchers capable of generating and using knowledge of forest and tree systems • Researchers up to date with current knowledge, tools and methods • Stronger national institutions • Increased focus on issues relevant to CRP6 objectives	• More high-quality research done • More research implemented by developing country scientists to address developing country problems • Increased generation of knowledge and dissemination relevant to forest and tree management, use and conservation • Equitable research partnerships	• Improved management of tree and forest systems resources • Enhanced recognition of developing country scientists and institutions
3. Institutional capacity building	• Collaborative partnerships and support with research organizations • Targeted training of senior management and scientists • Capacity to plan and execute quality research on forests and agroforestry systems • Engagement with intermediary organizations to support their ability to define, manage and use research	• Stronger, more strategic research organizations • More effective and engaged intermediary organizations • Ability to attract research resources • Increased publishing by national research partners • Improved research management • More research and more effective use of research to serve conservation and poverty alleviation	• Ability to attract research resources • Increased publishing by national research partners • Improved research management

Capacity-strengthening strategies	Outputs (direct result of Consortium Board efforts)	Outcomes (change in behavior)	Impact (long-term effects)
4. Supporting teaching and training organizations	• Current, relevant and holistic knowledge incorporated in curricula and learning resources • Updated and relevant learning materials, with local content • Integrative links established between education and research institutions	• Colleges and universities adopt strategies to update and improve learning • Exchange of expertise across disciplines, institutions and between researchers and educators	• Graduates with improved knowledge, skills and attitudes • Increased demand for and employment of graduates
5. Support to networks	• Effective, affordable and fast links and sharing of knowledge among individuals and institutions	• Exchange of forest and tree information is given a high priority • Increased ownership of tree and forest knowledge	• Substantive impact of knowledge to development (knowledge to action) • Enhanced access and use of forest and tree knowledge by disadvantaged sectors

4. Program Support

4.1. Communications and knowledge sharing in CRP6

Knowledge-sharing processes will be essential to achieve the sustained impact targeted by CRP6. Indeed, at least part of the reason research outcomes have not translated into impacts in the past has been a failure to communicate and share knowledge—the critical bridge between science and policy.[1] Therefore, in this proposal, we give priority to developing and implementing a knowledge-sharing strategy that will target multiple audiences. We will generate knowledge on our component topics, build the communications capacity of our national partners and widely disseminate lessons learned and results emerging from the components during Year 1 and throughout the life of the program.

However, the knowledge pathways within and outside the program of research described in this proposal will be complex. Target audiences can be viewed as residing within a series of concentric rings, where an item of information at the core is leveraged, packaged and shared as it becomes available and each recipient has multiple pathways to respond and provide input to the source (see Figure 4.1).

CRP6 researchers, managers and partners comprise the audience in the first ring of knowledge sharing; they can share research methods, working data and emerging research results. Occupying the second ring are scientists and development practitioners working on similar topics in a broader community of research and development organizations. In the third ring are Consortium audiences, donors, policymakers and other decision makers that will benefit from the key implications distilled from the emerging research results, offered before projects are officially completed. Information will be shared with the media and general public in the final outer ring to bolster impacts on decision makers. All these groups can become part of the CRP6 knowledge-sharing community.

The proponents of CRP6 seek to ensure that the program's research results are known and used by adopting a comprehensive strategy developed with the communications teams of partners and stakeholders, which bring a wide range of capabilities. In many developing countries, universities, National Agricultural Research Systems (NARS) and NGOs have varying levels of communications programs, both internal and external. Similarly, they differ in their levels of Internet access (high in Latin America and Asia, low in Africa), access to new media tools and training in how to use them. By actively involving these teams in the creation of the strategy, and the subsequent production and sharing of knowledge emerging from CRP6 component research, the CRP6 center information teams will be conducting an additional and critical level of capacity building. This approach will further extend the knowledge-sharing platform into different cultures and contexts and strengthen the impact pathways.

[1] Groffman, P.M. et al. 2010. Restarting the conversation: challenges at the interface between ecology and society. Frontiers in Ecology and the Environment 8(6): 284–291.

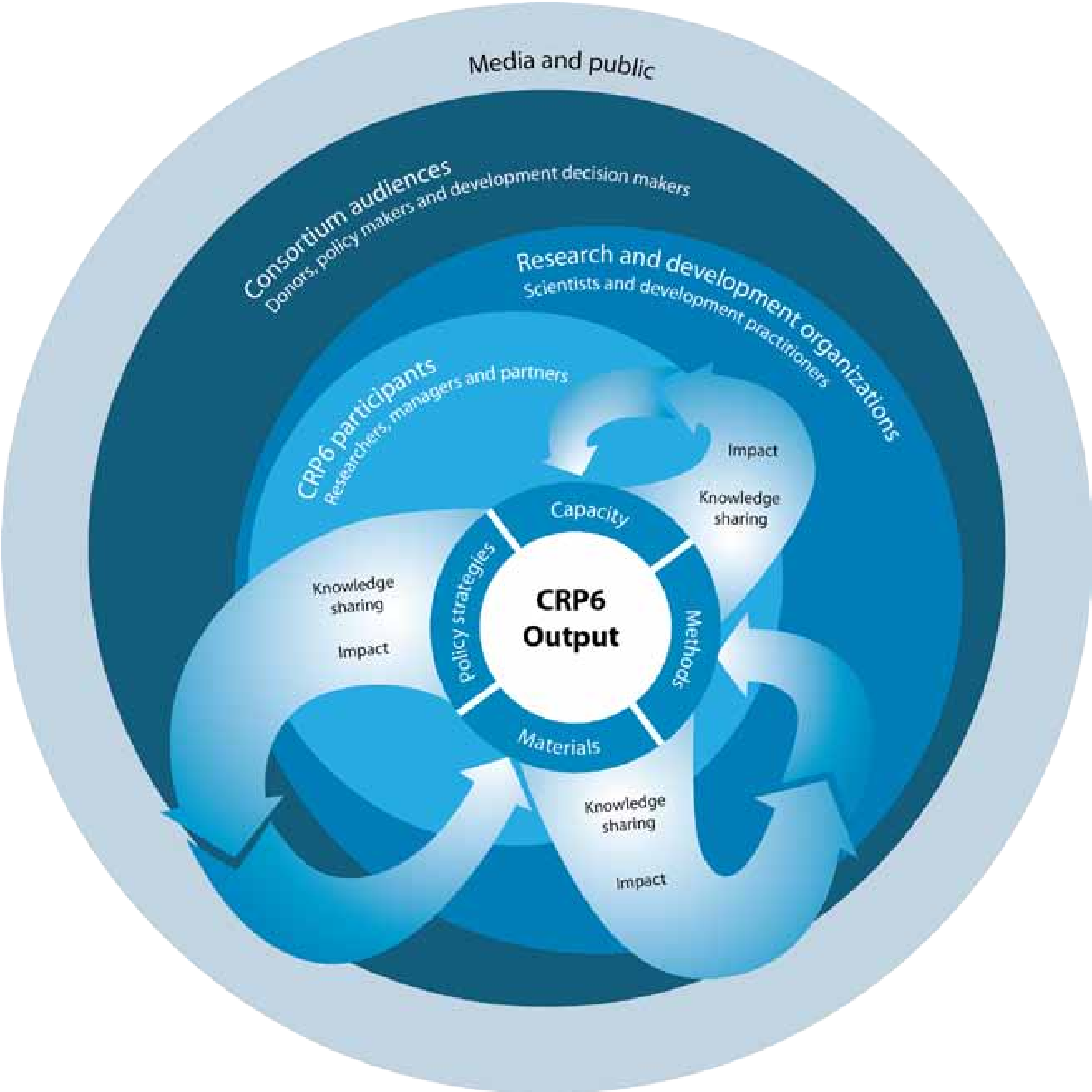

Figure 4.1 Knowledge sharing for impact. The traditional CGIAR communications model has been largely unidirectional and moving outward, similar to the ripples from a stone dropped in a lake. By contrast, the CRP6 knowledge-sharing model operates like a hurricane: swirling, multidirectional, viral and constantly gaining strength as outputs are shared and feedback is received from stakeholders and target audiences. In the same way that warm seas strengthen hurricanes, the force of knowledge sharing increases when there is demand for the information produced.

Source: CIFOR

4.1.1. Scope and approach

We will work to develop a targeted, efficient and cutting-edge system of research knowledge sharing that connects partners and beneficiaries across different cultures, continents and disciplines. We have built knowledge-sharing activities directly into each of the research components described in this proposal. Our approach will be iterative, evolving in response to evaluations and feedback from scientists, stakeholders and partners, and will take advantage of emerging or unforeseen opportunities and technologies.

Our vision is to be providers and custodians of high-value data used to improve the management and governance of our remaining forests and to promote the adoption of agroforestry practices. We will achieve this in an open and transparent manner, allowing data to be retrieved and used effectively and efficiently by a global community striving to meet goals that are aligned with those of the CRP6 and consistent with the aims of publicly funded research.

In addition, we will build a modest level of CRP-wide communications activities to coordinate and implement the overall CRP6 communications strategy, working closely with the center and partner communications staff at the component level. The bulk of the communications effort—content creation, outreach, publishing and dissemination, collaboration with regional partners—will be carried out at the component level.

We will begin by surveying each center's communication and knowledge assets—capabilities, tools, activities, networks, listservs, databases. We will then canvass those of our partners, before aggregating and merging our efforts. Together, we will create a global communications strategy and build the knowledge-sharing platform. To build and expand the knowledge-sharing community, we will collaborate with and leverage the skills and networks of specialized communications and science intermediaries, such as Burness Communications, Inter Press Service, Panos and Green Ink.

4.1.2. The knowledge-sharing opportunity

Agricultural research communications are undergoing a transformation driven by the rapid spread of high-speed Internet access, digital media and the development of new platforms and methodologies. Today, almost 2 billion[2] people can access the Internet, including 110 million in Africa alone. Two-thirds of these people visit social networking or blogging sites.[3] Member communities (such as Facebook friends) have developed on every major continent, especially in developing countries (50% of Internet users in Germany, 80% in Brazil). More than 27 million Indonesians belong to Facebook,[4] a 12,000% increase in 24 months. Between 57% and 64% of journalists who participated in one survey reported using social networking sites to research their stories.[5]

Proven digital media tools, such as academic and issue-based listservs and blogs, can now be combined with more recent innovations, including social media platforms, issue-based online community sites and microblogging, for broader, global reach. At the same time, new packagers and distributors of information—environmental and agricultural news aggregators, specialized development websites and open access portals—can be optimized, targeted and used in tandem with traditional communications models, such as conferences, symposiums and science journalism. CRP6 creates an opportunity to engage all audiences described in the concentric rings model to share knowledge, generate impact, raise awareness and influence

[2] http://www.internetworldstats.com/stats.htm.
[3] Nielsen Company. 2009. Global faces and networked places: a Nielsen report on social networking's new global footprint. The Nielsen Company, New York. http://blog.nielsen.com/nielsenwire/wp-content/uploads/2009/03/nielsen_globalfaces_mar09.pdf.
[4] www.checkfacebook.com (1 September 2010).
[5] Cision Social media and online usage study. http://us.cision.com/news_room/press_releases/2010/2010-1-20_gwu_survey.asp.

policy. Moreover, new ways to monitor outreach efforts (Google analytics, daily news monitoring services, online surveys) allow us to adapt and redirect our efforts to maximize impact and reach.

Enhancing the knowledge-sharing opportunity is the current demand for, and interest in, the research outputs of CRP6. Governments of forest-rich countries around the world are urgently developing strategies for REDD+. They and other stakeholders need information on the methods to ensure the mechanism works on the ground in ways that are effective, efficient and equitable. At the same time, in consumer countries, environmentally sensitive markets for forest products and commodities that avoid deforestation are creating demand for policy options to ensure that emerging trade and development patterns are legal and sustainable. Donors and development agencies are currently developing strategies to improve governance of these processes. Farmers, people who depend on forests, and local communities need to know how they can adapt to climate change and market and political forces beyond their immediate domain. Journalists and NGOs are searching for reliable sources of information on these issues so they can better inform the public and carry out their mandates. These dynamics, combined with the UN's designation of 2011 as International Year of Forests, create a window of opportunity that may not exist five years from now.

Box 4.1 A modern research conference: A marriage of the old and the new

To appreciate the opportunities presented in this section, consider, for example, a research conference.

Traditionally, a limited number of scientists, partners and occasionally local media would come together in, say, Lima, Peru, or Yaoundé, Cameroon, to present and discuss papers that would be later compiled and distributed as proceedings and reports.

Today, such papers can be uploaded to the Internet and used by scientists around the world the same day. Dissemination can be targeted through listservs. Live web streaming, blogging in different languages and podcasts can increase the real-time audience several times over. Dissemination of media advisories during the conference keeps journalists engaged, alerting them to interesting research findings and other developments.

Translating press releases and other material into local languages improves the conference outreach to national media, while dissemination in English and other international languages reaches reporters globally. News aggregators and specialized websites (The Progressive Farmer, Forest Carbon Portal and Earth News Podcasts) further expand the reach. Feedback can be rapidly gathered by monitoring web hits and downloads, as well as through inexpensive news monitoring services (Meltwater News and Google). Online surveys (Survey Monkey) can gather more detailed feedback. All these tools and techniques were used by the Collaborative Partnership on Forests (including CIFOR and the World Agroforestry Centre) at Forest Days 3 and 4 in 2009 and 2010, effectively increasing the audience by four times the 1400 and 1500 participants.

4.1.3. Knowledge pathways

To create knowledge pathways for CRP6, the communications team will develop a consistent schematic for knowledge pathways for all components, with each center continuing to work with specialized contacts and networks in their respective research areas. All the centers have highly developed dissemination channels: listservs and mailing lists of scientists and policymakers; international, regional and local networks of media, NGOs and intergovernmental organizations; and specialized websites and annual conference gatherings through which they present and distribute their work. As described above, the team will first survey the centers to evaluate and aggregate these contacts and channels, and then develop clear targets for each component in collaboration with our non-CGIAR partners.

For example, CIFOR will leverage its knowledge-sharing strategy, platform and experience developed over the past 18 months for its Global Comparative Study on Forests, Climate Change and REDD+. As part of that study, CIFOR has completed country-specific media surveys and profiles, created listservs, mailing lists and media networks, and built an evolving knowledge-sharing platform that circulates traffic from global and regional member communities around a central website (ForestsClimateChange.org). From this portal, scientists can download the most recent publications and papers, review suggested reading lists and join forums. Information is widely shared at side events of international forums (SBSTA, IUFRO and Forest Day). The teams are currently building a joint website in Indonesian with the research and training arms of the Indonesian Ministry of Forestry to further disseminate the project's findings. A database of global carbon stock will soon be uploaded to the site for use by scientists and other members of the community.

Bioversity has developed genetic resources networks such as LAFORGEN, SAFORGEN and APFORGEN, which will also benefit CRP6 communications. For example, LAFORGEN, the Latin American Forest Genetic Resources Network, consists of more than 40 forest genetic experts from 15 countries. Their aim is to demonstrate the benefits of conservation of forest genetic resources and the consequences of their loss, and to communicate with different relevant stakeholders in a way that encourages common understanding.

The World Agroforestry Centre has extensive experience in knowledge sharing and capacity building. For example, its series of narrated slide presentations on domestication of agroforestry trees are open educational resources. These presentations are available for download for use by research scientists, technicians, development specialists, students or anyone else active or interested in this area. Put together, they can support a short course that could enable learners to develop a tree domestication program within the framework of multifunctional agriculture, based on the most appropriate strategy and package of techniques.

CRP6 centers, in collaboration with local partners, can use similar approaches to those detailed above to develop a comprehensive suite of capacity-building materials to transmit research knowledge directly to those who need it most.

The proponents of CRP6 will ensure that mechanisms are in place to manage intellectual assets generated and accessed by research activities, to protect indigenous knowledge and national sovereignty, and to give appropriate recognition to the inventions of both public and private sector entities. The primary knowledge-sharing objective of CRP6 is to make international public goods (IPGs) widely available, while protecting the rights of individuals, communities and nations.

After gathering input from the centers and partners, the CRP6 communications team, consisting of center and partner information services staff, will seek to establish reference levels for audience perceptions and knowledge levels. The team will identify target audiences' knowledge needs and product preferences. Building on these initial activities, the team will, in conjunction with partners, conduct further audience research using interviews and surveys. A report on audience research findings will feed into the strategic planning process.

We will also consult with partners, other CRP communications teams, NGO and practitioner networks and media and information intermediaries in order to establish agreements and processes for sharing knowledge. This work will help the CRP6 knowledge community avoid duplication of knowledge-sharing efforts and greatly expand audience reach and impact.

In Year 1, we will produce a report on the results of audience research (the depth of which will depend on funding levels) as well as a comprehensive knowledge-sharing strategy. In Year 2 and each year thereafter, we will produce an implementation plan for communications activities.

4.1.4. Disseminating research outputs

Articles in peer-reviewed journals. As is the current practice, publishing in peer-reviewed academic journals will be favored as a way of reaching the scholarly community and legitimizing suites of related products. Peer-reviewed publications are important primarily because the peer-review system provides a tested, low-cost means of quality control; furthermore, such publications are an effective means to build on external science by inducing new research. However, as highlighted by the Stripe review:[6]

> peer review can be a straightjacket sometimes, and not all innovative and relevant work fits neatly into leading journals, which are often not receptive to truly path-breaking research. But when authors are highly respected, editors are typically more open to more innovative research; innovation without reputation is difficult to publish.

At the same time, the cost of accessing this information, even electronically, is too high for most developing country scientists. As more commercial publishing companies allow authors to pay to make their papers open access, the independent open access movement is rapidly gaining credence. For example, a service by Informatics dedicated to the promotion of the open access movement for scholarly journals is already publishing 7474 open access journals, 4418 of which are peer reviewed.[7] CRP6 scientists will therefore be publishing in open access journals under a creative commons license to generate IPGs to be shared by partners and collaborators as widely as possible.

CRP6 publications. The Stripe review found that of the 115 research reports self-published between 1983 and 2008 at one CGIAR center, only 22 had ever been cited, and only one had been cited five or more times. The review panel concluded that, apart from policy and information briefs, centers' internal publications offered little added value. These findings support the approach of concentrating information in a centralized web resource, with limited hardcopy production and distribution.

Therefore, the focus of delivery of research findings will be online publishing, combining printed summaries and information briefs that are linked to more in-depth publications available online. Unreviewed manuscripts and unpublishable but valuable material will also be made available on the website. This will reduce costs and increase speed of delivery to users. Seminal research publications and books will still be published in print. Translations will be targeted to the various national and regional audiences for specific research. For example, research on conversion of degraded land to oil palm plantation might be translated into Indonesian for Indonesian audiences.

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[6] CGIAR Science Council. 2009. Stripe review of social sciences in the CGIAR. Science Council Secretariat, Rome.
http://www.sciencecouncil.cgiar.org/fileadmin/user_upload/sciencecouncil/Systemwide_and_Ecoregional_Programs/SSSR_for_web.pdf

[7] http://www.openj-gate.com/Search/QuickSearch.aspx

Conferences. We will share knowledge through conferences, workshops and seminars, using our ongoing participation and leadership in international events within and beyond the forestry community. These include IUFRO's World Congresses, World Agroforestry Congresses, FAO's Committee on Forestry conferences, Forest Days in association with UNFCCC Conferences of the Parties, and the UN's International Year of Forests (IYF) events in 2011. CIFOR and the World Agroforestry Centre will both be actively involved in and committing considerable resources to events tied to IYF.

Regional forums, especially in Africa and Latin America, will also be essential in transmitting knowledge. Our communications strategy will also seek to take part in forest-related events by key partners and policymakers such as meetings of parliamentarians, indigenous peoples and journalists.

Dynamic, interactive website. We will develop a website for information and knowledge sharing, linked to the sites of other organizations and partners, to enable rapid, interactive and dynamic sharing of results and lessons learned, and the development of a demand-driven learning community. Here, "dynamic" means that any knowledge product placed on the website of any knowledge partner organization will also appear on the CRP6 platform, thereby further enabling real-time learning and sharing. Website functions will include collaborative learning tools, social networking and moderated discussions. Users will be able to follow their interests in component research to partner sites and will receive alerts through microblogging (Twitter).

The critical feature of the CRP6 learning community site is that it can be updated rapidly, interactively and dynamically as knowledge evolves. It will also feature tools and materials to support individual and group learning. Equally important is the availability of traffic monitoring tools (Google analytics, CGNET). Such tools allow web administrators and CRP6 management teams to continually learn and adapt to such information as the number of downloads of certain publications, the pages and topics most visited and read, or the geographic spread of visitors.

4.1.5. Data availability and storage

The data that CRP6 project activities generate will form the essential building blocks for eventual impact. Unless the results of project work are easily available to partners, little use will be made of the new knowledge.[8] To promote knowledge sharing, a comprehensive meta-database of primary and secondary research data will be uploaded to the website; thus, in the spirit of generating IPGs, CRP6 scientists and partners can access and apply the knowledge. The data will be made available to external audiences as appropriate and will include research data generated by CRP6 partners undertaking research for project activities.

As well as developing efficient knowledge-sharing mechanisms that will promote the use of data all along the impact chain, CRP6 will establish mechanisms to systematically preserve primary and secondary data sets, including documentation on the data and project, to make them easily retrievable. A primary activity will be thorough archiving of all socioeconomic and biophysical data, georeferenced wherever possible, together with the infrastructure to

[8] Peine, J.D. and Burley, T.E. 2010. The future of geospatial data management: a natural-resource perspective. Geoworld 23(7): 20–23. http://www.geoplace.com/ME2/dirmod.asp?sid=&nm=&type=MultiPublishing&mod=PublishingTitles&mid=13B2F0D0AFA04476A2ACC02ED28A405F&tier=4&id=20097AEA214C4B9CB788E8007358A83B.

electronically store, catalogue, retrieve and back up research data for institutionalized access and disaster recovery. Proper data management procedures, intellectual property rights and systems will be implemented at project and institutional levels to ensure data quality, integrity and preservation.

E-newsletter. An e-newsletter will be disseminated periodically to stakeholders, using CRP6's extensive listserv, which will be regularly updated, refined and expanded.

Media. Policymakers and practitioners are more likely to adopt researcher-generated knowledge that is shared and debated publicly, according to a recent study by Panos,[9] commissioned by the UK Department for International Development (DFID). Thus, traditional media remain central to our communications strategy. We will engage the media through the dissemination of press releases, media advisories and press briefings, highlighting emerging research findings and inviting the media to join the various CRP6 digital communities. Opinion articles on key policy issues will be submitted to top-tier newspapers and other media.

Original multimedia content will be produced to engage with a broader audience, including the production of short or long documentaries and radio broadcasts, in international and local languages. By maximizing web-based searching and keywording of our media materials, we will be able to move our messages through the news aggregators and web-based multimedia channels now forming around environment, agricultural policy and climate change.

4.1.6. Evaluation and response

The CRP6 communications strategy will be overseen and evaluated by a communications group drawn from among the various partners involved. Iterative testing of all aspects of the model by soliciting feedback and responding to the results will ensure continued refinement both of the products themselves and of the partnerships they serve. Assuming funding is available, periodic audits will assess the effectiveness of the communications strategy among both internal and external audiences.

4.1.7. Resources

As highlighted above, most of the costs for CRP6 communications will be budgeted at the component level and implemented by the centers' existing communications teams. The CRP6 budget for communications covers only institutional costs for CRP6-level activities, as explained below. Leveraging the communications budgets of other organizations (e.g., CTA, AgFax, UNEP) will boost resources.

Several categories of costs are associated with CRP6. First, there will be the cost of developing a comprehensive communications and knowledge-sharing strategy that will address the needs of all partners. Integral to that will be base-level studies against which subsequent impact can be assessed; these will require funding for specialized consultants. Fixed costs necessary to build a knowledge-sharing community include the design, development and hosting costs of the core website and knowledge-sharing platform. In Year 1, several formative and regional meetings of CRP6 center and key partner communications professionals will be necessary for the implementation mapping of the knowledge-sharing strategy; we foresee an initial meeting

[9] Carpenter, J. and Yngstrom, I. 2010. Research makes the news: strengthening media engagement with research to influence policy. Panos, London. http://www.panos.org.uk/?lid=32245

of center communications teams, followed by two regional conferences with non-CGIAR partners, to be held alongside component planning meetings.

There will be costs associated with outreach activities to introduce CRP6, such as press conferences, media advisories and NGO forums; such activities will lead to the creation and maintenance of media and partner networks. Support will be required for CRP6 representation at events such as the GCARD (Global Conference on Agricultural Research for Development), among others. There will be a need for content creation for the websites and the media events. Each year, there will be a call to produce, translate and disseminate CRP6-wide publications such as cross-component research reports, annual reports, brochures and e-newsletters.

In Year 2, regional meetings with partners will be necessary to gather feedback and develop annual plans; these will be conducted by the center communications teams in each region. Publishing needs will likely increase in Year 2.

Additional resources will need to be allocated for staff to design, develop and implement the high number of cross-cutting activities. We envisage three CRP6-level communications staff members. First is a Strategic Communications Manager, who will manage the CRP6 communications budget, aggregate and manage the CRP6-level databases (mailing lists, listservs), networks and relationships with communications partners, and oversee the event strategy. This manager will work closely with the Component Implementation Teams (see Section 4.3) and CRP6 center and partner communications teams, which will be responsible for producing and disseminating publications, event management, and content creation for websites, web platforms and media channels. A second staff member will oversee day-to-day management of the CRP6 website and knowledge-sharing platform, and at least one communications support staff member will be needed. These staff could be based in any of the Consortium centers involved in CRP6, or in a partner center.

Finally, additional funding, if made available, could be used to provide for further, deeper outreach and dissemination into key and secondary target countries. For example:

- Publications and media releases could be translated into Spanish, French and other relevant languages (e.g., Portuguese, Indonesian, Chinese).
- Second language sections of the website and Facebook pages that are regionally targeted (Spanish for Latin America, French for francophone Africa) could be created.
- Developing country journalists could be trained in more than one language (as CIFOR has done for REDD+ in Asia, Africa and Latin America).
- General training materials could be produced in multiple languages (as CIFOR has done for REDD+ in Asia, Africa and Latin America).
- Perception surveys and audits by polling agencies could be conducted.
- Outreach at conferences (side events, press conferences and media advisories) or in policy arenas such as parliamentary hearings could be expanded.
- Additional multimedia products could be contracted, produced and disseminated.

4.2. Monitoring and evaluation for impact

4.2.1. Systematic learning

Monitoring, evaluation and impact assessment are essential in the effective management of research as a way to learn, to improve and increase the relevance of the work and to demonstrate the value of the work. The CRP6 program has multiple pathways to impact, as detailed in each component description. It seeks change through the adoption of new technologies by smallholders and through reforms adopted in policy arenas. The research is expected to have an impact by helping to develop technical, institutional and policy innovations to address constraints and realize opportunities directly in the sites and systems where the research is carried out. The lessons learned in those sites and the emerging recommendations can then be applied more broadly. The program will also have impact by (1) influencing the research and development agenda, giving due attention to the needs of all stakeholders; (2) developing new research approaches; (3) networking and coordinating with other actors in the knowledge-to-action process; and (4) helping to strengthen the capacity of developing country institutions to generate and apply knowledge more effectively. In this way, the research produces IPGs as well as providing a national and local context for participating partners.

The program needs to be flexible, adaptive and able to learn from its successes and mistakes. Contemporary evaluation approaches have evolved dramatically from the earlier emphasis on transparency and accountability, toward a much stronger emphasis on learning, decision making and impact.[10] Logical framework analysis (or log-frame), a cause-and-effect model that links inputs, activities, outputs, outcomes and longer-term impact, has been widely used in development projects and in research,[11] including by CGIAR centers. However, logical framework analysis has been criticized on several fronts. It is considered especially unsuited to complex situations where performance depends on a variety of resource inputs, outputs, intermediate outcomes, end outcomes or impacts, and unintended outcomes.[12] Logical framework analysis is also somewhat inflexible in that the design does not allow changes to be accommodated as learning proceeds.

The impact of interventions depends on the behavior of people who respond to many stimuli, not just the policy or project under evaluation.[13] The logical framework analysis approach also contradicts three key discourses that guide much of the new thinking and practice in rural resource management: adaptive management, collaborative resource management and sustainable rural livelihoods.[14] These ideas, and the practice that has developed around them, focus on adaptive behavior, collective learning and interactive decision making, with the overall aim being institutional transformation.

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[10] Segone, M. 2006. New trends in development evaluation. UNICEF/IPEN, Geneva.

[11] Montague, S. 1999. Focusing on inputs, outputs and outcomes. Are the international approaches to performance management so different? Performance Management Network Inc., Ottawa, Canada.

[12] Montague, S. 1999. Focusing on inputs, outputs and outcomes. Are the international approaches to performance management so different? Performance Management Network Inc., Ottawa, Canada; Smutylo, T. 2005. Outcome mapping: a method for tracking behavioural changes in development programs. ILAC Brief No. 7. Institutional Learning and Change (ILAC) Initiative, Consultative Group on International Agricultural Research (CGIAR). http://www.idrc.ca/uploads/user-S/11235064481Brief-FINAL.pdf.

[13] Allen, W.J. 1997. Towards improving the role of evaluation within natural resource management R&D programmes: the case for "learning by doing". Canadian Journal of Development Studies XVIII: 629–643.

[14] Guijt, I. 2008. Seeking surprise: rethinking monitoring for collective learning in rural resource management. PhD dissertation. Department of Communication Science, Wageningen University, The Netherlands.

CRP6 will base its approach on Outcome Mapping developed by the International Development Research Centre (IDRC)[15] and Participatory Impact Pathways Analysis (PIPA),[16] which describe outcomes in terms of logic models and network maps. A narrative describes the steps in the logic model as well as the key risks and assumptions and, finally, explains the overall plausibility of the impact pathway. This approach recognizes the essential roles of other "actors" (as they are called in PIPA) or "boundary partners" (in Outcome Mapping), and deliberately designs tactics to influence partners' actions as an integral part of the impact strategy. An impact pathway describes how the project will develop its research outputs and who outside the project needs to be engaged in the process to achieve the intended outcomes and impact.

The process of developing impact pathways involves partners and stakeholders working together to map how knowledge and research products must scale out and scale up to achieve the development goals. Scaling-out is understood as a horizontal spread of knowledge and technology from user to user and from organization to organization within the same stakeholder groups. Scaling-up involves building a favorable institutional environment for the emerging change process through such mechanisms as positive word of mouth, organized publicity, political lobbying and policy reform. It also requires understanding that other actors, with whom principals often have little influence or contact, require many prerequisite and corequisite results in a wider context.

Constructing an impact pathway at the scale of an individual project might involve an extension agency that could encourage broad adoption, or staff from a donor-funded project working in an area that has related interests and resources for implementation. At the scale of a theme or a component, the research emphasis is more on comparative analysis and learning generic lessons about effective methods, practice and policy. At this scale, key partners include national and international organizations that need the kind of information and analysis the component will produce. Effective communication between the CRP6 team and these partners, and even joint implementation, can dramatically increase the likelihood that the research will be relevant (informing research design) and will be used (facilitating uptake and implementation).

Identifying (and engaging) key partners and describing intended impact pathways helps to focus monitoring, evaluation and impact assessment activities (described below). Each element of the program's work needs to be clear and specific about what results are being sought and what means will be used to achieve them, and then systematically collect information to assess and analyze progress. Well-defined objectives and a clear understanding of, and engagement with, the stakeholders and institutions involved can lead to the identification of transmission channels needed to trigger the results that we seek at different levels and time horizons to reach our ultimate objectives. CRP6 will retain the flexibility to be responsive to specific monitoring, evaluation and impact assessment needs that emerge during the implementation of the research program.

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[15] Smutylo, T. 2001. Crouching impact, hidden attribution: Overcoming threats to learning in development programs. International Development Research Centre, Ottawa, Canada. http://www.idrc.ca/en/ev-26968-201-1-DO_TOPIC.html; Smutylo, T. 2005. Outcome mapping: a method for tracking behavioural changes in development programs. ILAC Brief No. 7. Institutional Learning and Change (ILAC) Initiative, Consultative Group on International Agricultural Research (CGIAR). http://www.idrc.ca/uploads/user-S/11235064481Brief-FINAL.pdf

[16] Douthwaite, B. et al. 2008. Participatory Impact Pathways Analysis: a practical method for project planning and evaluation. boru.pbworks.com/f/PIPA-ILAC-Brief-pre-print.doc; PIPA Wiki. The Participatory Impact Pathways Analysis Wiki. http://impactpathways.pbwiki.com

4.2.2. Monitoring

Monitoring is an ongoing or regular process of tracking progress by and for a project or program as a way to learn, manage and adapt. All CRP6 activities will be monitored. The type and intensity of monitoring will depend on the purpose and scale of the activity. A small project, with relatively few partners, may need only light and relatively informal monitoring to ensure the project is on track and to provide early warning of problems or unanticipated opportunities. Larger and more complex projects and the main program elements (themes, components) will require more formal and systematic monitoring. Three main types of information can be monitored on an ongoing basis: organizational practices, progress toward outcomes, and strategies that are employed to encourage change.[17] Some potential uses for monitoring information include:

- improving performance by feeding learning into management cycles;
- helping the program meet reporting requirements;
- supplying information for planned evaluations;
- informing publicity documents and communications activities;
- learning about a particular partner strategy or practice over time; and
- supporting the learning needs of a partner.[18]

As discussed above, the key is to start with a clear and explicit description of the intended outcomes and of the means by which those outcomes will be achieved. To effectively learn about “strategies that are being employed to encourage change”, the monitoring system must be aligned with component research teams to develop formal research hypotheses about alternative strategies or methods used in achieving outcomes and impacts, and then design and monitor tests of these alternatives. The notion that monitoring is a separate function for a different set of specialists is a construct that actually hinders learning by the larger team.

4.2.3. Evaluation

Evaluation is a process to assess the conceptualization, design, implementation and utility of a project or program. Evaluation is done at different levels and frequencies. For a project manager or lead investigator, informal evaluation is almost a continuous activity based on monitoring information that itself is generated at various frequencies. More formally at a project or program level, it is a periodic activity, for example at mid-term or on completion of a project or other component of work. Evaluation is typically done with strong involvement of the program evaluator or team of evaluators that have not been directly involved in the design and implementation of the project. Teams formed by external and internal staff can enrich learning, with external members injecting new perspectives and ideas from the outside and internal members providing insights on process and context.

Evaluation activities in CRP6 will also be based on the outcome/impact logic discussed above. Evaluators will need to consider the process and the actual impact logic (is it appropriate? is it sound?), as well as assessing program implementation and the actual achievement of outcomes. In practical terms, that means seeking and assessing evidence of engagement by,

[17] Earl, S. et al. 2001. Outcome mapping: building learning and reflection into development programs. International Development Research Centre, Ottawa, Canada.
[18] Adapted from Earl et al. 2001.

and change within, the behavior or actions of the key partners in the impact pathway. Evaluation will consider:[19]

- the design and articulation of the program logic;
- the recording and use of monitoring data;
- cases of positive performance and areas for improvement;
- intended and unexpected results; and
- assessing influence on changes in partners.

4.2.4. Impact assessment

Impact assessment is the measurement or estimation of the quantity and quality of actual changes brought about by a project or program. Impact assessment can be done *ex ante*, to estimate the impact that could be achieved, for example as a way to set priorities, or *ex post*, to help evaluate the effectiveness of a program. In terms of CRP6, the overarching changes sought are sustainable improvements in the use and management of forests and trees and/or the well-being of a large number of forest-dependent communities.

Impact assessment for natural resources management research is notoriously difficult, for many reasons. As discussed above, the impact logic requires actions and changes that are outside the control of any research program. The typical results chain involves inputs (staff, equipment), activities (research and partnerships), outputs (methods, results, peer-reviewed articles and recommendations), outcomes (new technologies adopted, new policies implemented) and impacts (improved environment and livelihoods). The program, including its various partnerships, has a high level of influence on how the work is done, on what research outputs are produced, and on how these outputs are disseminated and used. Published papers have enabled science to "move forward on the collective confidence of previously published work" but with the growth in publishing and the flaws in the Thomson ISI Journal Impact Factor, we need further research into "both the most effective measurement techniques and the most effective uses of these in policy and decision making".[20]

A program can influence outcomes through its partnerships and communications activities. CRP6 recognizes this and actively seeks to engage a broad range of partners to help achieve positive outcomes. However, many other factors also influence outcomes and, ultimately, impacts. All social and environmental change takes place in dynamic environments with multiple variables that affect what actually happens. Any effort to attribute impacts to particular interventions must be made with caution. As an example, CRP6 will devote substantial resources to research that aims to influence climate change-related negotiations and policy development (c.f. Component 4). However, this is a highly political process, and it is impossible to control or to predict how the process will unfold or even the extent to which evidence-based information will be used. Moreover, CRP6 will have manifold impact pathways, at several scales. The program will help to bring about on-the-ground changes at its research sites through to large-scale changes effected by influencing policy and practice at national and international levels. There will also be multiplier effects through capacity building, methods development and agenda setting.

[19] Adapted from Earl et al. 2001.
[20] Neylon, C. and Wu, S. 2009. Article-level metrics and the evolution of scientific impact. Public Library of Science Biology 7(11): e10000242.

Also complicating efforts to measure is the general lack of counterfactual information. A proper evaluation of the impact of a program must compare the actual situation with the situation that would exist in the absence of the program. At a small (project) scale, it may be possible to use a controlled or quasi-experimental design, but at the scale that CRP6 aims to have impact, counterfactual information can, at best, be estimated only.

For these reasons, CRP6 impact assessment will build on the impact pathway approach. It will monitor and assess outcomes and progress indicators and seek evidence that those outcomes have resulted in impacts.

The program’s use of priority research sites and sentinel sites will allow for more rigorous assessments of environmental, social and governance change. Baseline and subsequent data collection will be used to monitor changes in selected outcome and impact indicators by controlling for potential sample selection biases in evaluating the impacts of program interventions using instrumental variables and double difference methods. This will then be extrapolated to estimate social returns to donor investment and to help inform efforts for targeting, scaling-up and priority setting of proposed future interventions.

To assess how the interventions affect different social groups, data collection and analysis will integrate strong gender and social dimensions. In addition to indicators and designs of treatments, we will track other variables of context and conditions, to understand why and how different expected outcomes and impacts did, or did not, occur. Given the integrated research for development approach of CRP6, unpacking the effects of specific interventions will require attention to the following: (1) careful measurement of interventions/outputs and their combinations; (2) quantitative assessment using relatively large numbers of observations; (3) analysis of process documentation; and (4) qualitative assessments of influences from the perspectives of different stakeholders.

There is a known lack of reliable approaches for evaluating the impact of policy and natural resources management research. The dearth of studies within the CGIAR system itself that address non-marketed environmental benefits and costs of research has been criticized.[21] Recent efforts by SPIA have made good progress,[22] but methods for assessing critical outcomes such as capacity strengthening, institutional development and policy reform require further development and testing. CRP6 will tackle this as a means to improve its own monitoring, evaluation and impact assessment. This then will be another important output of the program.

4.2.5. Managing monitoring, evaluation and impact assessment

Monitoring, evaluation and impact assessment will be a key accountability of the Management Support Unit described in Section 4.3. It will draw on teams of impact scientists from the partner CGIAR centers. The teams will:

- coordinate overall monitoring and evaluation work: establish evaluation priorities and develop a rolling five-year monitoring and evaluation plan.

[21] Lele, U. 2004. The CGIAR at 31: an independent meta-evaluation of the Consultative Group on International Agricultural Research. World Bank, Washington, DC.

[22] SPIA. 2006. State of the art in impact assessment of policy-oriented research in the CGIAR. Mimeo, CGIAR Science Council, Rome; Raitzer, D.A. and Ryan, J.G. 2008. State-of-the-art in impact assessment of policy-oriented international agricultural research. Evidence and Policy 4(1): 5–30.

- support monitoring: engage with component, theme and project teams to support their efforts to align with CRP6 outcome and impact indicators, to develop and articulate impact pathways using Outcome Mapping, PIPA or other appropriate methods, and to develop and implement monitoring plans.
- conduct evaluations: undertake internal evaluations and support and coordinate external evaluations.
- assess impact: coordinate and undertake impact assessments either in-house or outsourced.
- develop methodologies: work with leading theorists and practitioners to develop effective and efficient monitoring, evaluation and impact assessment methods for natural resources management research, to be used within CRP6 and made available as valuable products of the program.
- support evaluation: identify and support training opportunities to help build monitoring, evaluation and assessment capacity internally and in partner organizations; develop a roster of skilled consultants to provide additional support as needed.

4.2.6. Risk management

The monitoring, evaluation and impact assessment processes described above are all constituent components of a broader risk management strategy. Because research is inherently risky, an important function of CRP6 management will be to identify risk factors, to describe how risks can be anticipated or attenuated, and to outline fallback positions if outputs and outcomes do not materialize as expected (see Table 4.1). Management of CRP6 will include routine mechanisms to identify "non-achievement" and to stop any research approach that is unlikely to yield results (but not too early, in view of uncertainties). Some of the most important breakthroughs in agricultural research took years, even decades, to achieve, whereas others were serendipitous, discovered while aiming for something else. It will therefore be important to evaluate CRP6 on its *actual* achievements, not solely in relation to the outputs originally envisaged.

Table 4.1 Summary of risks facing CRP6

Risk	Risk management
Insufficient funding to match needs and expectations	Funding commitments by donors secured by CGIAR in advance of start of CRP6 Effective fundraising by individual participating centers and through coordination and synergy between participants Early recognition of potential funding shortfalls, and prioritization of activities to minimize risks to accomplishing CRP6 objectives
Partner non-performance in managing program activities, generating sound data, analysis, outreach or financial management	CRP6 Management Support Unit (MSU), assisted by staff in each participating center and partner organization, provides adequate monitoring and evaluation, early detection of problems, and technical and managerial support
Lack of clarity of research boundaries	Carefully articulated research proposal, and annual work plans, agreed to by all partners Steering Committee provides effective oversight of research strategy
Suboptimal coordination of research activities	Steering Committee provides effective oversight of research activities and supports coordinating role of MSU
Difficulty of measuring impact	Achievable targets and impact pathways identified and agreed, and sound methodologies employed at outset of activities to capture data

4.3. Program management

The goals of the management structures and processes proposed will enable the participating CGIAR centers and external partners to accomplish the objectives of CRP6, in line with the CGIAR's Strategic Results Framework (SRF), and in ways that are transparent, effective, efficient and equitable. The structures and processes described below are informed by and largely derived from the document "Principles for Consortium Research Programs Governance and Management, Version 6", with some modifications.

Consistent with the guidelines in that document, the proposed CRP6 approach to governance and management adopts the "single lead center" model. The model, which is as light as possible, builds on existing structures and processes, fosters collective action and operates with clear lines of authority and accountability. We anticipate that the management systems will evolve during the course of program execution as experience is gained and lessons are learned from the operation of CRP6 and other CRPs.

The constituent components of the CRP6 management system will work together to perform the following functions.

Strategic planning and monitoring

- Guide collective priority setting among participating partners on topics, approaches, regions and delivery collaborators.
- Undertake periodic revision of the CRP's overall strategy and approach, including rolling three-year annual planning processes.
- Link closely to the program monitoring and evaluation approaches described elsewhere in this proposal, and adapt accordingly.

Resource mobilization and allocation

- Provide support to the Consortium Secretariat and Consortium Board in resource mobilization for the SRF and the CRP.
- Determine which restricted projects are aligned with the objectives of CRP6 and are eligible for CRP6 endorsement for fundraising purposes, and provide support to partners in securing additional restricted funding.
- Implement transparent and equitable resource allocation processes to fund CRP6 research and outreach.

Management and reporting

- Provide sound administration and legal and fiduciary oversight of the work of CRP6.
- Coordinate CRP6 reporting to the Consortium.
- Ensure all data, information, analyses and evidence are well archived and publicly available.

Coordination and outreach

- Convene and organize CRP6 partner planning meetings, workshops and science congresses.

- Ensure synergy and complementarity of CRP6 work with that of other CRPs.
- Represent the CRP6 partnership at Consortium and related events (e.g., GCARD, Funders Forum).

Some of these functions can be achieved collectively and others will require delegated authority to the single lead center and associated Management Support Unit and to designated “leads” for each component and other CRP-level functions (see below).

4.3.1. CRP6 management structures and functions

The proposed management structures for CRP6 include the following entities:

- Lead center
- Participating CGIAR centers, some of which will lead individual components
- Partner institutions external to CGIAR
- Steering Committee
- Management Support Unit (MSU)
- Scientific and Stakeholder Advisory Committee (SSAC)
- Component Implementation Teams (CITs) coordinated by centers leading individual components

The composition, duties and responsibilities of these entities are described below, and in Figure 4.2. Organizational chart for CRP6.

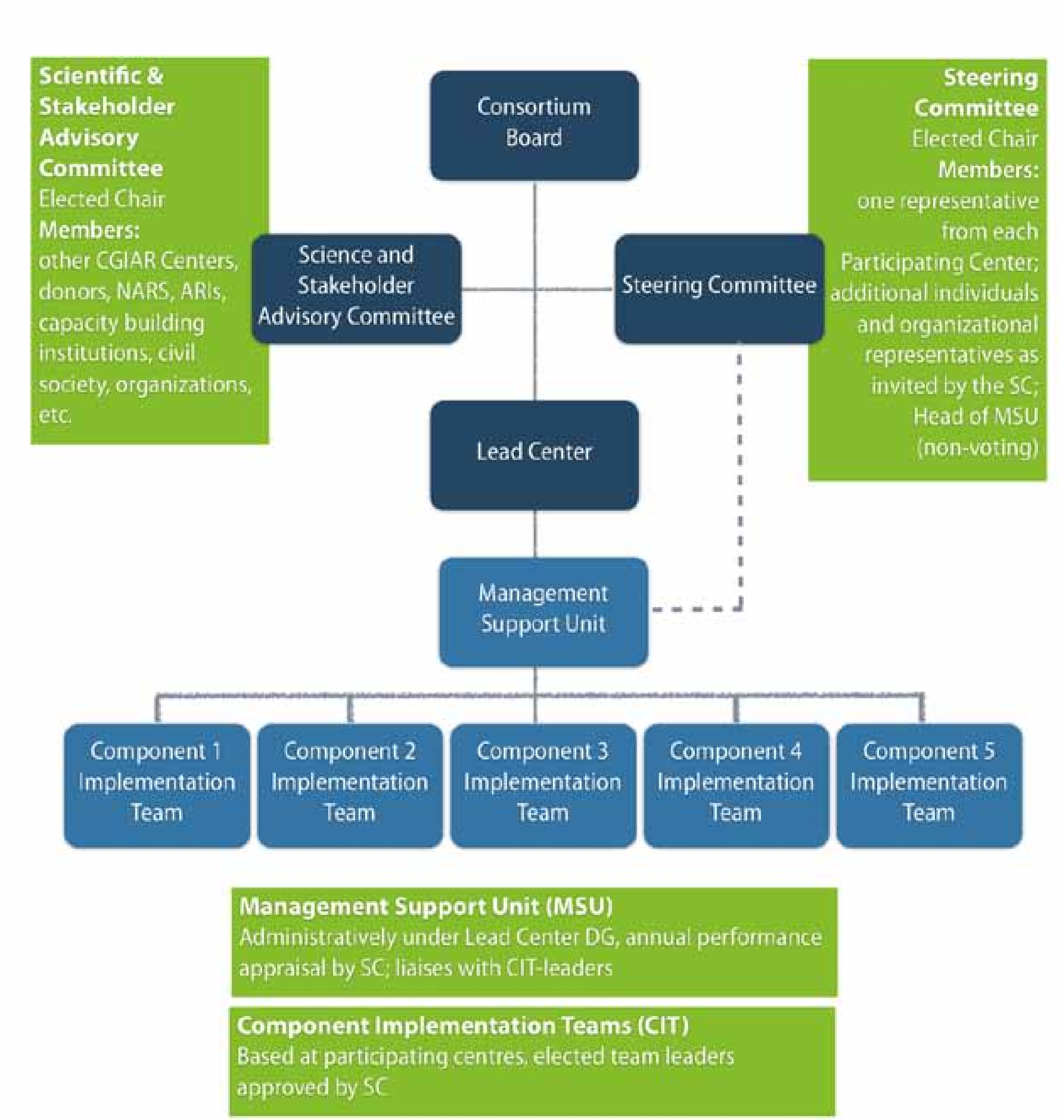


Figure 4.2 Organizational chart for CRP6

Lead Center: A single lead center will be responsible for managing CRP6 and its relations with the Consortium. For the first period of CRP6, the Consortium Board has designated CIFOR as the lead center. The lead center will sign a performance agreement with the Consortium Board and will be responsible for all reporting to the Board. The lead center will establish the binding performance subcontracts for the use of core funds with the center leading each CIT, and with other participating CGIAR centers in CRP6. The centers leading CITs, and the other individual participating centers, will establish binding performance subcontracts with the respective partner institutions. In accordance with legal requirements, CRP6 will be governed by the Board of the lead center, with oversight provided by the Consortium Board. The lead center's Board will have fiduciary and legal responsibility for execution of annual CRP6 performance contracts, as well as for financial, audit, management and reporting practices. It will also be responsible for ensuring CRP6 conforms to the highest international ethical, professional, regulatory and legal standards.

Specifically, the lead center will be:

- responsible and accountable to the Consortium Board and Secretariat for managing CRP6 contractual arrangements with participating centers, for associated fund transfers and reporting, and for performance-linked contractual obligations with respect to its own contribution to CRP6.
- responsible and accountable to other participating centers for facilitating effective management by the CRP6 Management Support Unit (see below), for involving and/or hosting relevant managers and staff from other institutions participating in CRP6, and for liaising with other CRPs to enhance synergy and complementarity of cross-CRP work.
- responsible and accountable to a broad set of stakeholders for convening partners (external and internal) and stakeholders across the scope of CRP6, for providing leadership through processes that are consultative and transparent, for avoiding conflicts of interest, for ensuring that concerns of participating centers and partner institutions are addressed, and for promoting a culture of inclusiveness and openness among centers, other CGIAR entities and external partners in the interest of maximizing CRP6's effectiveness and that of the whole SRF.

Criteria for selecting the lead center for CRP6 are those articulated in "Principles for Consortium Research Programs Governance and Management, Version 6" and subsequently endorsed by the Consortium Board. Given the lead center's asymmetric role with respect to other participating centers, a system of checks and balances will be put in place to contain the risk of unfair monopolization of funds or other resources, as well as undue profile and exclusive representation.

The lead center's performance will be reviewed by the Steering Committee toward the end of the initial three-year period. At that time, and especially in the case of poor performance, consideration will be given to shifting leadership to another center. This will take into account, on the one hand, the potential positive effects of fresh and equitable leadership progression to leverage the multiple strengths of the participating centers, and, on the other hand, the potential disruptive effects of change. A shift in leadership to a new lead center would require the concurrence of the Consortium Board. In case there is a change in the lead center for CRP6, where possible and legal conditions permitting, responsibility for overseeing ongoing contractual obligations will be transferred to the new lead center. In other cases, the previous lead center will fulfill its fiduciary and legal responsibilities until existing contracts can be finished. Contracts entered into by the lead center will include clauses to account for the possibility of such a change.

Participating Centers: CIFOR, the World Agroforestry Centre, Bioversity and CIAT are the main CGIAR centers participating in CRP6 at its inception.[23] The Boards of the participating centers will have fiduciary and legal responsibility for the execution of CRP6 performance subcontracts, as will the lead center's Board for its own CRP6-supported research. This includes abiding by applicable scientific, human resources, financial, auditing, management and reporting standards and practices and timetables. Participating centers are further

[23] IFPRI is contributing a small amount of work in the first year, but has not yet expressed interest in joining CRP6 as a full partner. Other CGIAR centers expressed interest in CRP6 at inception, but dropped out due to the heavy workload of participating in other CRPs. It is likely that the composition of centers contributing to CRP6 will evolve over time.

responsible for ensuring that work conducted with CRP6 funding conforms to the SRF, center/partner policy and the goals of CRP6.

Steering Committee: The Steering Committee's role will be to provide strategic direction to CRP6, and to oversee and review the operations and management of CRP-funded programs. Its membership will include a representative from each of the participating centers, as well as other internal or external individuals or organizational representatives as identified and invited by the Steering Committee, not to exceed eight members. Other organizations, from within or outside the CGIAR, may be invited to join the Steering Committee as voting members if they bring complementary expertise and make annual expenditures toward CRP6 objectives equivalent to or greater than those of the participating CGIAR centers. Participating centers and partner institutions may choose to leave CRP6 and the Steering Committee with six months' notice, providing their fiduciary and reporting obligations are met. Representatives of participating centers will be appointed by center directors general, or their equivalents at non-CGIAR organizations. The Head of the CRP6 Management Support Unit (MSU; see below) is a non-voting member. The Steering Committee will elect its own chair, and will have staff services provided by the MSU. The Steering Committee will meet regularly, no less than twice annually, to review CRP6's progress. This would include one annual meeting to review accomplishments and agree on and approve work plans and budgets for the coming year, and a mid-term meeting to review progress and course correction needs. Steering Committee members are also expected to be active participants in Scientific and Stakeholder Advisory Committee meetings. The MSU will be charged with providing logistics for meetings and preparing the agendas.

The Steering Committee will be responsible for setting scientific direction and the monitoring and evaluation of ongoing research funded through the CRP mechanism. The Steering Committee will approve annual budgets, proposals submitted to the Consortium Board by the lead center for performance contracts, and associated budgets.

The Steering Committee's responsibilities will include the following.

Strategic planning, oversight and monitoring

- Review and approve strategic and annual plans and budgets prepared by the MSU based on inputs provided by the CITs (see below).
- Review CRP6's reporting (by the MSU and participating centers) against work plans, milestones and outcomes.
- Oversee monitoring and evaluation processes for CRP6 consistent with guidelines from the Consortium Board and the Independent Science and Partnership Council (ISPC), and recommend external reviews and course correction where necessary.
- Review CRP6's communications and outreach strategies and planning to ensure effectiveness as well as equity in such areas as media coverage across participating centers.
- Provide the MSU Head with guidance and direction in carrying out its role in developing and updating the CRP6 research strategy, and in the development of annual and rolling three-year work plans.

Ensuring that CRP6 benefits from external input from expert and stakeholder groups

- Review suggestions and recommendations of the SSAC (see below) to ensure they are taken into account as appropriate.
- Incorporate advice and direction from the Consortium Board, Fund Council and ISPC.
- Appoint scientific advisory panels comprising leading international experts in CRP6's areas of research, or using other methods to obtain advice and guidance.

Performance review

- Review the selection of the Head of the MSU by the lead center, and review his or her annual performance, as well as that of the CIT leaders based at other participating centers (see below).
- Review the performance of the CRP6 lead center and recommend changes when justified.
- Review the performance of CRP6 participating centers.
- Establish policies and procedures for membership of new participating centers in CRP6, invite and approve new members of the Steering Committee, as well as removing members.

Resource allocation and design of performance contracts

- Facilitate collective agreement on equitable mechanisms, processes and decision criteria for funding allocations among CRP6 participating centers.
- Recommend the content of performance contracts and associated annual budgets between the Consortium Board and the lead center, and the content of the performance contracts and associated budgets between the lead center and participating centers.
- Members of the Steering Committee will facilitate negotiation and implementation of performance contracts between the lead center and the management of the centers they represent, and may report to their center Boards to ensure that due diligence takes place.
- Budgets and performance contracts will be approved via an annual meeting of the Steering Committee with the directors general of all participating centers.

The Steering Committee will operate by consensus. However, to avoid deadlock, participating centers will agree on a mechanism to make decisions should consensus prove elusive; this will be done no later than the first meeting of the Steering Committee. For example, decisions could be considered final if supported by an agreed percentage of the votes of the membership, with the voting shares apportioned according to the respective members' stakeholdership. It is expected that the lead center will normally defer to the decisions taken by the Steering Committee. Nevertheless, consistent with its legal and fiduciary responsibility, and the tolerance of the lead center's Board for programmatic and financial risk, the lead center may in rare cases challenge a decision taken by the Steering Committee. In cases where irresolvable conflicts exist within the Steering Committee, or between the position of the Steering Committee and that of the lead center, the dispute may be brought to the attention of the Consortium Board for resolution as the final arbiter.

Management Support Unit (MSU): An MSU will be established and based at the lead center. The MSU will put in place and support mechanisms to ensure the quality, relevance and impact of research, and will develop procedures for planning, reporting, impact assessment and monitoring and evaluation of activities, projects and processes spanning CRP6. The MSU will comprise a Head hired by the lead center and a small team of support staff, sized as appropriate to available funding. The MSU, in collaboration with the CIT leaders (see below) will provide the day-to-day operational support to implement CRP6.

The Steering Committee will review candidates for the position of MSU Head and approve the recommendation of the director general of the lead center regarding the appointment and term. The responsibilities of the Head will include (1) providing intellectual leadership to CRP6; (2) building a shared vision for CRP6 objectives among participating centers and other partners; (3) coordinating among the different participating centers; (4) supervising the MSU staff; (5) providing staff support for the Steering Committee and the SSAC; (6) representing CRP6 externally as needed; and (7) exercising decision-making authority for day-to-day operations of CRP6, including sign-off on deliverables and the release of funding.

The MSU, with support from the participating centers and the CITs, will prepare an overall CRP6 annual business plan and individual performance contracts for participating centers and other subcontractors. These performance contracts will specify required inputs, financial disbursements, reporting and other obligations. Rolling annual contracts will adjust future funding, contingent upon performance.

In close cooperation with the Steering Committee and the Scientific and Stakeholder Advisory Group, the MSU will perform the following specific duties.

Planning, monitoring and reporting

- Develop and update the CRP6 research strategy, to be reviewed by the Steering Committee, including the compilation of annual rolling three-year work plans and budgets (e.g., Medium Term Plan equivalents).
- Support the development of annual work plans by all participating centers, which will include participatory monitoring and evaluation.
- Develop performance subcontracts for CRP6 participating centers.
- Provide tracking and oversight of the granting of contracts to other institutions and individuals to accomplish the objectives of CRP6 components.
- Coordinate the annual reporting process by all CRP6 participating centers to the Consortium Board.
- Manage a website with online resources concerning the CRP.
- Submit annual CRP6 documentation and funding requests through the lead center.
- Coordinate external reviews, audits and other studies for CRP6, as requested by the Steering Committee, or as needs are identified.

Scientific renewal

- Coordinate with, and provide technical and administrative support to CRP6 CITs.
- Develop and adopt peer-review mechanisms such that partners and stakeholders can jointly review major results, achievements and process outcomes, and identify new opportunities.
- Organize periodic CRP6 meetings to bring together the best scientists from across the CRP to present results, discuss and exchange research techniques, develop strategies to maximize impacts and build stronger collaborations.

Support to other management system components

- Support, manage and coordinate meetings of the Steering Committee and the SSAC.
- Act on decisions made by the Steering Committee and the recommendations of the SSAC.

Coordination and outreach

- Represent CRP6 at international meetings, maintain donor relations and engage in resource mobilization activities as needed and required.
- Ensure coordination and information flow between the different CRP6 partners, as well as with other CGIAR centers and CRPs.

Component Implementation Teams: CITs will be established for each major component of CRP6. These will comprise the key senior research staff working within each component. A component lead center will be designated for each component by the Steering Committee. A CIT leader will be nominated for the component by the component lead center on the basis of discussions among the senior research staff from all centers working in the component. The nomination will be put to the CIT staff for ratification. The appointment of the CIT leader will then be subject to approval by the Steering Committee. CIT leaders may be based at participating centers, including outside the CGIAR centers, but will also form part of the MSU. These teams will provide component leadership, planning, reporting and implementation functions. These teams will be kept lean to avoid duplicating center functions and bureaucracy, and thus will need the full support of participating centers' administrative structures to work effectively.

The CITs, with support from the MSU, will develop annual work plans for each component, breaking down responsibilities and deliverables by participating center so that these can be incorporated into the individual participating centers' performance contracts.

Scientific and Stakeholder Advisory Committee (SSAC): Recognizing that input from experts and a diverse array of stakeholders is required to capture the range of experience, perspectives and expertise needed to make CRP6 a success, a Scientific and Stakeholder Advisory Committee (SSAC) will be formed. The Steering Committee will identify and invite representatives of key organizations to ensure diversity. The SSAC will advise CRP6 on its research and impact strategies; review scientific quality, achievements and approaches; and make suggestions for improvement or inclusion of additional work. It will further provide advice on partnership and impact strategies, gender and capacity-building issues. The SSAC is expected to meet annually, and as needed and requested, if possible in conjunction with other international meetings and Steering Committee meetings to minimize costs. The SSAC will elect its own chair, and with staff support provided by the CRP6 MSU. Steering Committee members are expected to be active participants in SSAC meetings.

Potential members include representatives from:

- other entities within the CGIAR Consortium
- key donors
- National Agricultural Research Systems (NARS)
- Advanced Research Institutes (ARIs)
- capacity-building organizations
- civil society organizations, especially women's organizations
- representatives from community organizations representing poor forest-dependent communities or local farmers
- international organizations.

4.3.2. Distributed leadership strategy

Although the lead center will accept overall accountability for CRP6 in the performance agreement with the CGIAR Consortium, a principle of CRP6 management will be to promote distributed leadership among the other participating centers and partners across various research components and other elements of the collaboration, such as CRP-level communications.

Accordingly, it is expected that the Steering Committee will designate other participating centers or partners in addition to the lead center as "leads" for one or more elements of the work program described in this proposal. Such leadership could be designated at the component level, the theme level or the level of a cross-cutting element (such as coordination of one or more sentinel landscapes, or management of partnerships with gender-oriented organizations) as described below.

For example, a participating center serving as a "component lead" would be responsible for providing overall (but not exclusive) intellectual leadership to the research agenda for that component, coordinating the roles of other contributing centers and partners and producing component-level output, outcome and impact reporting. A participating center serving as a "component lead" would appoint (subject to nomination and approval processes described above) and host the individual scientist/manager serving as the leader of the CIT. The incremental accountabilities and costs of providing component leadership would be built into the performance contract between the lead center and the center providing component-level leadership.

In some cases, functional leadership might be appropriately located at the theme level, such as when the preponderance of staff capability and partnerships relevant to one or more themes within a component is located at a different participating center or partner from the "component lead". Such functional divisions of labor will be agreed at the component level, subject to endorsement by the Steering Committee.

Other opportunities for distributed leadership include management of overarching (such as communications) or cross-cutting (such as gender research) functions. As with component leadership, a participating center or partner organization accepting leadership over one of these functions would be responsible for coordinating the roles of other participating centers and relevant partners, and would have associated accountabilities and budgets included in its performance contract. In addition, the lead organization would be responsible for ensuring that service-oriented functions are meeting the needs of "clients" in the CITs, and conducting the necessary reporting.

Details of performance contracting for these and other roles shared between the lead center and other participating centers and partners are still being developed at the CGIAR system level as well as within CRP6. In constructing such contracts, we will strive to ensure that, to the extent feasible, responsibility for financial and partnership management functions is aligned with contractual accountabilities. Thus, responsibility for managing a partnership linked to a large number of outputs across a component would be included in the performance contract for the organization serving as the "component lead", whereas responsibility for managing a partnership linked to a cluster of outputs for which another center will be responsible would be included in that center's performance contract.

4.3.3. Management of sentinel landscapes

Assuming that CRP6 attracts sufficient long-term funding commitments to warrant moving ahead on the concept of sentinel landscapes (see Annex 4), an early task of the Steering Committee will be to select among alternative models for managing individual research sites and ensuring the appropriate level of coordination among them. Consistent with the distributed leadership strategy described in Section 4.3.2, such functions would not necessarily be centralized at the lead center nor at any other single participating center or partner organization.

Important objectives to be advanced through the choice of management structure would be to ensure integration and synergy across different components and participating centers, to avoid over-identification of the approach with any single element of the CRP6 research agenda, to ensure an appropriate level of harmonization of methods across the sites without stifling innovative approaches, and to ensure an appropriate level of coordination with other CRPs. Options to be considered include:

- managing sentinel landscapes out of the Management Support Unit;
- managing sentinel landscapes as part of Component 3;
- managing sentinel landscapes on a regional basis, with different participating centers and other partners (such as CATIE) assuming management and coordination responsibilities; and/or
- combining a diversity of management "leads" for individual landscapes with a central coordination function located within a particular component, participating center or partner organization.

These and other models will be considered as part of the organizational workshop on sentinel landscapes to be held in 2011, with subsequent decision making to be at the discretion of the Steering Committee.

4.3.4. Management revision plan

Given the ongoing nature of CGIAR reform, and the need to take on board lessons learned during initial implementation, the proposed structures detailed above will be adopted as an interim management system for CRP6. During Year 3 of implementation, a full review will be undertaken of what has worked and what has not. Based on these results, and informed by experiences in other CRPs, as well as by the ongoing process of CGIAR reform, a revised management structure will be developed and implemented.

5. Budget

5.1. Overview

The proposed total CRP6 budget for 2011–2013 is US$ 232.9 million. (See Annex 8 for the detailed budget). Overall, about 33% of the budget is expected to be funded from unrestricted sources through the CGIAR Fund; 34% of the proposed budget is to be funded from contracted restricted donor projects; and 32% of the budget is expected to be covered through proposals or is a funding gap.

As illustrated in the Table 5.1, the budget includes US$ 220.1 million for research activities associated with the five components. The budget also includes US$12.8 million for activities across the five components:

- US$3.9 million toward integrating gender into the research activities
- US$3.7 million toward the development of sentinel landscapes
- US$2.9 million toward CRP6 coordination
- US$2.4 million for CRP6-level communications

Table 5.1 Main budget components for the first three years of CRP6 (2011-2013)

$ 000

	2011	2012	2013	TOTAL
Component 1	13,386	14,938	16,455	44,780
Component 2	14,265	16,450	18,482	49,197
Component 3	14,686	16,174	17,791	48,651
Component 4	18,408	20,721	22,508	61,637
Component 5	4,761	5,283	5,813	15,857
TOTAL COMPONENTS	**65,506**	**73,565**	**81,049**	**220,121**
Program Co-ordination	824	996	1,071	**2,890**
Gender	830	1,231	1,798	**3,859**
Sentinel Landscapes	300	1,680	1,680	**3,659**
Communications	382	887	1,119	**2,388**
TOTAL CRP6	**67,843**	**78,359**	**86,715**	**232,916**

As illustrated in the Figure 5.1, the budget is provisionally allocated across the four participating centers as follows:, 47% to CIFOR, 41% to the World Agroforestry Centre (ICRAF), 11% to Bioversity and 1% to CIAT.

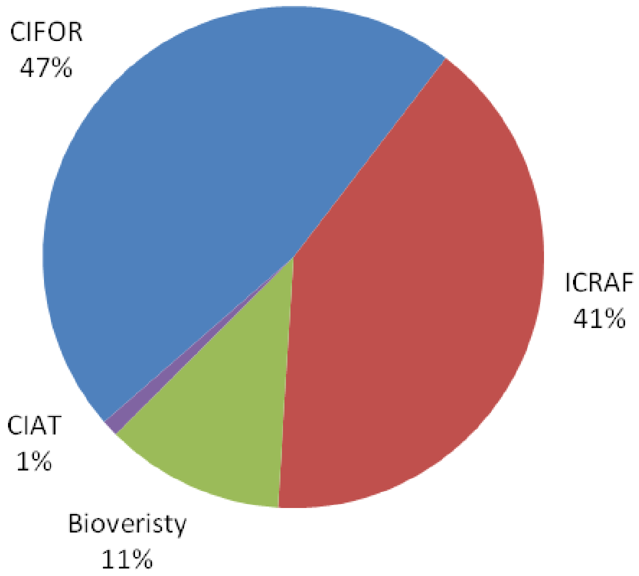
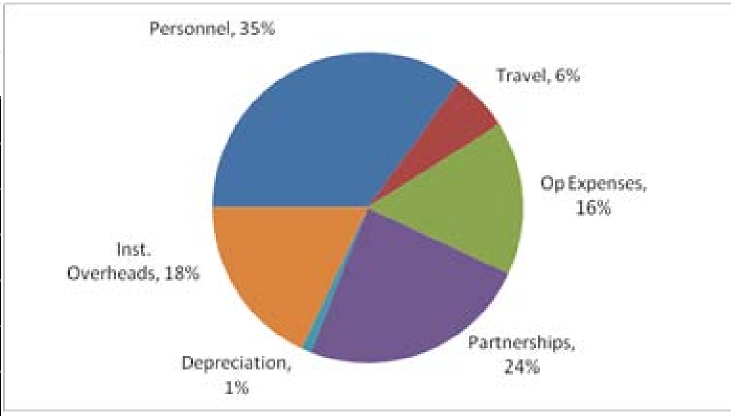


Figure 5.1 CRP6 budget allocation by center

In terms of natural expense classification, the budgetary allocation for CRP6 is as follows:

Natural Classification	$ 000
Personnel	81,521
Travel	13,975
Op Expenses	37,267
Partnerships	55,900
Depreciation	2,329
Inst. Overheads	41,925
TOTAL	**232,916**



The regional distribution of the budget is as depicted in the Figure 5.2:

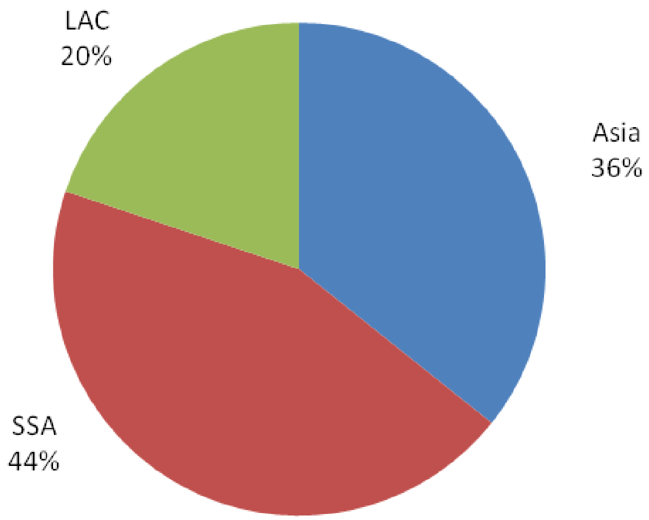


Figure 5.2 Regional distribution of the budget

5.2. Assumptions and basis of projections

5.2.1. Budgets for 2011

2011 will be a transition year. Because the participating centers are already operating against Board-approved budgets in 2011 prior to formal CRP6 approval, the budget for 2011 has been developed based on a “business as usual +” model. Each participating center has attributed the relevant portion of its current research program among the various research components and themes.

The budget assumes that each center will receive at a minimum 2010 levels of unrestricted funding overall, consistent with Consortium Board and Fund Council commitments to stabilization. CRP6-level program coordination and communication costs, as well as the costs of initiating a new network of sentinel landscapes and CRP-level support for gender research, have been budgeted separately based on projected levels of activities and an expectation of additional funds. Funds for these CRP6-level activities would need to be top-sliced from the expected funding from Windows 1 and 2. The implication is that, unless additional funding above and beyond “business as usual” for a 2011 start-up can be provided to defray envisaged CRP6-level costs, the initiation of activities would need to be delayed until 2012, or the level of funding to support research would be lower than required.

To initiate CRP6 activities in 2011, a budget of US$ 67.8 million is envisaged.

$ 000

	CIFOR	ICRAF	BIOVER	CIAT	TOTAL
Component 1	2,980	9,810	379	216	13,386
Component 2	5,765	1,766	6,733	-	14,265
Component 3	3,269	11,417	-	-	14,686
Component 4	14,164	3,806	190	248	18,408
Component 5	4,551	160	-	51	4,761
TOTAL COMPONENTS	**30,729**	**26,960**	**7,302**	**516**	**65,506**
Program Co-ordination					**824**
Gender					**830**
Sentinel Landscapes					**300**
Communications					**382**
TOTAL CRP6					**67,843**

Of this, US$ 23 million is expected from unrestricted funding, US$ 33.5 million from confirmed restricted grant projects and the remaining US$ 11.3 million from proposals including the funding gap. The funding gap for 2011 is estimated at US$ 3.7 million. Restricted grants include current ongoing grant activity.

To maintain center stability, 2011 funds would be allocated based on the relative proportion of budget submissions of participating centers, subject to funding availability. A lower or higher level of CGIAR funding would result in proportional center allocation based on this ratio to minimize shocks or leverage existing work, respectively.

5.2.2 Budgeting for 2012-2013 “Business as usual”

Participating centers submitted their budget proposals for 2012-2013 on the basis of a “business as usual” model. This was based on assumptions of modest growth in center budgets reflected in their CRP6 budgets.

The CRP6 budget for 2012 is US$ 78.3 million and for 2013 is US$ 86.6 million (Figure 5.3).

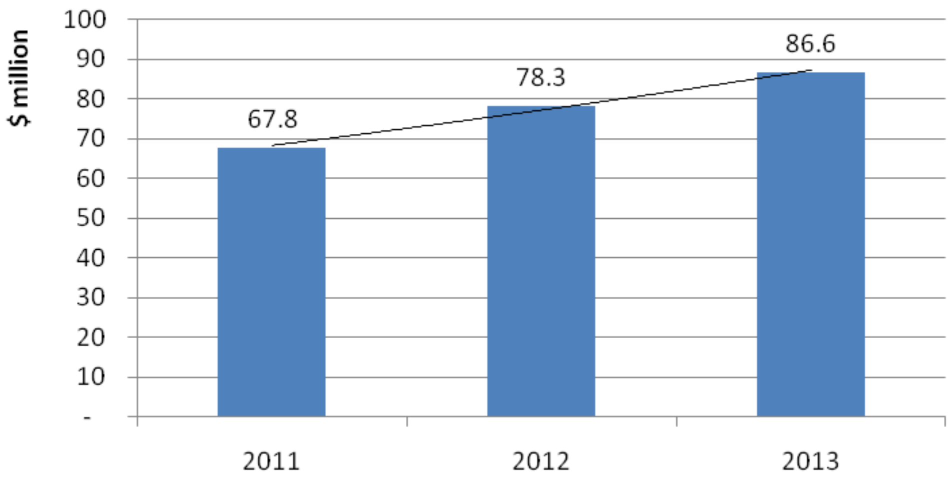


Figure 5.3 CRP6 budget 2011, 2012 and 2013

The budgets for 2012 and 2013 include proposals to the amounts of US$ 23.2 million and US$ 40.6 million, respectively including funding gaps of US$ 14.7 million and US$ 30.8 million, reflecting the uncertain nature of long-term funding to the centers.

5.2.3. Budgeting for 2012-2013: "What it takes"

Although it is expected that detailed 2012-2013 output-based budgeting will be carried out in conjunction with a three-year planning process post-CRP6 approval, for the purposes of this proposal, the participating centers have put together a high-level "what it takes" budget based on an assumed level of effort required to produce the outputs as proposed. The main assumptions include estimates of the number of internationally recruited staff (scientists) needed by each center to work on outputs for the specific component and partnerships and project-related capital needs.

The 2012-2013, “what it takes” budget is US$ 223.4 million, as shown in the Table 5.2.

Table 5.2 “What it takes” budgets for 2012 and 2013

$ 000

	2012	2013	TOTAL
Component 1	24,152	24,887	49,039
Component 2	17,215	22,358	39,573
Component 3	34,835	35,085	69,919
Component 4	18,537	21,373	39,910
Component 5	7,674	7,664	15,337
TOTAL COMPONENTS			**213,779**
Program Co-ordination	649	609	**1,258**
Gender	1,231	1,798	**3,029**
Sentinel Landscapes	1,680	1,680	**3,359**
Communications	887	1,119	**2,006**
TOTAL CRP6			**223,430**

The high-level “what it takes” budgeting process projects a much larger budgetary requirement for the two years and indicates a further gap of US$59 million compared with the “business as usual” budgets (Figure 5.4).

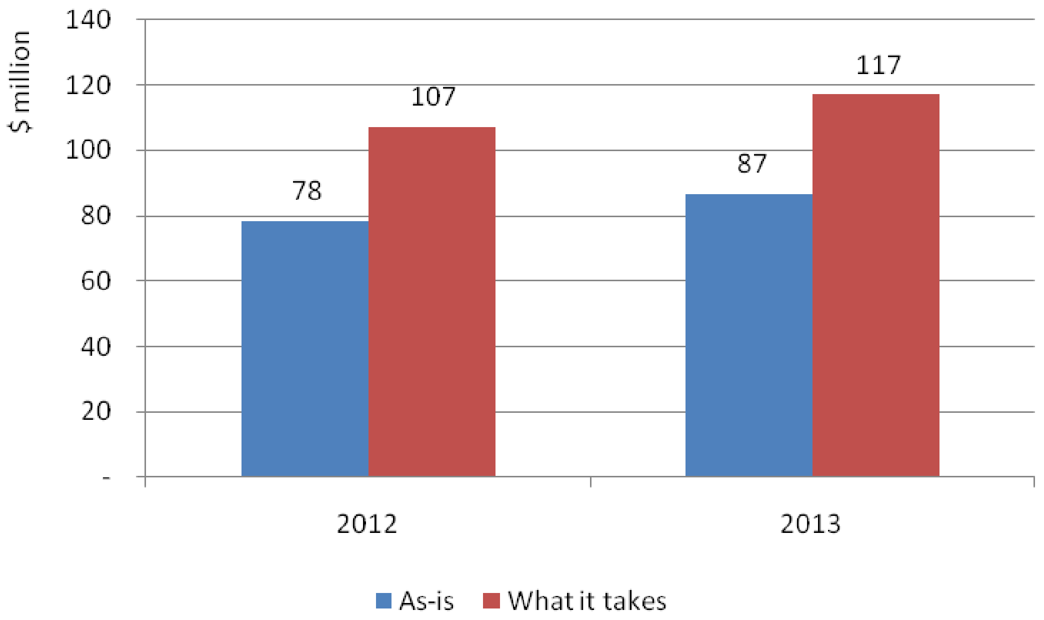


Figure 5.4 Comparison between "business as usual" and "what-it-takes" CRP6 budgets

Capital needs

CRP6-specific capital needs are projected at US$ 2.1 million for 2012 and 2013 combined.

5.3. Composition

5.3.1. Sentinel landscapes

Costs for sentinel landscapes include the design work in 2011 and coordination of data collection and analysis in 2012 and 2013. The proposed budget is US$ 3.7 million, based on costings for the implementation of six sentinel landscapes. If further funds were to be available, the work could be expanded to twelve sentinel landscapes; this would greatly increase the robustness of the research as well as the effectiveness and potential impact as it would enable research to capture more socio-ecological variation around the world. The cost for the second option would be US$ 7.3 million.

5.3.2. Gender

Costs for integrating gender into CRP6 for 2011-2013, are budgeted as US$ 3.9 million. This amount includes the cost of a Senior Scientist and Post Doctoral Fellow in 2011, growing to a five scientist team involving all participating centers by 2013.

5.3.3. CRP-level management and communications

CRP6-level program coordination

CRP6-level program coordination costs include costs for the Steering Committee, Scientific and Stakeholder Advisory Committee, Management Support Unit and CRP Component and Thematic workshops. The cost for Program Management for 2011–2013 is expected to be in the range of US$ 2.9 million.

CRP6-level communications

It is envisaged that communications and knowledge sharing at the macro CRP6-level will be an integral part of the program (in addition to such work integrated into the research components). Various publications, outreach, dissemination, media and related activities and a CRP6 website have been envisaged. The cost for 2011–2013 is expected to be in the range of US$ 2.4 million.

5.4. Resource allocation

As described in the Program Management section of this proposal, an important function of the CRP6 Steering Committee will be to strategically allocate funding made available through Windows 1 and 2 across the various activities of CRP6 as described above.

5.4.1 Procedure

Starting with the 2012 budgeting cycle- beginning in the second quarter of calendar year 2011 in conjunction with the MTP (or equivalent) planning process for CRP6- the Lead Center will facilitate a transparent and inclusive process for the strategic allocation of funds available for 2012. Coordinated by the Project Management Unit (PMU), the five Component Implementation Teams will submit budget requests associated with projected MTP outputs. The PMU will also coordinate the composition of requested budgets for CRP-level expenditures associated with sentinel landscapes, program coordination and communications. In each case, the proposed allocation of expenditures across participating centers and other partners will be specified, as will a “high” scenario describing what could be done with additional resources.

These requests will be presented to and considered by the CRP6 Steering Committee no later than September 2011, so that centers can incorporate Steering Committee guidance into their 2012 budget submissions to their Boards. Such guidance may have to be provisional, depending on the degree to which the Fund Council is able to make firm financial commitments to CRP6 by that time. This procedure would be repeated annually, with mid-year adjustments as necessary.

In the case of unexpected shortfalls, i.e., less funding is available than is necessary to undertake the activities described in this proposal, the following steps would be taken in the short term:

- the development of sentinel landscapes would be scaled back/postponed commensurate with available resources;

- operating expenses would be reduced through a marginal curb on all activities in each component, for example by reducing the numbers of countries and sites covered under each research component; and
- program coordination and communications expenses would be reduced, for example with fewer staff, fewer in-person meetings and restricted travel and consultancy budgets.

If such shortfalls were expected to persist, Component Implementation Teams would be asked to scale back/postpone lines of research at the theme level, in accordance with the priorities stated in other sections of this proposal, but also further revised during the course of program implementation and development of annual planning instruments.

In the case of windfalls, i.e., greater funding is available to undertake the activities described in this proposal, the CRP6 Steering Committee would strategically allocate funds to one or more of the "high" scenarios proposed in the Component Implementation Team and CRP-level budget requests.

5.4.2 Criteria

The CRP6 Steering Committee will apply the "3E" criteria – effectiveness, efficiency, and equity -- in resource allocation across activities, participating centers, and other partners.

Effectiveness

The first criterion for resource allocation is effectiveness, which is especially relevant for allocating resources across research components and themes. As described in previous sections, all five research components of CRP6 are essential to the success of the overall impact pathways, so even in the event of shortfalls in needed resources, we would expect a minimum level of funding to be maintained across all five.

However, given the often unpredictable pace of research and nature of research results, dynamic partnership opportunities, and other changes and emerging challenges in the external environment, it is likely that the marginal returns to investment across the five components will change over time. The CRP6 Steering Committee will consider the relative merits of alternative investments in the budget requests put forward by the Component Implementation Teams in terms of their potential for impact.

Efficiency

The second criterion for resource allocation is efficiency, which is especially relevant for allocating resources across participating centers and partner organizations. In the near term, funding available through Windows 1 and 2 is likely to total less than the "bilateral" funds raised by participating centers. As a result, an important element of efficiency will be the CRP6 Steering Committee's ability to channel co-finance bilateral funding to align with CRP6 objectives and impact pathways, and to avoid inappropriate subsidization of center projects that are not so aligned.

Another approach used to promote efficiency will be to consider the cost-effectiveness of alternative ways of delivering research and other services. Especially in allocating funds for performing CRP-level functions, the CRP6 Steering Committee will consider such factors as existing capacity, geographic proximity, opportunities for synergy and others that determine the relative cost of managing partnerships and sentinel landscapes, and providing coordination, research support, communications and other services.

Equity

The third criterion for resource allocation is equity, which is also especially relevant for allocating resources across participating centers. Although participation in the CRP6 does not create an entitlement to funding independent of the effectiveness and efficiency considerations mentioned above, all else being equal, the CRP6 Steering Committee will attempt to ensure equitable sharing of available resources across participating centers.

Unless and until significant increases in funding are available through Windows 1 and 2, the CRP6 Steering Committee will not be in a position to allocate a significant portion of such funding to non-CGIAR partners without jeopardizing the viability of participating centers. Accordingly, at least in the near term, resources for new partnerships are expected to be financed in large part through joint fund-raising for additional resources.

Annexes

Annex 1. Descriptions of CGIAR centers

CIFOR, the Center for International Forestry Research, is dedicated to advancing human well-being, environmental conservation and equity through research that enables more informed and equitable decision-making about the use and management of forests in less-developed countries. CIFOR's research and expert analysis helps policymakers and practitioners shape effective policy, improve the management of tropical forests and address the needs and perspectives of people who depend on forests for their livelihoods. CIFOR's multidisciplinary approach considers the underlying drivers of deforestation and degradation, which often lie outside the forestry sector; these include agriculture, infrastructure development, trade and investment policies and weak law enforcement. Headquartered in Bogor, Indonesia, CIFOR has 180 staff posted at offices in Asia, Africa and South America. CIFOR works in more than 30 countries worldwide and partners with some 175 international, regional, national and local organizations.

The **World Agroforestry Centre** is an autonomous, nonprofit research organization whose vision is a rural transformation in the developing world where smallholder households strategically increase their use of trees in agricultural landscapes to improve their food security, nutrition, income, health, shelter, energy resources and environmental sustainability. The center generates science-based knowledge about the diverse role that trees play in agricultural landscapes, and uses its research to advance policies and practices that benefit the poor and the environment. Headquartered in Nairobi, Kenya, the World Agroforestry Centre operates six regional offices located in Brazil, India, Indonesia, Kenya, Malawi and Mali, and conducts research in 18 other countries in the developing world.

Bioversity is the world's largest international research organization dedicated solely to the conservation and use of agricultural and forest biodiversity, with a particular focus on genetic resources. Based in Rome, Italy, Bioversity has more than 300 staff working from 16 offices around the world. Bioversity has initiated and collaborates with four regional networks in forest genetic resources, which have identified priority tree species and carried out research leading to the development of guidelines for conserving genetic diversity both *in situ* and *ex situ*, as well as enhancing the benefits of use by harnessing that variation.

CIAT, the International Center for Tropical Agriculture, founded in 1967 and headquartered in Cali, Colombia, conducts socially and environmentally progressive research aimed at reducing hunger and poverty and preserving natural resources. CIAT develops sustainable methods of food production—eco-efficient agriculture—to eradicate hunger and improve livelihoods in the tropics. More than 75 donor agencies and other organizations support CIAT's global staff of 650 people working in crop improvement, agrobiodiversity conservation and natural resources management. Working in partnership with national programs, civil society organizations and the private sector, the center generates a steady stream of international public goods from research and development activities in more than 50 countries. These goods include improved germplasm, technologies, methodologies and knowledge.

Annex 2. Consultation process

The CRP6 development process was designed to be as inclusive of partner and stakeholder input as possible, given budget and time constraints. Several parallel consultation processes were undertaken to maximize opportunity for stakeholder input. These processes included:

1. consultation via email;
2. consultation and outreach at related external events (e.g., international congresses);
3. consultation with participating CRP6 centers and a range of stakeholders at a specially convened workshop.

Consultation via email

A 20-page CRP6 concept note was sent to 328 partners via email on 27 May 2010, and recipients were asked to register their interest in providing comment on the full draft proposal. Of the 328 partners, 73 agreed to provide feedback.

On 14 July 2010, the full CRP6 draft proposal was sent to 171 partners (73 original respondents + 98 additional partners). As of 27 August 2010, 34 respondents had provided more than 55 pages of feedback (full list with comments are available on request). Feedback on specific sections of the proposal was allocated to respective lead authors and their teams to take into consideration and integrate into the proposal where appropriate.

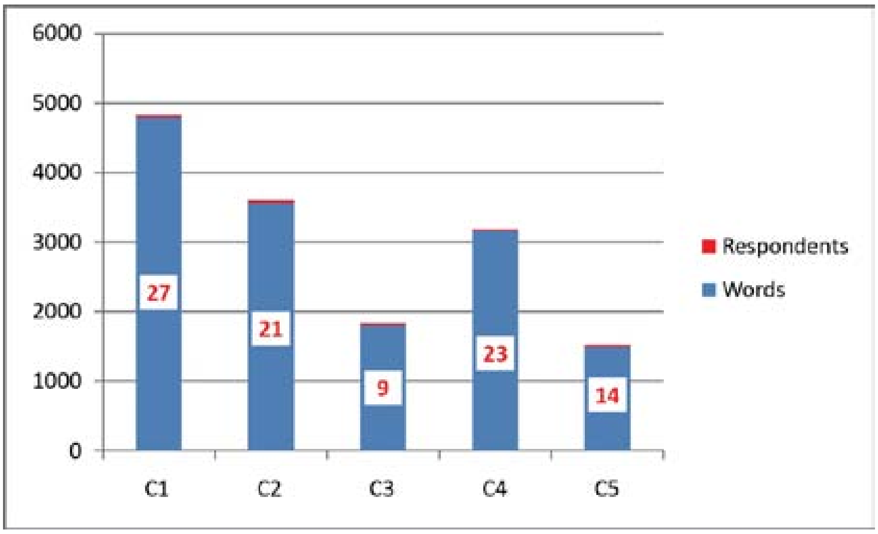


Figure A2.1 Number of words of feedback and number of respondents per component

Consultation and outreach at related external events

To maximize opportunities for stakeholder input, CRP6 outreach and consultation sessions were held at a number of relevant external events. These included:

- 2010 meeting of the Association of Tropical Biology and Conservation in Bali, Indonesia, 19–23 July 2010;
- Forum for Agricultural Research in Africa General Assembly in Ouagadougou, Burkina Faso, 19–24 July 2010;

- The Asia Forest Partnership Meeting and Dialogue 2010 in Bali, Indonesia, 4–6 August 2010;
- 23rd World Congress of the International Union of Forestry Research Organizations in Seoul, Korea, 23–28 August 2010.

In total, more than 50 partners attended the CRP6 sessions held on the sidelines of these events. Feedback from these sessions was combined with the input from email respondents and allocated to respective lead authors and their teams to take into consideration and integrate into revised versions of the proposal where appropriate.

Consultation with participating CRP6 centers and a range of stakeholders at a specially convened workshop

Staff from the four CGIAR centers participating in CRP6 and 26 partners from a range of research, policy and practitioner and knowledge-sharing partners from Africa, Asia and Latin America met at World Agroforestry Centre headquarters in Nairobi on 9–11 August 2010 to review the draft proposal and provide strategic direction to key elements such as the conceptual framework, partnerships strategy and impact pathways. The workshop was facilitated by Mr. Jurgen Hagmann. A report on meeting outputs is available on request.

Consultation with the Indonesian Ministry of Forestry's Forestry Research and Development Agency (FORDA)

On 1 September 2010, CIFOR and World Agroforestry Centre staff participated in a seminar with senior FORDA officials, including Mr. Tachrir Fathoni, the FORDA Director General, to explore potential synergies between FORDA's Integrated Research Plan (RPI) and CRP6. A number of research topics shared by FORDA's RPI and the CRP6 were identified, and the integration of FORDA's prospective long-term research sites into the CRP6 sentinel landscapes strategy was proposed. Participants in the meeting agreed to further explore partnership modalities during the CRP6 inception phase.

Consultation following receipt of comments from the CGIAR Consortium Board

On 24 December 2010, the CGIAR Consortium Board submitted its comments on the 6 September 2010 version of the CRP6 proposal, in addition to comments from four anonymous reviewers, to the CRP6 drafting team. During the week of 19–25 January 2011, these comments, along with sections of the CRP6 proposal that were revised in response to the comments, were shared with more than 100 organizations and individuals. This group had either previously provided written comment on the July 2010 version of the CRP6 proposal, attended a consultation session or provided a letter of endorsement. In total, 18 sets of responses were received from this round of consultation, and were addressed in the 7 February 2011 version of the proposal as far as possible given timing constraints.

Consolidated feedback on the draft CRP6 proposal versions of 14 July 2010 and 19 January 2011, summary reports from the Rome and Nairobi workshops, and CGIAR Consortium Board comments and those of four anonymous reviewers are available upon request. Please email cgiarforestsandtrees@cgiar.org for copies.

Annex 3. Linkages with other CRPs

CRP6 will fit strategically into the larger portfolio of CGIAR Research Programs (CRPs) framed by the CGIAR's Strategic Results Framework (SRF). As such, it will be important for CRP6 to establish operating methods to achieve an optimal level of coordination with other CRPs to capture available synergies and minimize inefficient overlaps and transaction costs.

In the table below, we summarize the intersections between CRP6 components and other relevant CRPs that have already been approved or are in development. The following considerations have guided the linkages.

- ***Specification of linkages and mechanisms for coordination are of preliminary necessity.*** Because the SRF and proposals for all but two of the other CRPs remain under development by the CGIAR Consortium, plans for collaboration across CRPs cannot be finalized at this time. Possibilities for co-locating research at "sentinel landscapes" (described in Annex 4) will be explored over the course of the first year of implementation. In addition, a number of "boundary issues" need to be addressed at the level of the Consortium. For instance, the most effective and efficient placement of various tree-crop-related work across CRPs may need attention.

- ***The optimal level of interaction between CRP6 and other CRPs will vary by CRP and over time.*** The Consortium Board and the Fund Council have both recognized the particular importance of coordination between CRP6 and CRP7 on the role of forests, trees and agroforestry in climate change mitigation and adaptation. Intensive interaction between teams of scientists involved in the two CRPs has been ongoing since the inception workshop of CRP7 in May 2010, and will continue. CRP6–CRP7 linkages are treated in greater depth in Section 2.4. The level of intensity of linkages with other CRPs will generally be lower, but could grow over time. For example, a proposal for collaborative research with CRP4 on forests and health has not yet been developed, but could become a priority in subsequent years.

- ***Transaction costs will limit capacity for coordination.*** The potential for coordination across CRPs is governed by transaction costs. Especially during the early years, coordination among centers *within* CRPs will be intensive, with the formation of new inter-center research teams and management mechanisms and associated travel and meeting costs. Given limited staff time and financial resources, it will be necessary, particularly at the beginning, to be selective in committing to participation in the planning processes of other CRPs.

Mechanisms for integration and collaboration	Possible inputs to CRP6 from other CRPs	Potential CRP6 inputs to other CRPs	Collaborative research opportunities
CRP1.1: Integrated Agricultural Production Systems for the Poor and Vulnerable in Dry Areas			
Coordination and planning on an annual basis through contact focal point in each CRP Co-location of intensive research including possible congruence between some CRP6 Sentinel Landscapes (locations tbd) and CRP1.1 Benchmark Sites	CRP6.1 • Holistic diagnostics on desirable characteristics for tree species and agroforestry practices CRP6.3 • Farmer/field-scale research results from benchmark sites • Analysis of land use change, and options, including land degradation and rehabilitation CRP6 – various components • Drylands research on how trees can best integrate with other agroecosystem components (e.g., crops, forage, livestock, fish, soil, water, rangeland, etc.) • Research and coordination on integration of outputs by other CRPs working in drylands in terms of: (i) complementarity; (ii) synergies (build understanding of the full agroecosystem puzzle); (iii) constructive feedback (to help refine/refocus outputs); and (iv) collective/combined impact pathways for more effective, efficient, productive, profitable and sustainable integrated agroecosystems	CRP6.1 • Knowledge and tools for selecting and delivering tree germplasm for integration into production systems tailored to specific socioeconomic and ecological circumstances • Tree-on-farm management options, including for tree species selection and species mixtures CRP6.2 • Management of forests and agricultural lands to address conflict (competing land use demands) and/or optimize synergies (multiple-use management) • Genetic improvement and development of tree crop cultivars to feed into production systems CRP6.3 • Knowledge on benefits from trees, forests, and the goods and services they provide, for landscape-scale governance, zoning and planning CRP6.4 • Knowledge on forest and tree component of climate change mitigation and adaptation in integrated agricultural systems • Knowledge on effects of REDD+ projects on other sectors • Knowledge on role of forest environmental services in adaptation	CRP6.1 • Complementary research focus in dry forest areas (a forest type facing high levels of threat) • Research on tree crops (section, management, marketing, etc.) within larger production systems CRP6.3 • Contribution of trees and forests to livelihoods and environmental services at the landscape scale, as part of farmer mixed production strategies • Interactions between trees, crops, livestock and soil CRP6.4 • Diversification options for livelihoods in forested areas as an adaptation strategy

Mechanisms for integration and collaboration	Possible inputs to CRP6 from other CRPs	Potential CRP6 inputs to other CRPs	Collaborative research opportunities
CRP1.2: Integrated Systems for the Humid Tropics			
Coordination and planning on an annual basis through contact focal point in each CRP Co-location of intensive research sites (CRP6 Sentinel Landscapes and CRP1.2 Action Sites). Current overlap countries and regions include: Central America, Peru, Cameroon, Ghana, Indonesia, Thailand, the Philippines and Vietnam	CRP6.1 • Holistic diagnostics on desirable characteristics for tree species and agroforestry practices • Research on tree systems, mostly systems related, for the humid tropics, including testing research results at specific sites • System-level research on the potential contributions of trees to households, including value-added potential for income, gender dimensions of decision making, and trade-offs • Developing capacity-building tools for system interventions • Coordination and integration of tree crop work done across the CG with other CRPs	CRP6.1 • Knowledge and tools for selecting and delivering tree germplasm for integration into production systems tailored to specific socioeconomic and ecological circumstances • Tree-on-farm management options, including for selecting tree species and mixtures CRP6.2 • Management of forests and agricultural land to address conflict (competing land use demands) and/or optimize synergies (multiple-use management) • Genetic improvement and development of tree crop cultivars to feed into production systems CRP6.3 • Knowledge on benefits that trees, forests and their goods and services provide for landscape-scale governance, zoning and planning CRP6.4 • Knowledge on forest and tree component of climate change mitigation and adaptation in integrated agricultural systems • Knowledge on effects of REDD+ projects on other sectors • Knowledge on role of forest environmental services in adaptation	CRP6.1 • Research on tree crops (section, management, marketing, etc.) within larger production systems CRP6.3 • Analysis of landscape dynamics in the context of agriculture/ranching intensification (including forests, natural capital and environmental services) linked to the “spare or share” debate • Continued research on tropical forest margins (e.g., ASB platform) (with CRP6.4) CRP6.4 • Diversification options for livelihoods in forested areas as an adaptation strategy. • Trade-offs (include C emissions vs. economic performance)

Mechanisms for integration and collaboration	Possible inputs to CRP6 from other CRPs	Potential CRP6 inputs to other CRPs	Collaborative research opportunities
CRP2: Policies, Institutions and Markets to Strengthen Assets and Agricultural Incomes for the Poor			
Coordination and planning on an annual basis through contact focal point Collaboration and/or overlap between sentinel sites for both CRPs to build upon and create new longitudinal panel data sets (e.g., ICRISAT village data sets)	CRP6.1 • Research on agriculture land tenure, collective action and gender • Cross crop studies for eco-certification—potentially including timber and NTFPs • Methods developed for cross-commodity analysis • Market information systems • Local institutional arrangements and policies CRP6.2 • Broader eco-certification schemes (e.g., which could integrate timber and NTFPs from production forests) CRP6.3 • Formulation of policies, institutions and market-based strategies relevant at the landscape scale • Trends and scenarios for poverty, markets and environmental conditions potentially affecting forests, agroforests and trees, and forest-dependent peoples at the landscape scale • Tracking CGIAR's commodity-focused research programs (CRP3.1 to CRP 3.7) to understand impacts: (i) agricultural intensification reducing pressure on forests and trees at the scale of landscapes, versus (ii) leading to increased incentives for deforestation, and non-optimal configurations of landscape elements for forest- and tree-sourced goods and services. CRP6.4 • Influence of policies on people's vulnerability	CRP6.1 • Tree tenure research and collective action for marketing forest products • Eco-certification of timber and NTFPs at scale of farm plots • Land tenure and property rights • Local institutional arrangements and policies CRP6.2 • Improved policies for the management of forests and tree resources, including through eco-certification (e.g., of production forest products) CRP6.3 • Knowledge and tracking of impacts of the CGIAR's commodity-focused research programs (CRP3.1–3.7) at the landscape scale (e.g., promotion of agricultural development that affects forest land cover, and landscape-level change and transformation) • Application of PES schemes at the landscape scale CRP6.4 • Options for integrating forests and adaptation into food security policies CRP6.5 • Trends and likely impacts from international/globalized trade and investment on select forest and agroforestry landscapes • Analysis of trade and other macroeconomic policies on forests and forest enterprises, which are frequently omitted from models	CRP6.3 • Securing tenure and collective action for trees and forest management (clarifying the role of trees and forestlands as assets of the poor) • Building understanding of drivers of land-cover change • Understanding and acting on impact channels for bolstering policy and governance of relevance at the landscape scale CRP6.4 • Interaction between climate and forest policies with other policies and institutions (e.g., agriculture and development policies) CRP6.5 • Integrating and identifying key trade and other policies required for broad-based agricultural growth with trade policies affecting the forest environment, and associated livelihoods • Integrating data on forests and forest enterprises into broader analysis of trade and other macroeconomic policies

Mechanisms for integration and collaboration	Possible inputs to CRP6 from other CRPs	Potential CRP6 inputs to other CRPs	Collaborative research opportunities
	CRP6.5 • Knowledge and tracking of global trends of trade and investment-led pressures on forest and agroforestry landscapes (including land acquisition). • Cross-crop research assessing global consumer demand for eco-certification (taking into account governances of international trade and investment and standards) could integrate timber and NTFPs	• Knowledge on conditions that determine the effectiveness or failure of social responses (taking into account environmental implications) from local communities to global trade and investment	
CRP3.1–3.7: Commodity CGIAR Research Programs			
Coordination and planning on an annual basis through contact focal point in each CRP where needed		CRP6.2 linked to CRP3.7 (Livestock and Fish): • Undertake research and policy work on the use and sustainability of forest wildlife	CRP6.2 linked to CRP3.7 (Livestock and Fish): • Research and policy work to integrate forest wildlife and related freshwater fish resources into broader production systems to benefit the poor and disadvantaged
CRP4: Agriculture, Nutrition and Health			
Coordination and planning on an annual basis through contact focal point in each CRP CRP6 sentinel sites host monitoring and surveillance work on disease emergence and trends	All CRP6 components • Identification of pathogens and assessment of changes in disease transmission and links to others doing (ex-CG) large-scale surveillance of disease emergence. CRP6.1 (also CRP6.2, CRP6.3) • Undertake research and build capacity on/for nutrition and health	CRP6.1 • Research, policy and market research (including tenure and gender) for NTFPs and fruit trees for vitamins and minerals, as well as medicinal trees for disease and disease prevention CRP6.2 • Research on the link between forest products and food security (conservation of the wild relatives of important food, oil, fodder and medicinal resources, bushmeat) CRP6.3 • Research on forest and health issues at the landscape scale linked to the emergence of new diseases in the context of land use change and improper resource management (e.g., the bushmeat–Ebola link)	CRP6.3 • Health and biodiversity links; e.g., disease emergence, prevalence and transmission rates at the landscape scale as related to mosaic configuration CRP6.4 • Links between health and adaptation to climate change in forest-associated communities

Mechanisms for integration and collaboration	Possible inputs to CRP6 from other CRPs	Potential CRP6 inputs to other CRPs	Collaborative research opportunities
CRP5: Water, Land and Ecosystems			
Coordination and planning on an annual basis through contact focal point in each CRP Joint geographies for potential collaboration (e.g., on NRM and PES): CRP6 Sentinel Landscapes Sentinel sites in sub-Saharan Africa under AfSIS (60 × 100 km^2 sites) (coupled with ongoing: probability sampling and monitoring of diachronic land health variables) River basin/watershed-level work in the Mekong and other large river systems CRP5 ecosystem best bets	CRP6.1/6.2 • Targeting methods developed and applied to select where different forest and agroforest germplasm and management options are most likely to have greatest impact and be successful • Research on-farm/*in situ* fruit genetic resources (cultivated and wild) diversity in (i) temperate Central Asia and (ii) tropical South and Southeast Asia CRP6.1/6.3 • Research on pollination (w/FAO), especially regulating services for enhancing pollination and reducing pest and disease damage that (fruit) tree genetic diversity provides to agroecosystems CRP6.3 • Surveillance methods for targeting and monitoring impacts of large-scale interventions on soil functional capacity and land health • Research on the regulating and supporting environmental services that fruit trees provide • Research on environmental services (particularly “blue” water) at the scale of basins and landscape mosaics CRP6.4 • Methods for landscape monitoring of soil carbon stocks	CRP6.1 • Research on desirable tree densities to balance productive and environmentally protective roles of trees • Research on productive capacity of fruit tree diversity CRP6.2 • Research and knowledge on provision of environment services (e.g., from production forests) CRP6.3 • Research and knowledge on provision of environment services, along with potential livelihoods benefits (e.g., from PES) from forests, trees and agroforestry at the landscape scale, particularly water flow buffering role of forests (“green” water) from upper catchments, which modulates hydrological impacts of rainfall • Research and knowledge on socioeconomic and behavioral risk factors for deforestation and land degradation CRP6.4 • Research on climate change effects on hydrological services and potential role of forests and trees in water sector adaptation	CRP6.3 • Joint methods development and implementation of long-term monitoring landscapes/sites for assessing impacts of large-area natural resource management and related policy interventions • Joint meta-analysis of baseline and long-term monitoring data across CGIAR sentinel landscapes/sites for evaluating land and water degradation problems, risk factors and intervention targeting and evaluation • Individual and collaborative research for developing concepts and applications on payments or incentives for environmental services • Research at the scale of river basins or watersheds on water regulating functions and reduction of sediment load valuable to downstream users (e.g., forests, tree cover and rainfall pattern changes and hydrological impacts; water management in stressed basins) along with water usage charges and carbon benefits of more trees (e.g., within Ganges basin). CRP6 to focus on “green” water, CRP5 to focus on “blue” water

Mechanisms for integration and collaboration	Possible inputs to CRP6 from other CRPs	Potential CRP6 inputs to other CRPs	Collaborative research opportunities
CRP7: Agriculture and Climate Change			
See details of CRP6.4 and CRP7 coordination on the Component 4 section of this proposal Coordination and planning on an annual basis through contact focal point in each CRP	See details of the CRP6.4–CRP7 links in the Component 4 section	CRP6.1 • Identification and promotion of tree species for agroforestry of relevance to climate change sequestration and adaptation CRP6.2 • Characterization of useful tree genetic sources, in terms of temperature and moisture stress, of promise for adaptation and mitigation CRP6.3 • Research on the adaptation challenge for long-life organisms (i.e., trees) for sustaining multifunctional landscapes in the face of climate change CRP6.4: See details of the CRP6–CRP7 links in the Component 4 section; including (but not limited to): • data, approaches, tools and methods for adaptation (e.g., vulnerability assessment, impact studies, climate change scenarios) • lessons learned from experiences with mitigation in the forest sector and their applicability to agriculture • integrated approach to adaptation and mitigation in landscapes and policies • impacts of mitigation projects on hydrology, potential role of forests and trees in the adaptation of the water sector to climate change	See details of the CRP6.4–CRP7 links in the Component 4 section

Annex 4. Sentinel landscapes

Introduction

One of most innovative approaches proposed for CRP6 is to invest in the development of a set of "sentinel landscapes". This approach responds to a key recommendation from the 2009 Stripe Review of Social Sciences in the CGIAR[1] commissioned by the CGIAR Science Council to leverage and strengthen the CGIAR's competitive advantage in conducting long-term, comparative research. As envisaged for CRP6, research in sentinel landscapes would generate panel data to support the testing of hypotheses on drivers and impacts of land use change, as well as approaches to mitigate threats and maximize benefits both for environmental resilience and for the poor. Sentinel landscapes would also provide an instrument for integrating research and impact pathways, while building and exploiting potential synergies across all five of the components that comprise CRP6. These components seek to provide a range of benefits, including: increasing understanding of the needs of individual poor families at the level of timber stands or agroforestry farm plots (CRP6.1), generating ecologically sustainable forestry options for communities (CRP6.2), balancing the interests of multiple sectors of society with differing claims on multifunctional landscapes (CRP6.3; e.g., "learning landscapes"), identifying prospects for mitigating and adapting to climate change through forests and trees (CRP6.4) and creating a geographic context in which, for instance, to address the effects of globalized trade and investment on society and the environment (CRP6.5).

Background

The need for long-term research at specific sites first emerged in agroecological sciences where the processes studied were slow and impacts could only be perceived and measured after many years. In Europe, long-term agricultural experiments began in 1843 at the Rothamsted Farms in England. The record for the longest series of continuous observation goes back to the ice cover measurement on Suwa Lake in Japan, which has been conducted since 1443. The idea of "sentinel sites" emerged from the field of epidemiology and has since been extended to other scientific fields, including management of natural resources. For example, in 2009 the University of Minnesota's Ecosystem Health Program, in conjunction with the Smithsonian Institution Global Earth Observatory Network (SIGEO) and STRI's Center for Tropical Forest Science (CTFS)[2] held a workshop called "Long-Term Ecological Monitoring Plots as Sentinel Sites for Emerging Infectious Disease". The Africa Soil Information Service (AfSIS)[3] uses a similar terminology for studying "land health" in Africa.

The first formal long-term ecological research (LTER) sites were implemented in the United States in the 20th century, and today the International Long-term Ecological Research (ILTER)[4] network spans 38 countries, although with poor representation of developing countries. In the social sciences, similar long-term observations have been implemented in

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[1] CGIAR Science Council. 2009. Stripe Review of Social Sciences in the CGIAR. Science Council Secretariat, Rome.
http://www.sciencecouncil.cgiar.org/fileadmin/user_upload/sciencecouncil/Systemwide_and_Ecoregional_Programs/SSSR_for_web.pdf
[2] http://www.ctfs.si.edu/
[3] http://www.africasoils.net/
[4] http://www.sitemaker.umich.edu/ifri/home

many disciplines (medicine, economics, education—generally at national scales and primarily in developed countries). Other comparable initiatives have flourished in developing countries starting in 1975 with the National Household Survey Capability Programme (NHSCP) launched by the United Nations. In 1980, the World Bank initiated the Living Standards Measurement Survey (LSMS), which collected information in more than 30 countries. Between 1987 and 1992, a similar program (Dimensions Sociales de l'Ajustement) assessed the impact of structural adjustment policies imposed on West African countries. With the increased attention given to poverty alleviation at the turn of the century, countless "observatories" or "rural observation posts" were created to document, measure and follow change in socioeconomic conditions at sites with sizes ranging from individual village to small region to country to group of countries.

However, combining long-term ecological research with social science research in a more holistic approach is a relatively recent idea. For instance, the integration of social science into LTER and the proposed change of acronym to LTSER (long-term socio-ecological research) were not formalized until 2005.[5] Expected impacts and interventions associated with climate change provide new urgency and justifications for the integration of ecological and social sciences. Research into people's adaptation to climate change will not be possible without a comprehensive network of LTSER sites.

LTSER sites have been used to monitor the evolution of ecosystems, to measure the impact of market fluctuations and policy interventions, and even to monitor the evolution of political parties. However, where they are most useful is in the monitoring of socio-ecological transitions. Socio-ecological transitions are fundamental changes in the relationship between natural and social systems.[6] They are one result of coevolution that merits special attention. Such transitions are particularly useful in understanding challenges to environmental and social sustainability—clearly burgeoning around the world. Recently, Sachs et al.[7] pleaded for the establishment of a global network to monitor the effects of agriculture on the environment across major ecological and climatic zones. Such a network would involve stakeholders—policymakers, farmers, consumers, corporations, NGOs and research and educational institutions—coming together to develop a set of metrics that quantify the social, economic and environmental outcomes of various land use strategies. A network of monitoring organizations would then collect the appropriate information, and the resultant, freely available data could inform land use management, policy and research priorities.

What are sentinel landscapes?

A sentinel landscape is essentially a site or a network of sites, geographically or issue-bounded, in which a broad range of biophysical, social, economic and political data are monitored, collected with consistent methods and interpreted over the long term. Classically, a long-term monitoring site fulfills three major roles: record, analyze and alert. The first role is documentary (scientific knowledge), where every relevant item of data is recorded and

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[5] Haberl, H. et al. 2006. From LTER to LTSER: conceptualizing the socioeconomic dimension of long-term socioecological research. Ecology and Society 11(2): 13. [online] http://www.ecologyandsociety.org/. vol11/iss2/art13/; Ohl, C. et al. 2010. Long-term socio-ecological research (LTSER) for biodiversity protection: a complex systems approach for the study of dynamic human–nature interactions. Ecological Complexity 7(2): 170–178. doi: 10.1016/j.ecocom.2009.10.002.
[6] Martens, P. and Rotmans, J. 2002. Transitions in a globalising world. Swets and Zeitlinger, Lisse, The Netherlands; Raskin, P. et al. 2002. Great transition: the promise and lure of the times ahead. Stockholm Environment Institute, Boston, USA.
[7] Sachs J. et al. 2010. Monitoring the world's agriculture. Nature 466: 558–560.

tracked. The second role is explanatory, where information collected contributes to building comprehension of various phenomena. This role is closer to an experimental model for the measure of a known or supposed dynamic, such as the impact of a policy or a change in commodity prices on poverty alleviation or forest conservation. In some cases, such data may be more actively used, for instance in adaptive natural resource management. The third role is predictive, typically to inform decision making, through long-term surveillance of thresholds and alert levels.

Baseline data are critical for gauging temporal dynamics as well as the magnitude and character of transitions. Because social and ecological change happen over long periods, it is valuable to explore the past for different sources of data/evidence to detect and discern those transitions. The impacts of successive waves of investment and disinvestment in land use, for example, can be observed only through historical examination. Looking backward is also critical for examining the impact of historical legacies[8] on present-day socio-ecological systems. Examination of such legacies also provides a means to explore the unintended consequences of human action, in environmental and social terms, that generated "surprises" that were not or could not have been foreseen.[9] Historical data combined with present-day and continuing monitoring can be used as an empirical basis for scenario building. This would also provide the means for long-term analysis and provide a solid empirical basis and opportunity for scenario and model validation—ultimately to guide practice, management and policy.[10]

The outputs of a sentinel landscape can include:

- descriptions of a state or process;
- basic data collection (for surveillance);
- understanding of a phenomenon, including causality; and
- experimentation, especially to provide recommendations, suggest interventions and assess their efficiency (e.g., adaptive management).

Researchers at sentinel landscapes can:

- provide information or data to stakeholders for its further use;
- analyze the information recorded;
- use the results of the observation and/or analysis for dissemination or for further intervention; and
- assist decision making by providing indicators and predictive modeling tools.

[8] Foster, D. et al. 2003. The importance of land-use legacies to ecology and conservation. BioScience 53: 77–88; 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.

[9] Holm, P. 2005. Becoming aware of the sea's potential richness. Newsletter of the International Human Dimensions Program on Global Environmental Change (IHDP) 2/2005: 12–13.

[10] Leemans, R. and Costanza, R. 2005. Integrated history and future of people on earth (IHOPE). Newsletter of the International Human Dimensions Program (IHDP) 2/2005: 4–5; Wardell, A.D. and Reenberg, A. 2005. Framing field expansion strategies in the savanna biome: land use and land cover dynamics in and around the Tiogo forest reserve, Burkina Faso. In: Mistry, J. and Berardi, A. (eds) Savannas and dry forests: linking people with nature, 19–52. Ashgate, Aldershot, UK.

Why is there a need for sentinel landscapes?

Long-term data are essential for addressing scientific challenges such as linking biophysical processes to human reactions and understanding the impacts of those reactions on ecosystems. The major justification for sentinel landscapes is the need for a common observation ground where reliable data from the biophysical and social sciences can be tracked in consort and over time so that long-term trends can be detected, and society can make mitigation, adaptation and best-bet choices.

Traditionally, ecologists tended to prefer to study environments that have experienced minimal impact by human activities as a window into “properly” functioning ecosystems. For their part, social scientists have tended to neglect the study of human influence on nature. Ethno-ecologists were the first to work at the interface, but still with a clear preference for studying human societies living in little-disturbed ecosystems such as hunter–gatherers in tropical forest environments. Today, the imperative of sustainability challenges science to embrace new interdisciplinary approaches that cut across traditional disciplinary boundaries. To understand and address land use change, linking local and regional ecologies with changes in the behavior and consumption patterns of their inhabitants has become unavoidable. Society and nature interact on several spatial and temporal scales, a process termed “coevolution” by those who approach it with a long time perspective.[11] The analysis of coevolution needs common observation sites to transcend the boundaries of individual biomes and to encompass landscapes in which users of forests, farmland and water bodies interact.

In both natural and social systems, research has to cope with processes of markedly different velocities occurring at the same place and time. It further has to account for the cyclical or recurrent properties of some processes, and for feedback and nonlinearity.[12] Change, by definition, encompasses time. Changes in ecosystems often happen only slowly and gradually, and as such can only be measured over long periods—sometimes decades or more. Historical perspectives increase our knowledge of the dynamics of forest landscapes and provide a frame of reference to assess contemporary patterns and processes.[13] Similarly, major societal changes are generally slow—indeed, sometimes take generations. The role of education, the impact of sensitization campaigns and the adoption of innovations are often lengthy processes. Similarly, a one-time snapshot assessment of poverty is inadequate, as forest-dependent communities can move both into and out of poverty in the absence of safety nets.

Assessing climate change impacts on forest-dependent communities provides a particularly compelling example of the need for long-term observations. Communities might well be affected by climate change mitigation policies before they can detect the real effects of climate change on their environment. Adaptation to change in different circumstances might take many forms, from major modification of farming systems to outmigration and, as a result, consequences could vary from increased deforestation to reforestation of abandoned agricultural land.

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[11] Norgaard, R.B. 1994. The coevolution of economic and environmental systems and the emergence of unsustainability. In: England, R. (ed.) Evolutionary concepts in contemporary economics, 213–225. University of Michigan Press, Ann Arbor, USA.

[12] Gunderson, L. and Holling, C.S. (eds) 2002. Panarchy: understanding transformations in human and natural systems. Island Press, Washington, DC.

[13] Wardell, D.A. et al. 2003. Historical footprints in contemporary land use systems: forest cover changes in savannah woodlands in the Sudano-Sahelian zone. Global Environmental Change 13: 235–254.

In addition, in the broad context of globalization, this is a time of rapid social and economic transition with major consequences for the environment, as discussed throughout this proposal. The economies of developing countries are increasingly becoming monetized. Even in the remotest rural areas, households have new and increasing needs and wants. Subsistence agriculture has given way to new commodities and to new farming systems. Where land and capital are available, more intensive systems replace former, more biodiversity-friendly systems with considerable impact on the natural environment. Off-farm work has become the main source of income of many households, and processes of deagrarianization have been well documented in, for instance, Southeast Asia.[14] Where off-farm work is not available or insufficient, younger generations opt for circular migration, urbanization or even international migration.[15] Increased urbanization may result in reduced pressure on agricultural lands as city dwellers reinvest in agricultural activities in their villages of origin, with a preference for commodities, such as forestry plantations, that provide good returns and need little daily attention. In rural areas of Africa and Asia, where international migration has become a preferred option, the age distribution of local populations becomes skewed, the labor force is disrupted and the local economy becomes dependent on remittances. Understanding the processes and consequences of these and other factors would clearly benefit from long-term, site-based research.

Last but not least, there is a major need for reliable long-term data especially in developing countries, where basic information is often neither available nor reliable. Despite considerable efforts to improve data collection, budgetary constraints often disrupt the collection of data, impede storage and prevent dissemination. Observations over a long period would serve for internal comparison “before vs. after”, and for external comparisons with other sites (similar or not) where alternative “treatments”—new economic incentives, altered governance arrangements, technical innovations—have been applied. In contrast to traditional ecological research sites (commonly protected environments with minimal anthropogenic impact), the socioeconomic and environmental information provided by researchers to other stakeholders during long-term observation can have a direct influence on decision making, and in turn might affect outcomes. This kind of research is clearly not neutral but dynamic, and provides direct opportunities for the assessment of its impact.

The burdens associated with ecological change now weigh heaviest on developing countries, which could be intensely affected by climate change. To best track and evaluate the impact of these changes on the terrestrial biosphere and its inhabitants, long-term research sites established across dominant biomes and climates, and across dominant social organization and governance types, are ideal. These will provide the means not only to understand change at local levels, but also to help us make broader findings through comparative approaches across social and environmental circumstances and trends. Some long-term studies are already underway (see below), but their number is insufficient to cover the huge diversity of countries and to address the spiraling and increasingly complex stresses.

[14] Rigg, J. and Nattapoolwar, S. 2001. Embracing the global in Thailand: activism and pragmatism in the ear of deagrarianization. World Development 29(6): 945–960.

[15] See, for example: Cordell, D.D. et al. 1996. Hoe and wage. A social history of a circular migration system in West Africa. Westview, Boulder, CO, USA; Gidwani, G. and Sivaramakrishnan, K. 2003. Circular migration and the spaces of cultural assertion. Annals of the Association of American Geographers 93(1): 186–213.

For whom is a network of sentinel landscapes useful?

Longitudinal data collected at sentinel landscapes are potentially useful for a broad range of stakeholders. Ensuring that data are appropriately interpreted and shared is the responsibility of the scientists who designed the research, assisted by specialists (potentially community-based para-technicians) who can fill in for the scientists where the observation post produces routine indicators for a specific use. The stakeholders who are entitled to claim ownership and usufruct of the data include:

- the target population, i.e., the people directly concerned or the rightful owners of the conserved patrimony who, paradoxically, in the past have often not had access to such data, basic or analyzed (one reason why considering such sites as passive "observatories" may not be optimal);
- the designers of the observation post and the collectors of the information;
- the developers of the information who analyze and make data accessible to others and who distribute them to a wider audience; and
- sponsors or authorities that use the information further upstream (e.g., to inform broader policy and practice).

In summary, observation posts in a network of sentinel landscapes would be privileged locations for the collection of long-term data sets and the dissemination of scientific results to benefit farmer groups, NGOs, administrators, development projects, donors, government agencies and the broader scientific community, among others. They would further be excellent locations for fostering dialogue among stakeholders and for addressing contentious issues such as the sustainable exploitation of a disputed natural resource. Last but not least, they would provide excellent locations for assessing the uptake of research results and for overall impact assessment.

Our comparative advantage and existing sites

According to the authors of the Stripe review, the CGIAR appears:

> uniquely positioned to lead an effort focused on long-term monitoring and analysis of rural communities and agro-ecosystems in the developing world if it can establish effective funding and management mechanisms – as should be feasible under a core-funded Mega-Program – and create incentives and funding for the protocol standardization, meta data compilation and results dissemination necessary to create a true international public good from the data collection and analysis efforts.

The proponents of CRP6 have direct experience in deploying biophysical and social science researchers working in teams in the same location over long periods; some of these locations would be candidate sentinel landscapes (see Box A2.1). The ASB benchmark sites[16] and the Malinau Research Forest (Kalimantan),[17] for instance, would likely meet selection criteria developed for socio-ecological observation posts. In addition to interdisciplinary data collection, most of these sites have been active locations for participatory research with local

[16] http://www.asb.cgiar.org/about_us/.
[17] Gunarso, P. et al. (eds) 2007. Managing forest resources in a decentralized environment: lessons learnt from the Malinau research forest, East Kalimantan, Indonesia. CIFOR, Bogor, Indonesia.

communities, capacity building at village and district levels, dissemination of technical information and material, and stakeholder consultation and future scenario building.

Box A2.1 Current long-term landscape-scale sites or networks where CRP6 centers are already working, and which could be candidate sites for a future CRP6 Sentinel Landscape network

- Two World Agroforestry Centre initiatives on "rewards for environmental services" have a network of 10 project sites plus 15 associated sites in which active learning at local level is coupled with the development of replicable diagnostic tools. The number of direct beneficiaries averages 30,000–50,000 people per site. (http://rupes.worldagroforestry.org/# in Asia and http://presa.worldagroforestry.org/ in Africa).
- The Landscape Mosaics Project, a collaborative effort between CIFOR and the World Agroforestry Centre that focuses on changes in how multifunctional landscapes are managed along the forest transition, includes five distinct geographic regions in the following countries: Cameroon, Tanzania, Madagascar, Indonesia and Laos. These sites cover between 620 km^2 and 1750 km^2.[1]
- CIFOR partners in the implementation of IUCN's Livelihoods and Landscapes Strategy (LLS). Working in 25 landscapes representing 11 distinct geographic regions, LLS is a global initiative that examines the rights and access of the rural poor to forest products in the context of the entire landscape in which people and forests interact (www.iucn.org/about/work/programmes/forest/fp_our_work/fp_our_work_initiatives/fp_our_work_ll/).
- The ASB Partnership for Tropical Forest Margins has been able to maintain a long-term research presence in sites in Peru, Cameroon, Indonesia, Philippines and Thailand with opportunities to combine research for and on development (http://www.worldagroforestrycentre.org/af2/node/157).
- CIFOR is a member of the International Model Forestry Network (http://www.imfn.net/). The IMFN is a global community of practice whose members and supporters work toward a common goal: the sustainable management of forest-based landscapes through the Model Forest approach. With 58 sites in 25 countries, Model Forests are based on an approach that combines the social, cultural and economic needs of local communities with the long-term sustainability of large landscapes in which forests are an important feature.
- The DIVERSITAS global network of agrobiodiversity research sites intersects in Jambi (Indonesia) with current CRP6 partners (http://www.diversitas-international.org/index.php?page=cross_agro).
- CIFOR's current network of "learning landscapes" includes the Tapajos region of Brazil, the Tri-National de la Sangha in Central Africa, the Fouta Djallon (Guinea/Sierra Leone), three diverse landscapes in Indonesia and several sites in the Lower Mekong.
- The Malinau Research Forest in East Kalimantan has been the focus of long-term multidisciplinary, multi-institutional research coordinated by CIFOR. It provides a comprehensive baseline data set of biological and socioeconomic significance and would possibly be a suitable "sentinel landscape". (http://www.cifor.cgiar.org/publications/pdf_files/Books/BGunarso0801.pdf)

Reference:
[1] Colfer, C. and Pfund, J.L. (eds). 2010. Collaborative governance of tropical landscapes. Earthscan, London.

How would establishing a network of sentinel landscapes benefit CRP6?

As mentioned above, developing a network of sentinel sites is a key recommendation of the Stripe review:

> The panel strongly recommends renewed emphasis on multidisciplinary social science research on productivity growth by and for the poor, perhaps especially on *ex ante* research prioritization, on long-term, field-based data collection in a range of sentinel sites in order to identify and measure changes in the behavior and well-being of rural peoples, especially the poor.

All five CRP6 components (see descriptions above) will be implemented by multidisciplinary teams researching various elements of the forest transition framework. Using sentinel landscapes for at least a portion of the research under each component would give a strong boost to the integration of research across components and limit the risks of “research silos”. Each multidisciplinary team would monitor the selected sentinel landscapes to observe key ecological, economic and social processes in order to discern changing patterns of resource availability and use, and welfare outcomes within regional-scale ecosystems, market-sheds and populations. Each landscape would support both qualitative and quantitative ecological and social science research using the best current approaches to mixed methods in research design. This framework would promote comparative analysis at multiple scales, from intensive studies specific to a single location to national-, ecoregional- and international-level analysis using large-scale samples (e.g., to support global comparative research). This would allow the generation of high-value international public goods (IPGs) when conducted within a robust conceptual framework and research design.

As highlighted in the Stripe review:

> The resulting data series would feed into research prioritization based on ex ante impact assessment in response to evolving constraints and opportunities in the system, including commodity-specific research prioritization. The sentinel sites would also provide natural locations for careful ex post impact assessment based on longitudinal monitoring and, where appropriate, randomized controlled trials using repeated experimental designs to more convincingly establish the impacts of CGIAR (and other) interventions.

We aim to:

- identify a coherent set of sentinel landscapes for long-term research where existing data sets and partnerships can be used to monitor the impacts of exogenous and endogenous change at the landscape scale; and
- develop and apply field-tested and standardized research protocols to allow global comparative studies of forest transition stages, economic and demographic conditions, and climatic/biophysical determinants of environmental services and livelihood options.

Preliminary criteria and research design features expected of a sentinel landscape network

The network would ideally:

- ensure sufficient standardization of data collection and analysis methods across regions, major habitat types and socioeconomic contexts to ensure comparability and representativeness of results;
- build a research network and convene regular inter-regional meetings to engage in explicitly comparative analysis to identify global patterns;
- feed aggregated information into global-scale analyses and use them to influence the global forestry and agroforestry research and development agendas;
- provide an opportunity to link and collaborate with other long-term research sites being established within other CRPs of the CGIAR.

Following in part Douthwaite et al.,[18] we consider that a network of sentinel landscapes should:

- allow the blending of both "hard" and "soft" science in such a way as to develop technical solutions and processes that work and are adopted at the local level, and then to scale these experiences out and up;
- support the central role of social and experiential learning through a number of tools, including monitoring and evaluation, based on commonly agreed indicators, and modeling future scenarios to support negotiation and decision making;
- allow reasonable access and adequate security to enable long-term research;
- allow scaling-out (spread of innovation or transmission of knowledge within similar stakeholder groups beyond the sentinel landscapes) and scaling-up (institutional expansion from "pilots"/local to decision makers/global);
- offer a good level of "representativeness" of the site/network to permit extrapolation relative to the issues/trends/parameters of interest (e.g., similar forest type, common drivers of change, etc.);
- be subjected to strong and rapid change for some anthropogenic reasons, so that equilibriums resulting from a long history are threatened or brutally ruptured (although having sites distributed across the full range of change pressures would provide useful insights).

The research and monitoring design at such sites should:

- consider from the outset the aggregation, maintenance and dissemination of data;
- allow diachronic (from t_0 to t_n) as well as synchronic (controls/treatments) comparisons;
- blend hard and soft sciences and support the creation of knowledge networks;
- be practical and flexible in considering the key problems to be solved or key trends/changes to be monitored (allow for "surprises"); and
- be simple and start small with a budget fully secured for the minimum necessary time to produce expected results considering "slow" and "fast" variables.
- Sentinel landscapes would also provide natural locations for carefully controlled ex post impact assessment (EPIA). Explicitly integrating ex ante and ex post impact assessment under a single CRP would increase the demand for and uptake of high-quality EPIA research and reorient a system that currently risks overburdening researchers with demands to generate what are too often small-scale, limited-quality, one-off EPIAs that lack external validity, and thus are not effective in generating IPGs.

[18] Douthwaite, B. et al. 2005. Ecoregional research in Africa: learning lessons from IITA's benchmark area approach. Experimental Agriculture 41: 271–298.

Prospective collaborations

The following are among a number of existing networks that are undertaking long-term monitoring. This set provides a pool from which to draw lessons learned, as well as for exploring opportunities for collaboration and synergy with a CRP6 sentinel landscape network.

- The International Long-Term Ecological Research (ILTER) network groups 38 countries with projects focusing on documenting, analyzing and explaining ecological patterns and processes operating over long time spans and broad ecological gradients. In particular, one mission of ILTER is to detect signals of global environmental change. Since 2005, the ILTER network has become a network of LTSER sites, now integrating social sciences.
- The International Forestry Resources and Institutions (IFRI)[19] network is comprised of 12 collaborating research centers (CRCs) located around the globe with a database containing information, collected since 1992, on forest ecology, livelihood, governance arrangements and forest user groups for more than 250 sites in 15 countries.
- The International Model Forest Network (IMFN)[20] is comprised of all member Model Forests in existence or under development around the world. It is organized into regional networks; of which the most relevant for CRP6 include the Ibero-American MFN and the Asia and Africa Model Forest Initiatives.
- The Center for Tropical Forest Science (CTFS) is a global network of forest research plots and scientists dedicated to the study of tropical and temperate forest function and diversity. The multi-institutional network comprises more than 30 forest research plots across the Americas, Africa, Asia and Europe, with a strong focus on tropical regions.
- The Man and the Biosphere Programme (MAB)[21] has an interdisciplinary research agenda and capacity-building initiative that aims to improve the relationship of people with their environment globally. Launched in the early 1970s, it notably targets the ecological, social and economic dimensions of biodiversity loss and the reduction of this loss. It uses its World Network of Biosphere Reserves as vehicles for knowledge sharing, research and monitoring, education and training, and participatory decision making.
- The International Sentinel Plant Network[22] currently in development would connect *ex situ* plant collections at botanic gardens around the world that are capable of serving as early warning systems to help predict and prevent the incursion of new pests (insects, pathogens or plants) and/or invasive species.

It might also prove useful to increase collaboration with the following global research programs: International Geosphere Biosphere Program (IGBP), International Human Dimensions Program (IHDP), Global Land Project and the Global Earth Systems Governance Program. The new Satoyama (UNU-Japan) set of sites and some of the Globally Important

[19] http://www.sitemaker.umich.edu/ifri/home
[20] http://www.imfn.net/
[21] http://portal.unesco.org/science/en/ev.php-URL_ID=6393&URL_DO=DO_TOPIC&URL_SECTION=201.html
[22] http://www.bgci.org/usa/sentinel/

Agricultural Heritage Systems (GIAHS; an FAO initiative) could be of special interest for the interface between forestry and cropland.

Finally, it will be extremely useful for a sentinel landscapes network in CRP6 to explore links, opportunities for synergistic research and monitoring, and cost savings with other longitudinal site-based research approaches being developed as part of several of the other CGIAR CRP proposals. For instance:

- Benchmark Sites – CRP1.1. Integrated agricultural production systems for the poor and vulnerable in dry areas.
- Action Sites – CRP1.2. Integrated systems for the humid tropics (e.g., in Central America, Peru, Cameroon, Ghana, Indonesia, Thailand, Philippines and Vietnam).
- Sentinel Sites (linked to CGIAR Benchmark Sites) – CRP5 Water, Land and Ecosystems. This CRP's work will further include major river basin/watershed long-term research (e.g., Mekong).

Way forward and budgetary implications

We envisage a stepwise approach, depending on funding availability.

Year 1

- Undertake a detailed analysis of existing networks: lessons learned, impacts and opportunities for collaboration
- Convene a workshop for CRP6 participating centers and partners to define needs (sites, data, methods, collaborations, modi operandi) and criteria for site selection, objectives, and research and monitoring design (see Box A2.2)
- Establish one (or several) working group(s) on methods to design a minimum set of common methods to use across sites
- Visit candidate sites and develop official partnerships and protocols with relevant partners

Year 2

- Develop database and data management procedures
- Establish the baselines:
    - analyze existing information and available data
    - carry out specific measurement campaigns as needed
- Provide support to Component Implementation Teams to initiate research at the sites

Years 2–6

- Coordinate research undertaken by Component Implementation Teams at sentinel landscapes, at both site and global levels

Year 6

- Measure changes since Year 2 and analyze and interpret trends and changes
- Develop EPIA reports

An initial estimate of the human and financial resources required to carry out these activities is summarized in this proposal's budget section.

Box A2.2 Questions to be addressed at the proposed CRP sentinel landscapes network conceptual and design workshop

During the workshop to be held during the first year of CRP6's implementation, we will need to address the following key issues in order to frame the design of a future sentinel landscape network.

- What lessons have been learned (design, priorities, locations, partnerships, impacts) from other long-term site-specific research networks to inform our discussion?
- What are the relevant problems or trends (likely differing between components) that can be addressed through long-term research at a network of sentinel landscapes?
- What criteria for selection of landscapes would be optimal to meet the different needs of the various CRP6 research components?
- What model(s) to base the sentinel landscape research design on?
    - Non-bounded network of specific study sites/sampling units (e.g., households) remeasured at regular intervals (e.g., IFRI, PEN, Smithsonian-type forest dynamic plots)
    - Fixed-size area monitored by remote sensing with ground truthing complements (e.g., AfSIS sentinel landscapes)
    - Benchmark area approach (e.g., IITA Ecoregional Program, ASB Benchmark sites, Landscape Mosaics project)
- What collaborations and networks need to be developed?
    - within and across CRP6 components
    - with other CGIAR CRPs (e.g., CRP1.1, CRP2, CRP5)
    - with other existing long-term monitoring networks (may enhance long-term sustainability and economies of scale, but may constrain design and landscape placement)
- What interventions and who intervenes?
    - Under what conditions can sentinel landscapes without interventions be justified?
    - What are the respective roles of research organizations and other partners in interventions?
    - How to deal with the effect of interventions on the natural development of the sentinel landscapes, i.e., how to separate the study of effects of interventions from the study of the natural impacts of exogenous and endogenous change at the landscape scale?

Annex 5. Assumptions and evidence used to develop 10-year impact projections

Within CRP6 we aim to develop research outputs and to influence research and development outcomes that ultimately result in the following social and ecological impacts:

1. reduced deforestation and degradation;
2. increased net carbon storage;
3. conservation and increased use of forest and tree genetic resources;
4. increased social and economic benefits from forest and agroforestry goods and services;
5. reduced risk for rural livelihoods; and
6. enhanced access of women and other disadvantaged groups to benefits at all levels.

In the following, we set out our vision of the impact of CRP6. However, given the nature of the problems and the complexity of processes, we must first provide a word of caution: the following estimates can only present indicative impact values and provide chains of causality to explain why we believe CRP6 will result in impact. It is not feasible to provide accurate estimates for several reasons. First, many of the estimates are based on a number of assumptions and generalizations. Second, baseline data are lacking for many of the indicators we are interested in. Finally, appropriate measuring tools also are lacking for many of the indicators we are interested in. Indeed, part of the CRP6 research agenda includes testing those assumptions, filling in missing data and developing appropriate measuring tools. Notwithstanding the above, we can provide some estimates of the impacts we aim to achieve.

Environmental benefits

The world is covered by approximately 4 billion hectares of forests, of which 95% is natural forest and 5% plantations.[23] Work under CRP6 is expected to take place in countries[24] in Africa, Southeast Asia and Latin America that together include approximately 46% of global forest cover.[25]

Research in CRP6 is intended to directly influence policy and processes that lead to reduced deforestation and degradation (Components 2, 3, 4 and 5). The current annual deforestation rate is estimated at 13 million hectares.[26] Deforestation from forest conversion and degradation from logging, understory fires, fuelwood harvesting and other activities are a substantial source of greenhouse gas emissions; they are also of concern because of biodiversity and livelihood considerations. Degraded forests can sequester significantly less

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[23] FAO. 2010. Global forest resources assessment 2010. Key findings. FAO, Rome.
[24] While no final decision on research sites has been made, we expect the list of target countries to include the following: Indonesia, Malaysia, Papua New Guinea and Vietnam in Asia-Pacific; Bolivia, Brazil, Colombia, Ecuador and Peru in Latin America; and Cameroon, Central African Republic, DRC Congo, Gabon, Mozambique, Tanzania, Zambia and Zimbabwe in Africa.
[25] CIFOR GIS lab.
[26] FAO. 2010. Global forest resources assessment 2010. Key findings. FAO, Rome.

carbon than natural and sustainably managed forests can.[27] Given that our target countries account for 46% of global forest cover and assuming that our research can contribute to reducing the annual deforestation rate by 10%, 20% or 30%, an estimated 0.5–1.7 million hectares of forest can be saved annually from deforestation, resulting in lower carbon emissions of between 0.15 and 0.65 Gt CO_2 yr^{-1}.[28]

Many outcomes in CRP6 are formulated to influence the design and adoption of standards and criteria for sustainable forest management, either indirectly through trade and investment (Component 5) or directly through community-based or individual smallholder forest management (Components 1, 2 and 3), that will, if adopted, reduce degradation of forests. Forest certification schemes, likely one of the most significant non-state market-driven processes in place as an important platform for standard setting and governance, have an adoption rate of 23% after 15 years.[29] Assuming that research conducted within CRP6 will contribute to informing stakeholders such as participants in commodity roundtables, enterprises, forest managers and policymakers and will successfully influence the decision-making process at a similar rate of success (20%), a lower rate of success (10%) or a higher rate of success (30%), our research may contribute to the adoption of ecologically and socially sustainable production and management practices in 9.3–27.8 million hectares of managed forests in target regions. This may result in secondary benefits of between 0.01 and 0.03 averted Gt CO_2 yr^{-1} emissions,[30] not taking into account the non-carbon ecological and social benefits that would follow as the result of the adoption of these standards.

Outcomes generated through research in Components 2 and 3 aim to contribute to conservation and increased use of forest and tree genetic resources. Such outcomes intend to inform national agencies and other relevant policymakers about status and threats related to species and strategies for biodiversity conservation. There is evidence that research on genetic diversity that influences the current and future capacity of organisms and populations to adapt to future environmental conditions, has, when conducted in collaboration with practitioners, great potential to influence decisions regarding the protection status of selected forests.[31]

[27] Murdiyarso, D. et al. 2008. Measuring and monitoring forest degradation for REDD: implications of country circumstances. CIFOR Infobrief No. 16. CIFOR, Bogor, Indonesia.
[28] This depends on the model applied (for details, see Kindermann, G. et al. 2008. Global cost estimates of reducing carbon emissions through avoided deforestation. Proceedings of the National Academy of Sciences USA 105(30): 10302–10307).
[29] Auld, G. et al. 2008. Certification schemes and the impacts on forests and forestry. Annual Review of Environment and Resources 33: 187–211.
[30] Putz, F.E. et al. 2008. Improved tropical forest management for carbon retention. Public Library of Science Biology 6(7): e166.
[31] Gallo L. et al. 2008. Knowing and doing: research leading to action in the conservation of forest genetic diversity of Patagonian temperate forests. Conservation Biology 23(4): 895–898.

Social benefits

Predicting the social impacts of the research to be conducted under CRP6 may be even more challenging than providing estimates about environmental benefits, because of the significant gap in knowledge about the degree to which forest and agroforestry resources contribute to livelihoods—a gap that research in CRP6 intends to address. Areas with high forest cover tend to be characterized by a high poverty rate.[32] Here, we base our assumption on the global estimate provided by the World Bank: 1.08 billion poor people depend on forests totally or partially for their livelihoods.[33] We thus estimate that CRP6 has the potential to provide direct or indirect benefits to approximately 500 million people living in or close to forests in Asia, Africa and Latin America. For many of these households, forest products contribute a significant share to overall income. Preliminary results from ongoing research in 27 PEN sites across the tropics suggest that forests contribute substantially to rural livelihoods; on average, they may contribute as much as one-fourth of household income.[34] Data from sites without dominant forests or woodlands also show the importance of tree and tree crop income. For example, from a sample in arable Kenya, almost 90% of households are growing fruit trees, more households sell tree fruits (58%) than sell the dominant staple food (maize) and increased participation in fruit markets was strongly associated with households that moved out of poverty between 2000 and 2007.[35]

Research conducted on the impact of technological innovations related to forests and trees (a focus of work in Components 1 and 2) shows that when technology interventions are targeted to the real needs of small-scale farmers and producers in relevant locations, with active encouragement of user modification and adaptation of the technology, adoption rates are high. The literature provides evidence that adoption for a single technology can reach up to 77,500 farmers in eastern Zambia (improved tree fallow technology)[36] and 205,000 small-scale dairy producers in east Africa (fodder trees)[37] after about eight years of modest dissemination efforts. We thus expect at least 3 million rural households (producers and traders) to benefit directly from enhanced technologies through productivity and income-related benefits. A meta-analysis of all published studies on the influence of organic nutrient sources on maize in Africa found that fertilizer tree systems increased not only the mean yield, more than doubling productivity in two out of three cases, but also the stability of yield.[38] Research on improved tree fallow technology has highlighted substantial improvements in livelihoods by generating an additional 57 to 143 person-days of maize consumption due to productivity increases.[39] Within CRP6 we expect

[32] Sunderlin, W.D. et al. 2008. Why forests are important for global poverty alleviation: a spatial explanation. Ecology and Society 13(2): 24. [online] http://www.ecologyandsociety.org/vol13/iss2/art24/.
[33] World Bank. 2004. Sustaining forests: a development strategy. World Bank, Washington, DC.
[34] PEN. 2009. Money does not grow on trees but can trees help the poor grow out of poverty? A poster presented at XIII World Forestry Congress. Buenos Aires, Argentina, 19–23 October 2009.
[35] Mathenge, M. et al. 2010. Participation in agricultural markets among the poor and marginalized: analysis of factors influencing participation and impacts on income and poverty in Kenya. Working Paper. Tegemeo Institute of Egerton University, Nairobi.
[36] Ajayi, O.C. et al. 2007. Impacts of improved tree fallow technology in Zambia. In: Waibel, H. and Zilberman, D. (eds) International research on natural resource management: advances in impact assessment, 147–167. CAB International, Wallingford, UK.
[37] Place, F. et al. 2009. The impact of fodder trees on milk production and income among smallholder dairy farmers in East Africa and the role of research. World Agroforestry Centre. Occasional Paper No. 12. World Agroforestry Centre, Nairobi.
[38] Sileshi, G. et al. 2008. Meta-analysis of maize yield response to woody and herbaceous legumes in the sub-Saharan Africa. Plant Soil 307: 1–19.
[39] Ajayi, O.C. et al. 2007. Impacts of improved tree fallow technology in Zambia.

that technologies will help raise the average tree, land and labor productivity of target groups by at least 50%. Additional benefits for rural households are expected through a greater appropriation of the value of marketed products. We thus expect forest- and tree-based incomes for target households at least to double. Additional indirect benefits result through employment and consumption effects further down the chain but depend on specific elasticities and transmission effects.[40]

Increased direct and indirect benefits are expected through research on forest and agroforestry goods and services. A main outcome of Components 3 and 4 will be to influence policy processes that aim to regulate these goods and services, such as landscapes, water, energy and carbon, and to influence funding decisions. We expect that within 10 years, funding levels for ecosystem-based adaptation projects will increase from the current 14.1–22.9% to 30–40%, providing accelerated availability of funding for climate adaptation programs that will benefit an additional 60 million people.[41] Studies on the effects of enhanced community-based landscape management, a research theme in Components 2, 3 and 4, show that direct effects on income can be considerable, with increases in income in some locations reported to be threefold.[42] If a market-based mechanism eventually emerges for REDD+ that allows developing countries to sell carbon credits on the basis of successful reductions in emissions from deforestation and forest degradation, reduced carbon emissions due to reduced deforestation would generate significant additional income. CRP6 aims to accelerate the speed and effectiveness of these processes through scientific outputs, communication, capacity building and advocacy. Assuming that this reduces the gap between potential and "constrained" emission reductions from deforestation and degradation by 1–25%, the total value of the increased supply of REDD+ credits is estimated to be between US$108 million and US$2695 million per year.[43]

Indirect benefits for society generally are also significant. Indirect effects of enhanced ecosystem goods and services for society include health benefits and other benefits related to the reduced vulnerability of society to climate change. There is indication that the benefits of adaptation measures can be substantial if expressed as averted costs and could be as high as sevenfold the investment.[44] However, more research is required, and will be undertaken within CRP6, to understand and quantify the costs and benefits of ecosystems, to value adaptation measures and policies on poverty and livelihoods and to understand the impact on averted risk.

We aim for women and other disadvantaged groups to have equitable access to all benefits and goods developed and disseminated through research in CRP6, at output, outcome and impact levels. Women make up a disproportionate share of the poor in developing countries. Where women have poor access to benefits provided through forests and trees, we expect to significantly improve that access, with our ultimate aim being to ensure both genders have equal access to benefits; this will be a research theme across all components of CRP6. Experience with agroforestry systems shows that women can become active managers of

[40] Weinberger, K. and Lumpkin, T.A. 2007. Diversification into horticulture and poverty reduction: a research agenda. World Development 35(8):1464–1480.
[41] See Box 2.8 Section 2.5.7.
[42] Pye-Smith, C. 2009. Restoring lives and landscapes: how a partnership between local communities and the state is saving forests and improving livelihoods in Guinea. CIFOR, Bogor, Indonesia; World Agroforestry Centre, Nairobi.
[43] See Box 2.8 Section 2.5.7.
[44] Girot, P.O. 2008. Biodiversity and environment (and livelihood) security. In: Global environmental outlook: environment for development (GEO-4). UNEP.

trees, notably fruits and shrub species that are used for fodder and soils. For example, studies of fodder shrub planters in Kenya found that about half were women.[45] There is evidence that women heading households do benefit from the income generated by trees,[46] but there is a lack of evidence on intra-household generation and sharing of income, which the CRP6 research agenda will address. There is also evidence that increasing women's representation in the governance of natural resources such as by increasing the number of women in forest management committees and other executive bodies has a positive impact on forest regeneration and lowers the incidence of illegal extraction.[47] Research conducted across all components of CRP6 will provide evidence of the benefit of increasing women's participation. Partnerships with governments, civil society groups and media houses will stimulate the advocacy, awareness and commitment for moving knowledge to action.

Beyond contributing to quantifiable and tangible benefits for poor people, and the environments in which these people live, within CRP6 we also aim to accelerate the processes that lead to impact. On average, we expect impacts to occur 5–10 years earlier than they would without the concerted efforts for prioritizing and strategy setting that will form the basis for research in CRP6 and that will involve the diverse stakeholders and partners that are involved in forest and agroforestry research and dissemination activities at the global level.

[45] Place, F. et al. 2009. The impact of fodder trees on milk production and income among smallholder dairy farmers in East Africa and the role of research. World Agroforestry Centre. Occasional Paper No. 12. World Agroforestry Centre, Nairobi.
[46] For example: Mathenge, M. et al. 2010. Participation in agricultural markets among the poor and marginalized: analysis of factors influencing participation and impacts on income and poverty in Kenya. Working Paper. Tegemeo Institute of Egerton University, Nairobi.
[47] Agarwal, B. 2010. Gender and green governance: The political economy of women's presence within and beyond community forestry. Cambridge University Press, Cambridge, UK.

Annex 6. Statements of support

CATIE
Solutions for environment and development
Soluciones para el ambiente y desarrollo

August 24, 2010
DG-476/2010

Dr. Andrew B. Taber
Deputy Director General
Centre for International Forestry Research (CIFOR)
Bogor, Indonesia

Dear Dr. Taber,

The Tropical Agricultural Centre for Research and Higher Education (CATIE) is a leading institution dedicated to sustainable agriculture, forestry and natural resource management in the American tropics. We strongly believe that the Consortium Research Proposal (CRP) N° 6, *Forests and Trees: Livelihoods, Landscapes and Governance* is a novel and innovative initiative with potentially enormous positive impact on human livelihoods and the conservation of forests and trees in the tropics, and it has the full support of our organization.

We highly appreciate the opportunity to participate in the development of the CRP 6 proposal by both review of a draft and participation in the recent meeting in Nairobi, and feel that this inclusive approach can only increase the quality and impact of the work proposed. CATIE is prepared to provide the political support required for the approval and implementation of CRP6 because it fits perfectly with our own vision of a sustainable future for the millions of rural people dependent on forests and trees in the tropical American countries to whose needs we must respond.

In my capacity as Director General of CATIE, I am delighted to pledge my strongest support to CRP 6.

Yours sincerely,

José Joaquín Campos Arce
Director General

CENTRO AGRONÓMICO TROPICAL DE INVESTIGACIÓN Y ENSEÑANZA
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Miembros/Members: Instituto Interamericano de Cooperación para la Agricultura (IICA), Belice, Bolivia, Colombia, Costa Rica, El Salvador, España, Guatemala, Honduras, México, Nicaragua, Panamá, Paraguay, República Dominicana y Venezuela

cirad
LA RECHERCHE AGRONOMIQUE
POUR LE DÉVELOPPEMENT

Montpellier, January 10th 2011

Dr Frances Seymour
Director General
Centre for International Forestry Research (CIFOR)
Bogor, Indonesia

Subject: CIRAD's Contribution to the CRP 6 "Forests, Trees and Agroforestry, Livelihoods, Landscapes and Governance"

Dear Frances,

Greetings from Montpellier and very best wishes to all Cifor staff !

On behalf of Cirad, it is my pleasure to express the willingness of the CIRAD scientific teams working on forests and agroforestry issues to contribute to the construction and the implementation of the CRP6 "Forest, tree and agroforestry".

Cirad has a long standing tradition of collaboration with CIFOR and the World Agroforestry Center on these topics as well as with the two other CGIAR centers involved in CRP6, Bioversity and CIAT.

We are ready to consider how to better coordinate our research activities on forest and agroforestry. This could imply a strengthening of our contribution through an alignment of our activities with the objectives of the CRP 6.

Along with our French colleagues from IRD, we are enthusiastic about participating in this global initiative.

Yours sincerely.

Patrick Caron
Director General for Research & Strategy

www.cirad.fr Innovons ensemble pour les agricultures de demain
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FROM :BADAN LITBANG FAX NO. :021 5720189 Aug. 30 2010 09:32AM P1

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Ref: S. 133 /VIII-SET/2010 30 August 2010

Frances Seymour
Director General
Center of International Forestry Research (CIFOR)
Jalan CIFOR Situ Gede
BOGOR
Fax: 62-251-8622-100

Dear Ms Seymour,

Re: Letter of support for CRP6

Firstly FORDA (Forestry Research and Development Agency) would like to convey its utmost appreciation for the great cooperation between FORDA and CIFOR.

It is great to note that a Consortium Research Program (CRP6) is being developed by CIFOR and other CGIAR's centers encompassing the issues of forests, trees and livelihood of rural people. The key research themes of CRP6 are clearly complementary with a subset of FORDA's research plans. For the next 15 years, FORDA has set a 2010-2025 road map with 5 research themes, from which a strategic plan covering 9 research programs and 25 Integrated Research Plans (IRP) have been derived for the period of 2010-2014. Sustainable forest management, conservation of genetic resources, forest landscape management, promoting smallholder tree-growers outside forests, lifting the livelihood of rural people or those living in and around forests, and increasing the role of forestry in the mitigation and adaptation of climate change, are among the focuses of FORDA's IRP which are also key research themes of CRP6.

As you have been aware of, FORDA is responsible for providing information and technologies for supporting forestry and forestry-related development as well as finding solutions for problems faced by Indonesian forestry sector. It is definitely an enormous task given the wide array and the multidimensional nature of forestry problems. FORDA, therefore, is open to build synergies with other institutions both national and international. The complementary research themes/focuses between CRP6 and FORDA's IRP are a good starting point for such synergy. FORDA, therefore, is pleased to provide the strongest support to CRP6 and looking forward to establish a mutual partnership with CIFOR.

Yours sincerely,

Tachrir Fathoni, PhD
Director General

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RECEIVED 30/08/10

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Ref: KEFRI/52/03/05 Vol.VII/(159)

Date: 3 September 2010

Dr Dennis Garrity, Director General ICRAF
Dr Frances Seymour, Director General, CIFOR

Letter of Support of Consortium Research Programme on Forests, Trees and Agroforestry

Dear Dennis and Frances,

It is with pleasure that I write to express our support for the CGIAR Consortium Research Programme 6: Forest, Trees and Agroforestry. Certainly it is of great interest to the Kenya Forestry Research Institute (KEFRI) and complements well our own five core research programmes of Farm Forestry, Dryland Forestry, Natural Forests, Industrial Plantations Forestry and Tree Seeds as well as the supportive programmes of Technology Dissemination and Information and Partnership and Networks. Refreshingly, we were pleased to take part in the early formulation of the proposed research to ensure it was oriented to our own national circumstances, and to play an active role in the partner and stakeholder consultation meeting in Nairobi in August. Additionally, KEFRI feels that the interdisciplinary approach being adopted will lead to more significant outputs and outcomes and ultimately impact. Forests, trees and agroforestry are of immense national importance to Kenya as described in KEFRI's fourth Strategic Plan and our Kenya Forest Master Plan.

Internationally, forests are enjoying a resurgence of interest and we feel the emergence of a new CGIAR-led global programme with active involvement of national institutes will solve many of the pressing development challenges we all face. Some aspects of the proposal in terms of specific activities we hope to engage in still need finalizing but we are confident that as a substantive initiative it warrants approval. The four centers involved (ICRAF, CIFOR, Bioversity and CIAT) are to be congratulated for the positioning of the major global issues of relevance nationally and globally to forests and trees on farm in the proposal. On the issue of scheduling we support an early signal from the CGIAR Body that we can start committing our scientists and resources to a joint programme in advance of the UN International Year of the Forests. Profiling the need for greater research for IYOF by CGIAR is a worthy goal we stand with CIFOR and ICRAF on.

We look forward to continuing to strengthen our links with you and being active partners in the new Consortium Research Programme on Forests, Trees and Agroforestry.

Yours sincerely,

Ben E. N. Chikamai (PhD)
Director, KEFRI

All communications should be addressed to the Director

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DGDS/BD/LS/n° 048/10

Marseille, August 24th, 2010

Dr Glenn HYMAN
CIAT
Colombia

Subject : Contribution of IRD to the Megaprogramme *MP6* : FORESTS AND TREES

Dear Glenn,

This is to confirm IRD's agreement and wish to fully participate in the construction and implementation of the MP6 – Forests and Trees through the scientific contribution of our research teams and the participation in the future scientific management body of this Megaprogramme.

We appreciate that IRD was invited to participate in the writing process. This allowed integrating a significant part of our research activities in the product-lines of the MP6 proposal.

We consider that a new round of interaction is needed in the coming weeks to fully integrate IRD's offer to MP6 and also to involve other main actors from South and North. We very much want to take a co-construction approach. We, with other French institutions, are enthusiastic about contributing to this global initiative with our human resources and scientific platforms.

Best regards.

B. Dreyfus

Dr Bernard DREYFUS
Director of Scientific Research

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Dr. Andrew B. Taber
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Situ Gede
Bogor Barat 16115
Indonesia

2 September 2010

Dear Dr. Taber

Letter of support for the CPR6 proposal

The opportunity to have had inputs into the development of this MP6 proposal has been greatly appreciated and has provided an opportunity to further enhance our collaboration with ICRAF and CIFOR.

The focus on increasing income-generating opportunities for smallholders and farmers, expanding the area of forest that is sustainably managed, improving the management of multifunctional landscapes, and shaping trade and investment patterns are the fundamental issues that need to be tackled in order to address the global challenges for forest and tree landscapes. The programme design will position the consortium partners at the forefront of analytical thinking on the future use and management of forests, trees and agroforests.

IUCN, especially with ICRAF and CIFOR, have a long history of collaboration and cooperation in applied research. Since 2007, CIFOR has been an active partner in IUCN's Livelihoods and Landscapes Strategy (LLS) which is active in 23 countries in Asia, Africa and Latin America and shares a similar approach to the MP6 in that it aims to conserve forest resources through and for the benefit of the rural poor. CIFOR's strong scientific and analytical base has significantly strengthened the outcomes of this initiative and helped encourage other donors and partners to invest in this endeavour, resulting in 3:1 leverage of this €16 million programme.

Lessons emerging from the LLS highlight the need for a more global and systematic analysis of how forested landscapes and the people that depend upon them can interact in ways that enhance livelihoods and maintain biodiversity values. This proposal will certainly assist that process.

In conjunction with ICRAF, IUCN have been working in partnership with Unilever for nearly 10 years on developing a sustainable supply chain for the production of Allanblackia oil. This partnership has focused on the technical aspects of production as well as a strong focus on alleviating poverty for farmers in Africa. The ability to work together on compatible aspects of tree and forest landscape management is reflected in this proposal and demonstrates how partnerships framed around the MP6 can be mutually beneficial towards the desired impacts

The design of the MP6 will allow these partnerships to further enhance collaboration between these organisations, and it is through this type of partnership that we foresee the MP6 proposal providing valuable lessons on the management of forested landscapes. These lessons would strengthen and deepen related learning emerging from LLS landscapes, and as such we have no hesitation in supporting MP6.

Best Regards,

Stewart Maginnis
Environment and Development Group
IUCN (International Union for Conservation of Nature)
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IUCN
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2010 International Year of Biodiversity
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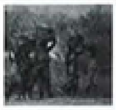

International Union of Forest Research Organizations

Union Internationale des Instituts de Recherches Forestières

Unión Internacional de Organizaciones de Investigación Forestal

Internationaler Verband Forstlicher Forschungsanstalten

Ms Frances Seymour
Director General, CIFOR

Vienna, 2 September 2010

Dr Dennis Garrity
Director General ICRAF

IUFRO Endorsement of CGIAR Consortium Research Programme on Forests, Trees and Agroforestry

Dear Frances and Dennis,

The International Union of Forest Research Organizations (IUFRO) is pleased to provide a letter of support to the proposed CGIAR CRP6 entitled: Forest, Trees and Agroforestry. IUFRO is a non-profit, non-governmental international network of forest scientists, which promotes global cooperation in forest-related research and enhances the understanding of the ecological, economic and social aspects of forests and trees. We are the largest independent body of forest and tree expertise, and we unite more than 15,000 scientists in about 700 member organizations in over 110 countries.

IUFRO accords a high level of gratitude to CIFOR, ICRAF, Biodiversity and CIAT for the constructive and inclusive way in which you have engaged with partners in developing this exciting new global programme to transform forest and tree-covered landscapes. Many individual member organizations were heartened to be involved in the preparatory meetings, and IUFRO itself was pleased with the active engagement of CRP6 CGIAR proponents in our just concluded 5-yearly IUFRO World Congress in Seoul.

The development of the innovative five components highlighted in the CRP6 proposal are very much in line with the evolution of IUFRO into nine Divisions and six thematic areas. IUFRO look forward to an exciting new partnership with the CGIAR to bring the best science to pressing development challenges in this domain.

IUFRO aspires to the early approval of the CRP by the CGIAR donors and Executive to sustain the great enthusiasm generated at the CGIAR side event of our IUFRO World Congress in Seoul and to capitalise on the high profile position that forest, trees and agroforestry is enjoying in the run-up to Forest Day 4 at COP 16 in Cancun, and 2011 as the UN International Year of the Forest.

Yours sincerely,

Niels Elers Koch
IUFRO President

International Union of Forest Research Organizations Headquarters - Secretariat

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LAFORGEN
Red Latinoamericana de Recursos Genéticos Forestales

30 August 2010

Dr. Andrew Taber

Subject: Contribution of the Latin American Forest Genetic Resources Network (LAFORGEN) to the CGIAR Consortium Research Program No. 6 Forests and Trees**,** Livelihoods, Landscapes and Governance, component

Dear Dr. Andrew Taber,

As coordinating committee of LAFORGEN we confirm on behalf of LAFORGEN our support to the CGIAR Consortium Research Program No. 6 (CRP 6) Forests and Trees**,** Livelihoods, Landscapes and Governance.

We appreciate the fact that several members of LAFORGEN have been invited to participate in the partner consultation (August 9-11) at Nairobi, Kenya and that others were given the possibility to provide comments on the draft proposal of CRP 6.

We are enthusiastic about participating in this global initiative and with our scientific platform we would be glad to be involved in the further development of the proposal. We are interested to participate in the implementation of the program activities, particularly the activities that involve the use and conservation of forest and tree genetic resources.

Please find below this letter the list of institutions that officially participate in LAFORGEN and the number of personal members per country.

Yours Sincerely,

Coordinating committee of LAFORGEN

Dr. Leonardo Gallo
Instituto Nacional de Tecnología Agropecuaria INTA
EEA Bariloche, Argentina

Dr Paulo Kageyama
Escola superior de agricultura Luiz de Queiroz, Universidade de São Paulo, Brasil.

Dr. Carlos Navarro
Instituto de Investigación y Servicios Forestales INISEFOR
Universidad Nacional de Costa Rica

Dr. Nahum Sanchez
Instituto de Investigaciones Agropecuarias y Forestales
Universidad Michoacana de San Nicolás de Hidalgo, Mexico.

c/o CIFOR Regional Office In Cameroon, P.O. Box 2008 Messa, Yaounde, Cameroon, Tel.(Bioversity): +237 22237465 ext. 1022, Tel. (CIFOR): +237 22227449 ext 1022, Fax: +237 22227450, Email: O.EYOG-MATIG@CGIAR.ORG

Dr Niéyidouba Lamien
Chairman of SAFORGEN
FTS Working Group

Ref.: SC/LS/CRP6

Dear Judy Loo
Senior Scientist
Bioversity International
Via dei Tre Denari,472/a
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Tel: (39) 066118292
E-mail: j.loo@cgiar.org

Date: 25th August 2010

RE: Letter of support of the Food Tree Species Working Group of the Sub-Saharan Africa Forest Genetic Resources Network (SAFORGEN/FTS-WG)

for the Consortium Research Program on Forest and Tree: Livelihoods, Landscapes and Governance referred as CRP6

The Sub-Saharan Africa Forest Genetic Resources Network (SAFORGEN) is a voluntary tool for international and/or regional collaboration in research and development on conservation and sustainable utilization of forest resources. For its implementation, the SAFORGEN Network has been organized in Working Groups. Four Working Groups were identified as follows: Food Tree Species (FTS); Fodder Trees Species (FdrTS); Wood and Fiber Species (WFS); Medicinal Tree Species (MTS). The geographical coverage of the Network is sub-Saharan Africa with the following member countries, which have endorsed SAFORGEN Agreement: Benin, Burkina Faso, Chad, Congo Brazzaville, Ethiopia, Gambia, Ghana, Guinea, Kenya, Madagascar, Mali, Niger, Nigeria, South Africa, Senegal, Sudan, Uganda and Togo. Further countries such as Côte d'Ivoire and Cameroon would like to join the Network.

SAFORGEN Food Tree Species Working Group has been re-organized in 2007 in Cotonou, Benin by the WG chairs. During this meeting the WG strategy document was elaborated adopted.

Since Benin WG meeting, sub-Saharan African experts on FTS have collated existing information on FTS-WG mandate list of species. The leaflets of 12 FTS species are being published. The importance of these species during food shortage period is being studied together with the impact of harvesting on the species genetic diversity.

As the Chairman of the FTS-WG, I was invited to participate in Nairobi, Kenya workshop, which objective was to finalize the development of CGIAR Mega Programme on Forest and Tree – Livelihoods, Landscape and Governance referred as CRP6.

The Working Group is impressed by different components of the CRP6 and the global partnership that the Mega Programme will foster. The Working Group encourages Bioversity, CIFOR and ICRAF to make sure that SAFORGEN Network and its members remain fully engaged in the further development and implementation of CRP6.

SAFORGEN encourages to see CRP6 becoming a clear and identifiable CGIAR Mega Programme with a special attention to the sub-Saharan African region.

Sincerely yours

Dr Niéyidouba Lamien

Chairman of the SAFORGEN
Food Tree Species Working Group
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STOCKHOLM ENVIRONMENT INSTITUTE

Dar es Salaam 30 August 2010

Dr. Andrew B. Taber

Deputy Director General

Centre for International Forestry Research (CIFOR)

Bogor, Indonesia

Subject: Support to Forests and Trees – Consortium Research Programme

Dear Andrew,

I write with great pleasure to commend you on the Forest and Trees Consortium Research Program. This is an important initiative and we appreciate that SEI was invited to participate in the proposal formulation workshop.

The thrust of the proposal fits well into SEI's 2010-2014 strategy, particularly under SEI's theme 1 strategy: Managing Environmental Systems for Human Development which objectives is to advance new insights on the interaction between land, air and water resources and the management of these resources, and support policy change taking into consideration social issues such as gender and equity.

SEI therefore supports the programme and looks forward to co-creatively contribute to its implementation.

Yours sincerely,

Anders Arvidson

Centre Director
SEI Africa

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Annex 7. Inception milestones

Inception milestones	Expected outputs	Quarter
CRP6 Research Planning		
	Form Component Implementation Teams; initial face-to-face meetings take place	Q1–Q2
	Component Implementation Teams develop 2012 annual work plans (MTP equivalents) and budgets for Steering Committee approval	Q3
Establish Steering Committee		
	First meeting of Steering Committee (agree terms of reference of Steering Committee, including Steering Committee membership)	Q1
	Review and approve work plan and budget for any Window 1 and 2 funds available for 2011	Q2
	Approve appointment of CRP6 Director	Q2–Q3
	Begin providing CRP6 oversight	Q2-Q3
	Approval of 2012 annual work plan and budget	Q3
Establish Management Support Unit		
	Develop Management Support Unit terms of reference (Lead Center)	Q2
	Recruitment of Director and other staff of Management Support Unit	Q2–Q3
	Performance subcontract development (Lead Center)	Q2–Q3
	Harmonized operations manual (policies, procedures) between CRP6 and CGIAR partner centers	Q2–Q3
CRP6 Joint Communications Strategy		
	Joint communications and knowledge-sharing strategy meeting with key partners	Q2–Q3
Establish Scientific and Stakeholder Advisory Committee		
	Establishment and membership	Q3
	First annual meeting (likely timed to coincide with center annual meetings)	Q3
Sentinel Landscapes Workshop		
	Sentinel landscapes strategy workshop	Q3

Annex 8. Budget detail

Table A8.1 Consolidated CRP6 Budget for years 2011–2013 by Component (in ‘000 $)

$ 000

	2011	2012	2013	TOTAL
Component 1	13,386	14,938	16,455	44,780
Component 2	14,265	16,450	18,482	49,197
Component 3	14,686	16,174	17,791	48,651
Component 4	18,408	20,721	22,508	61,637
Component 5	4,761	5,283	5,813	15,857
TOTAL COMPONENTS	**65,506**	**73,565**	**81,049**	**220,121**
Program Co-ordination	824	996	1,071	**2,890**
Gender	830	1,231	1,798	**3,859**
Sentinel Landscapes	300	1,680	1,680	**3,659**
Communications	382	887	1,119	**2,388**
TOTAL CRP6	**67,843**	**78,359**	**86,715**	**232,916**

Table A8.2 Consolidated CRP6 Budget for years 2011-2013 by Center (in ‘000 $)

$ 000

	2011	2012	2013	TOTAL
CIFOR	30,729	34,527	37,662	102,919
ICRAF	26,960	29,674	32,642	89,276
Bioversity	7,302	8,411	9,707	25,421
CIAT	516	952	1,037	2,505
	65,506	73,565	81,049	220,121
Program Co-ordination	824	996	1,071	2,890
Gender	830	1,231	1,798	3,859
Sentinel Landscapes	300	1,680	1,680	3,659
Communications	382	887	1,119	2,388
TOTAL	67,843	78,359	86,715	232,916

Table A8.3 Consolidated CRP6 Component 1 budget for years 2011-2013 (in '000 $)

Component 1: Smallholder production systems and markets

Project Cost

000$

	2011	2012	2013	TOTAL
Unrestricted	5,173	5,730	6,352	17,255
Restricted	5,935	5,307	4,239	15,481
Proposals/Gap	2,278	3,901	5,865	12,044
TOTAL	13,386	14,938	16,455	44,780
CIFOR	2,980	3,278	3,606	9,865
ICRAF	9,810	10,792	11,871	32,473
Bioversity	379	455	546	1,380
CIAT	216	413	432	1,062
TOTAL	13,386	14,938	16,455	44,780

Table A8.4 Consolidated CRP6 Component 2 budget for years 2011-2013 (in ‘000 $)

Component 2: Management and conservation of forest and tree resources

Project Cost

000$

	2011	2012	2013	TOTAL
Unrestricted	5,667	6,556	7,599	19,822
Restricted	7,808	7,444	4,730	19,982
Proposals/Gap	789	2,450	6,153	9,392
TOTAL	14,265	16,450	18,482	49,197
CIFOR	5,765	6,778	7,456	19,998
ICRAF	1,766	1,943	2,137	5,847
Bioversity	6,733	7,729	8,889	23,351
CIAT	-	-	-	-
TOTAL	14,265	16,450	18,482	49,197

Table A8.5 Consolidated CRP6 Component 3 budget for years 2011-2013 (in '000 $)

Component 3: Landscape multi-functionality

Project Cost

000$

	2011	2012	2013	TOTAL
Unrestricted	5,193	5,712	6,284	17,189
Restricted	5,283	4,946	3,021	13,249
Proposals/Gap	4,210	5,516	8,487	18,212
TOTAL	14,686	16,174	17,791	48,651
CIFOR	3,269	3,596	3,956	10,821
ICRAF	11,417	12,577	13,835	37,829
Bioversity	-	-	-	-
CIAT	-	-	-	-
TOTAL	14,686	16,174	17,791	48,651

Table A8.6 Consolidated CRP6 Component 4 budget for years 2011-2013 (in '000 $)

Component 4: Climate change adaptation and mitigation

Project Cost

000$

	2011	2012	2013	TOTAL
Unrestricted	5,355	5,912	6,529	17,796
Restricted	11,699	9,770	4,146	25,616
Proposals/Gap	1,353	5,039	11,833	18,225
TOTAL	18,408	20,721	22,508	61,637
CIFOR	14,164	15,869	17,139	47,172
ICRAF	3,806	4,186	4,605	12,597
Bioversity	190	227	273	690
CIAT	248	438	492	1,178
TOTAL	18,408	20,721	22,508	61,637

Table A8.7 Consolidated CRP6 Component 5 budget for years 2011-2013 (in '000 $)

Component 5: Impacts of trade and investment on forests and people

Project Cost

000$

	2011	2012	2013	TOTAL
Unrestricted	1,638	1,802	1,983	5,423
Restricted	2,822	1,888	1,253	5,962
Proposals/Gap	301	1,593	2,577	4,471
TOTAL	4,761	5,283	5,813	15,857
CIFOR	4,551	5,006	5,506	15,062
ICRAF	160	176	194	530
Bioversity	-	-	-	-
CIAT	51	101	113	265
TOTAL	4,761	5,283	5,813	15,857

Table A8.8 Consolidated CRP6 budgets by Center for 2011 (in '000 $)

$ 000

	CIFOR	ICRAF	BIOVER	CIAT	TOTAL
Component 1	2,980	9,810	379	216	13,386
Component 2	5,765	1,766	6,733	-	14,265
Component 3	3,269	11,417	-	-	14,686
Component 4	14,164	3,806	190	248	18,408
Component 5	4,551	160	-	51	4,761
TOTAL COMPONENTS	**30,729**	**26,960**	**7,302**	**516**	**65,506**
Program Co-ordination					**824**
Gender					**830**
Sentinel Landscapes					**300**
Communications					**382**
TOTAL CRP6					**67,843**

Table A8.9 CRP6 budgets by Natural Classification for years 2011-2013 (in '000 $)

Natural Classification	$ 000
Personnel	81,521
Travel	13,975
Op Expenses	37,267
Partnerships	55,900
Depreciation	2,329
Inst. Overheads	41,925
TOTAL	**232,916**

Table A8.10 Bioversity CRP6 budget for years 2011-2013 (in '000 $)

000 $

	2011	2012	2013	TOTAL
Unrestricted	3,791	4,549	5,459	13,799
Restricted Grants (confirmed)	3,511	2,100	2,113	7,724
Proposals or Gap	-	1,762	2,136	3,898
TOTAL CRP6 for Center (U+R+P)	**7,302**	**8,411**	**9,707**	**25,421**

Table A8.11 CIAT CRP6 budget for years 2011-2013 (in '000 $)

000 $

	2011	2012	2013	TOTAL
Unrestricted	51	61	73	185
Restricted Grants (confirmed)	100	105	110	315
Proposals or Gap	365	786	854	2,005
TOTAL CRP6 for Center (U+R+P)	**516**	**952**	**1,037**	**2,505**

Table A8.12 CIFOR CRP6 budget for years 2011-2013 (in '000 $)

000 $

	2011	2012	2013	TOTAL
Unrestricted	10,409	11,450	12,595	34,454
Restricted Grants (confirmed)	18,067	14,608	6,421	39,096
Proposals or Gap	2,253	8,469	18,647	29,369
TOTAL CRP6 for Center (U+R+P)	**30,729**	**34,527**	**37,662**	**102,919**

Table A8.13 World Agroforestry CRP6 budget for years 2011-2013 (in '000 $)

000 $

	2011	2012	2013	TOTAL
Unrestricted	8,776	9,653	10,619	29,048
Restricted Grants (confirmed)	11,870	12,541	8,745	33,155
Proposals or Gap	6,314	7,480	13,278	27,073
TOTAL CRP6 for Center (U+R+P)	**26,960**	**29,674**	**32,642**	**89,276**

Table A8.14 Program Co-ordination and Communications budget for CRP6 years 2011-2013 (in '000 $)

000 $

	2011	2012	2013	TOTAL
Steering Committee	59	59	59	177
Scientific and Stakeholder Advisory Committee	59	59	59	176
Management Support Unit	356	528	603	1,487
Component Implementation Plan	216	216	216	648
Thematic Workshops	134	134	134	402
TOTAL Program Co-ordination	824	996	1,071	2,890
Communications	382	887	1,119	2,388
Gender	830	1,231	1,798	3,859

Table A8.15 Sentinel Landscapes budget for CRP6 years 2011-2013 (in '000 $)

	Option 1	Option 2
Staff Costs	2,120	4,240
Partnerships (40% of scientists)	265	530
Equipment	100	200
Operating costs	600	1,200
Communication	100	100
Travel/Meetings	300	450
Sub total	**3,485**	**6,720**
Contingencies	174	336
Total	**3,659**	**7,319**

Table A8.16 "What it takes" CRP6 budgets for years 2012-2013 (in '000 $)

$ 000

	2012	2013	TOTAL
Component 1	24,152	24,887	49,039
Component 2	17,215	22,358	39,573
Component 3	34,835	35,085	69,919
Component 4	18,537	21,373	39,910
Component 5	7,674	7,664	15,337
TOTAL COMPONENTS			**213,779**
Program Co-ordination	996	1,071	**2,066**
Gender	1,231	1,798	**3,029**
Sentinel Landscapes	1,680	1,680	**3,359**
Communications	887	1,119	**2,006**
TOTAL CRP6			**224,239**

Table A8.17 CRP6 Scientific projections for "what it takes" by Center, years 2012-2013

(International scientist numbers, all categories)

		2012					2013				
		TOTAL	CIFOR	ICRAF	BIO	CIAT	TOTAL	CIFOR	ICRAF	BIO	CIAT
Component 1	Sr. Scientist	11.5	1.5	9.0	0.5	0.5	11.5	1.5	9.0	0.5	0.5
	Scientist	15.4	5.0	10.0	-	0.4	15.9	5.5	10.0	-	0.4
	Post Doc	18.5	5.0	13.0	-	0.5	18.0	1.5	16.0	-	0.5
Component 2	Sr. Scientist	7.0	3.0	1.0	3.0	-	9.0	5.0	1.0	3.0	-
	Scientist	14.5	5.5	2.0	7.0	-	20.0	11.0	2.0	7.0	-
	Post Doc	17.0	14.0	3.0	-	-	20.5	16.5	4.0	-	-
Component 3	Sr. Scientist	7.0	3.0	4.0	-	-	7.0	3.0	4.0	-	-
	Scientist	29.0	12.0	17.0	-	-	29.0	12.0	17.0	-	-
	Post Doc	42.0	14.0	28.0	-	-	42.0	14.0	28.0	-	-
Component 4	Sr. Scientist	13.2	8.9	3.3	0.5	0.5	14.7	9.7	4.0	0.5	0.5
	Scientist	14.7	10.7	3.0	0.5	0.5	16.5	12.0	3.5	0.5	0.5
	Post Doc	11.9	8.4	3.0	-	0.5	15.7	11.7	3.5	-	0.5
Component 5	Sr. Scientist	1.5	1.0	-	-	0.5	1.5	1.0	-	-	0.5
	Scientist	4.2	4.0	-	-	0.2	4.2	4.0	-	-	0.2
	Post Doc	7.0	7.0	-	-	-	7.0	7.0	-	-	-