Transforming Lives and Landscapes

World Agroforestry Centre

Strategy 2008-2015

About the World Agroforestry Centre

The World Agroforestry Centre is an autonomous, non-profit 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 Centre 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.

We are one of the 15 centres of the Consultative Group on International Agricultural Research (CGIAR). Headquartered in Nairobi, Kenya, we operate five regional offices located in Brazil, Cameroon, Indonesia, Kenya, and Malawi, and conduct research in eighteen other countries around the developing world.

We receive our funding from over 50 different governments, private foundations, international organizations and regional development banks. Our current top ten donors are Canada, the European Union, the International Fund for Agricultural Development (IFAD), Ireland, the Netherlands, Norway, Sweden, the United Kingdom, the United States of America and the World Bank.

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Contents

Abbreviations

ASB	ASB Partnership for the Tropical Forest Margins
CBD	Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Centre for Tropical Agriculture
CIFOR	Center for International Forestry Research
FAO	Food and Agricultural Organization of the United Nations
GRP	Global Research Priority
IAASTD	International Assessment of Agricultural Science and Technology for Development
IFPRI	International Food Policy Research Institute
ILRI	International Livestock Research Institute
K2A	knowledge to action
MEA	Millennium Ecosystem Assessment
NARS	national agricultural research systems
NGO	nongovernmental organization
R&D	research and development
REDD	Reducing Emissions from Forest Deforestation and Degradation
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

NOTE

In this report, "$" refers to US dollars.

Foreword

In a fast-changing world, an organization needs a strategy that enables it to respond effectively to emerging challenges while focusing on its long-term goals. The World Agroforestry Centre's new strategy defines who we are, what we do, why and how we do it, and where we undertake our research.

During the last 5 years, our Centre has undergone major institutional changes and programmatic adjustments in response to changing demands in the external environment. In 2005, we formulated a strategic planning framework and articulated our vision and aspirations in a document entitled *Trees of Change: A vision for an agroforestry transformation in the developing world*. Further evolution in our strategic direction has been triggered by our third external programme and management review, which made significant recommendations on the Centre's operational and organizational framework.

Building on our strategic planning framework, we have formulated this new strategy to guide our work through 2015. Its development has benefited immensely from the full engagement of our Board of Trustees, senior leadership team, project leaders, regional coordinators, heads of global units and professional staff in wide-ranging and iterative consultations with our national and international partners.

We now seek to maximize the ownership and use of this strategy by all staff members to ensure that our collective responsibilities are fully dedicated to achieving a global agroforestry transformation for livelihoods and the environment. Our reformulated vision, mission, values and goals will guide us for the foreseeable future. The strategy is nevertheless a flexible one, geared to our rapidly changing external environment. We pride ourselves on being agile and able to respond to emerging issues.

The strategy is more than an elaboration of a vision. It is a clear guide to the choices that we have made and how those choices translate into action. It identifies the major milestones that we have set before ourselves, the important obstacles we face and how we intend to overcome them. There are critical issues to be addressed in its implementation, including how to generate the necessary resources to implement it fully.

Through this strategy, we aim to open many doors to augment engagement and consultation with all our stakeholders. We believe that a global agroforestry transformation will create practical options for people and the environment in the developing world. But the necessary scale of this transformation will be realized only if we deepen our engagement with all of our valued stakeholders.

I would like to express my deep appreciation to everyone who contributed to the development and review of our new strategy. Without a doubt, their efforts have enhanced our ability to provide relevant science-based solutions to reduce rural poverty and ensure a more resilient environment for all.

Dennis Garrity
Director General

Executive Summary

This strategy document sets out the World Agroforestry Centre's role in responding to livelihood and environmental challenges through tree-based systems in agricultural landscapes. These challenges include poverty and hunger, food insecurity, ill health, energy scarcity, biodiversity and habitat loss, climate change, and resource degradation.

The document defines the Centre's vision, mission and values and identifies the challenges that confront the poor, especially the 'bottom billion' who continue to live under extreme poverty. It addresses in some detail the environmental and resource degradation problems common throughout the tropics and identifies pathways through which the Centre's research can respond to these global challenges. In addition, the text lays out our research agenda for the next 7 years and articulates how the Centre will implement its ambitious research-for-development agenda.

The Centre's **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.
Its **mission** is to generate science-based knowledge about the diverse roles trees play in agricultural landscapes and to use its research to advance policies and practices to benefit the poor and the environment.

Agroforestry is uniquely suited to address both (1) the requirement for improved food security and increased biomass resources for energy and (2) the need to sustainably manage agricultural landscapes for the critical ecosystem services they provide. The strategy identifies a number of pathways through which agroforestry provides livelihood and environmental benefits by:

- enriching the asset base of poor households through farm-grown trees;

- maximizing the productivity of agroforestry systems and the complementarities trees contribute to the productivity of crops and livestock;

- improving the income of poor households by better linking them to markets;

- expanding the multifunctionality of agricultural landscapes by balancing increased productivity with the sustainable management of the natural resource base; and

- maintaining or enhancing the supply of ecosystem services in agricultural landscapes, particularly regarding water, soil health, carbon sequestration and biodiversity.

Research Priorities. We developed the strategy and its research priorities through extensive consultations with stakeholders in both South and North. These priorities are vital to maintaining research focus and achieving impact at scales sufficient to address the development and environment challenges identified by partners. Four criteria were used in selecting these priorities:
- salience (the global importance of the problem, and its likely impact on poverty, hunger and environmental degradation),
- credibility (trustworthiness of our knowledge and capability to deliver),
- legitimacy (comparative advantage), and
- fundability (potential to generate research funding).

Each of our Global Research Priorities (GRPs) addresses both livelihood and landscape issues to some degree.

GRP1**: Domestication, utilization and conservation of superior agroforestry germplasm**
This GRP aims to increase farmers' access to improved germplasm of priority tree species and ensure better functioning of tree seed and seedling supply systems.

GRP2: **Maximizing on-farm productivity of trees and agroforestry systems**
The objective of GRP2 is to develop better understanding of and approaches for enhancing on-farm productivity through improved agroforestry systems. This includes nutrient cycling among trees, animals and crops; using local ecological knowledge to develop improved agroforestry management principles; expanding tree species diversity; developing coping mechanisms for climate variability; and considering tree-soil interactions to match species to sites and systems.

GRP3**: Improving tree product marketing for smallholders**
Research under this GRP will focus on expanding smallholders' access to value chains for agroforestry tree products and improving their incomes and livelihoods through better marketing.

GRP4: **Reducing risks to land health and targeting agroforestry interventions to enhance land productivity**
This GRP will focus on developing multi-scale and widely usable methods of land health surveillance and will quantify and map major risks to land health at different scales. Efforts will be made to evaluate the cost effectiveness and outcomes of intervention programmes and to develop national capacity in operational methods and tools of land health surveillance.

GRP5: **Improving the ability of farmers, ecosystems and governments to cope with climate change**
The research aims to improve the stability of farming systems and livelihood strategies of smallholder farmers in light of current climate variability and long-term climate change. This will be achieved through farmers' increased use of trees for intensifying, diversifying and buffering farm systems.

GRP6: **Developing policies and incentives for multifunctional landscapes with trees that provide environmental services**
Through this GRP, we will support better policies and the creation of incentives for maintaining the multifunctionality of landscapes with trees. This work will be based on improved understanding of the roles trees play in securing watershed services, storing carbon and maintaining biodiversity in landscape mosaics.

In implementing this research agenda, we will foster greater integration and coherence as key principles. Our assertion is that trees and agroforestry systems that are more productive, diversified, integrated and intensified can simultaneously address both livelihood and landscape problems. Overall, we seek to inform agricultural and forestry land-use decisions with knowledge of the tradeoffs and synergies of critical livelihood and environmental challenges, thereby making these decisions more rationale, sustainable and equitable.

Regional Context. The Centre will continue to operate in six ecoregions across sub-Saharan Africa (eastern, southern, and west and central) South and Southeast Asia, and Latin America. Its programmes will be driven by the specific needs and opportunities in each region. That said, most of our research expenditures will continue to be allocated to Africa, where persistent poverty and environmental degradation are particularly acute.

Executing the Strategy. The Centre will emphasize four key areas in implementing the strategy:

1. **Accelerating the use and impact of our research.** Using a knowledge-to-action framework, the Centre will strengthen its efforts to produce research outputs that target specific users.

2. **Enhancing science quality.** The Centre has developed a set of principles and criteria that ensure the quality of science at various stages of the research process, starting with the articulation of the problems (context), engaging in the research process (mechanism), and finally achieving outcomes or impacts.

3. **Strengthening partnerships.** The Centre will place even greater emphasis on partnerships to enhance the extent and quality of engagement with a range of partners in both South and North. It will implement a substansive part of its research agenda with partners, using mechanisms that reinforce synergy and complementarity to achieve desired outcomes.

4. **Enhancing operational efficiency.** The Centre's current investments in systems that enhance management operations, human resources, communications, monitoring and evaluation, resource mobilization, and risk management will ensure that all policies and procedures are consistent with the strategy.

Vision, Mission, Values and Strengths

The World Agroforestry Centre's strategy is defined by its role as a centre supported by the Consultative Group on International Agricultural Research (CGIAR), its vision and mission, its institutional objectives, its strategic advantages, and its core values.

The World Agroforestry Centre is guided by the broad development challenges pursued by the CGIAR. These include:

- poverty alleviation that entails enhanced food security and health,
- improved productivity with lower environmental and social costs, and
- resilience in the face of climate change and other external shocks.

The Centre contributes to these goals through research in agroforestry and natural resource management that addresses productivity and environmental constraints in smallholder agricultural landscapes and creates new tree-based livelihood options for the poor.

Agroforestry is a dynamic, ecologically sound system of natural resource management. By integrating trees on farms and in the agricultural landscape, it helps diversify and sustain production for enhanced economic, environmental and social benefits.

Our Vision. The Centre's 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.

This vision is founded upon three basic tenets:

1. the growing importance of trees and tree-based systems in sustaining livelihoods[1] and agroecosystems;
2. the Centre's experience and comparative advantage in advancing agroforestry research for development;
3. a global commitment to achieving the Millennium Development Goals.

Our Mission. The Centre's mission is to generate science-based knowledge about the diverse roles that trees play in agricultural landscapes and to use its research to advance policies and practices that benefit the poor and the environment.

Success in achieving this mission will be demonstrated by the increased use of improved trees and tree-based systems, significant gains in the overall productivity of smallholder farming systems, a marked reduction in poverty, and significant improvements in environmental quality.

Our goal is to become a partner of choice for a range of scientific and development institutions in their efforts to generate tree-based solutions to the global problems of rural poverty, hunger and environmental degradation.

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1   A livelihood comprises the assets (natural, physical, human, financial and social capital), access to them as mediated by institutions and social relations, and activities that together determine the living gained by the individual and household (Ellis 2000).

Our Values. We strongly adhere to shared core values that guide our work and relationships with colleagues and partners:

- **Professionalism**. We aspire to achieve the highest standards of professionalism in our research, communications, fiduciary management and operations; transparency in our methods and approaches; and fairness in sharing credit.
- **Mutual respect.** We genuinely respect all those with whom we work, irrespective of nationality, gender, religion, age, profession or workplace seniority. We celebrate the achievements of our colleagues and partners. We support a work environment that fosters trust, teamwork and diversity. We commit ourselves to an environment of mutual respect and collaboration with partners, donors and colleagues.
- **Creativity.** We promote a culture of innovation, continuous learning, problem solving and independent thinking.

We believe that success in living and fostering these values is fundamental to maintaining a vibrant organization, contributing to science and achieving impact.

Our Strengths. The World Agroforestry Centre has generated important knowledge and technology in the form of international public goods and has enhanced the evolution of policy and institutional innovations that have greatly benefited poor people throughout the developing world. These achievements are briefly summarized as follows:

1. Expanded knowledge on the multifunctional roles of trees and tree-based systems.
The Centre has accessed and collected a range of tree germplasm, developed datasets on agroforestry species and a toolkit for reference sources on tree seeds. The Centre

has synthesized knowledge on the diverse role of tree species on farms and landscapes. Examples of this work include improved trees and knowledge to replenish soil fertility; fruit trees and cultivation systems for food security, nutrition and income; medicinal trees that improve health and generate income; and fodder trees to increase smallholder dairy production. Other examples include advances in smallholder timber-production systems, live-fencing systems, smallholder rubber agroforestry systems, and robust methods of soil and water conservation for improved productivity and ecosystem functioning.

2. Enhanced enabling environments for the effective use of agroforestry science and practice.
The Centre's research has addressed the policy context and the human and institutional capacity needs for agroforestry research and development. This work enhanced the supply of high-quality germplasm to smallholder farmers, brought changes to land tenure policy that provide improved incentives for planting trees, produced policy analyses that remove barriers constraining competitive smallholder farming with trees, and provided training and capacity development. Important analyses have been conducted of market conditions for smallholder tree products and how to empower smallholder organizations and enhance property rights for vulnerable groups to better enable them to harness benefits from tree-based systems.

3. Challenges and opportunities addressed across ecosystems to leverage benefits for smallholders.
This work developed methods, tools and approaches for watershed protection, climate change adaptation and mitigation, and biodiversity conservation. It fostered improved understanding by policymakers about the role of tree-based systems in meeting these challenges. An important

outgrowth of this work is the development of mechanisms that reward small-scale farmers for the environmental services they provide to society.

In developing this strategy, we have focused on our comparative advantages in agroforestry research for development. These include:

- advanced expertise on the role of trees in the multi-scale, cross-scale and integrated management of landscapes for multiple functions;
- credibility in promoting policy processes through knowledge synthesis and brokerage, as well as expertise in providing science-based negotiation support and evidence-based design;
- a proven track record in capacity building;
- the ability to connect and interface at different levels, particularly across institutions;
- the capacity to address complex, integrated problems with interdisciplinary teams;
- the development of tools, expertise and approaches to understand tradeoffs at different scales in agricultural landscapes; and
- a strong base in the developing world, as our headquarters in Kenya places us near several United Nations hub offices, and our regional programmes span the tropics.

The Centre has established research infrastructure in key hotspots of rural poverty and environmental degradation through its presence in six regions and in key partner countries within those regions.

The Centre's global reach and integrative framework allow for rapid learning and synthesis so that the benefits of its work are relevant and applicable in a range of social, economic, ecological and institutional settings.

The Development Challenges for Agroforestry

The world population has now surpassed 6.5 billion. Population growth and rapid economic expansion in Asia and Latin America have significantly accelerated growth in global food demand. However, over 1 billion people — most of them in East and South Asia and sub-Saharan Africa — continue to endure lives of extreme poverty. These trends have brought into sharp focus the critical roles of agriculture in poverty reduction, food security and maintaining environmental services. This is reflected in a number of recent global assessments, including the *World Development Report (*World Bank 2008), the *Millennium Ecosystem Assessment* (MEA 2005), and the *International Assessment of Agricultural Science and Technology for Development* (IAASTD 2008).

Agriculture in developing countries must respond to a rapidly growing and diversifying demand for food, fibre, fodder and energy. At the same time, it must contribute to maintaining ecosystem functions and alleviating the intensifying pressures on natural forest, grassland and aquatic ecosystems. The IAASTD stresses the multifunctionality of agriculture and the need to value the functions of agriculture beyond the commodity and market perspectives that have been the principal drivers of global agriculture and have contributed to agriculture's large ecological footprint.

Dual Role of Agroforestry. Foraging for such resources as firewood, fodder, water and medicinal plants contributes significantly to the incomes and livelihoods of poor rural households, often approaching 30-40%. Yet, as rural population densities increase, the pressure intensifies on common property resources, protected areas and biodiversity in the landscape, often causing significant degradation and loss of ecosystem services. The authors of the MEA note that 60% of all the ecosystem services evaluated were either degraded or being used unsustainably. Agroforestry provides the basis for producing such goods and services on farms and, in the process, stabilizing agricultural landscapes and alleviating pressure on natural ecosystems.

Agroforestry reinforces natural intensification, which can be further strengthened by improved access to markets for agroforestry products. This is reflected in the fact that more than 1 billion rural smallholders grow trees on farms and in agricultural landscapes to access the goods and services that trees provide. A forest resource assessment published in 2005 by the Food and Agriculture Organization (FAO) of the United Nations (UN) notes that "the proportion of trees on farms and in forests varies considerably among countries, but two trends seem almost universal in the tropics: the number of trees in forests is declining, and the number of trees on farms is increasing" (FAO 2005).

These trends are particularly reflected in the provision of firewood. Solid fuels are the primary energy sources for the world's poorest people. Over 3 billion people worldwide use solid fuels for cooking, boiling water, lighting and heating
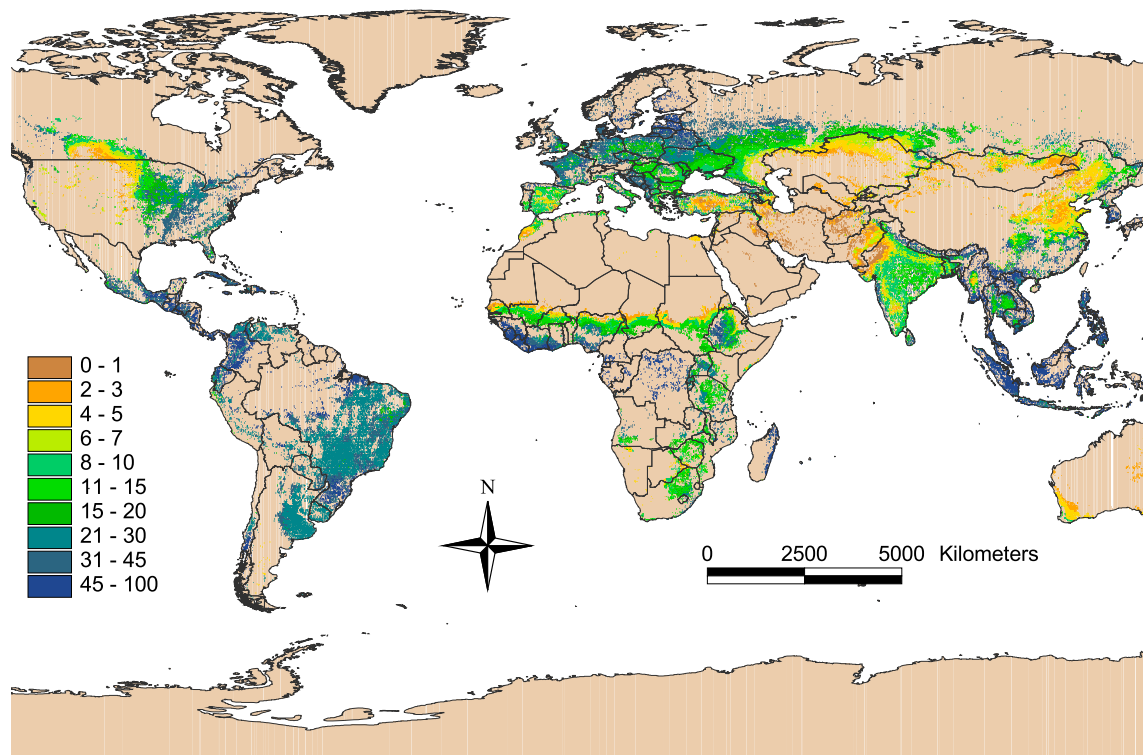
Figure 1. Percentage of tree cover on agricultural land, not including urban or other unfarmed areas. Source: Fritz et al. 2003 and FAOSTAT 2005.

(Rehfuess et al. 2006). These fuels account for more than 95% of domestic energy use in 25 of the world's low-income countries. Women do the bulk of firewood collection, which places a major demand on their time that grows as supplies become scarcer. Ensuring sustainable supplies of energy for smallholder farmers and their families is an ongoing challenge.

Closing the gender gap will unlock barriers to achieving many development objectives. Of the eight Millennium Development Goals, four directly concern gender. The cultivation of tree products that can be sold or bartered should benefit rural women. The Centre has documented the agroforestry species and management preferences of women, their decision-making powers, their ability to engage in tree planting, and how they can best access information about agroforestry. Centre scientists report, for example, that thousands of Kenyan and Zambian

farmwomen use, to the same degree as male farmers, nitrogen-fixing fertilizer trees to enrich the soil and fodder-producing trees. To benefit larger numbers of women, however, these technologies need to be further refined and adapted to a wider range of agroecosystems.

The impacts of land-use change, land degradation and agricultural intensification on the provision of ecosystem services to a landscape are the results of individual decisions made by the tens of thousands of smallholders who live there. Over time, these decisions have a significant impact on how land is used at the global scale. The MEA reports that "the most significant change in the structure of ecosystems has been the transformation of approximately one quarter of Earth's terrestrial surface to cultivated systems". More land was converted to cropland in the 30 years after 1950 than in the 150 years between 1700 and 1850.

Some areas of the world, particularly in Asia, have no more land that can be converted to agriculture. Food production increases in the last half century have depended principally on improved land productivity achieved largely through the increased use of irrigation, chemical fertilizers and improved crop varieties tailored for these inputs. This expansion of the yield frontier has, however, had significant impacts on the world's ecosystem processes, including the cycling of water, nitrogen, carbon and phosphorus. The quest to meet future food needs must address tighter resource constraints, particularly in terms of water and soil health. At the same time, agriculture must serve in the future as a principal means of curbing emissions of greenhouse gases by simultaneously slowing forest conversion to farmland and increasing the amount of carbon sequestered in trees on farms.

Maintaining or improving ecosystem services regarding water, soil health and biodiversity will have to be accomplished in agricultural landscapes suffering the effects of climate change. This is particularly so in most parts of sub-Saharan Africa and South Asia. Agroforestry systems have a critical role to play in helping to maintain the provision of key ecosystem services at the landscape scale. This will require both collective action at the grassroots and supportive national institutions and policies.

Pathways to Improving Livelihoods and Landscapes. Agroforestry is uniquely suited to address both the need for increased food and biomass resources and the need to sustainably manage agricultural landscapes to provide critical ecosystem services regarding water, biodiversity and carbon sequestration. Moreover, it is suited to achieving these objectives in highly impoverished rural areas.

The Centre recognizes this dual role of agroforestry and proposes three different pathways to improve the livelihoods of poor smallholders and two pathways to improve the sustainability and productivity of agricultural landscapes.

The first livelihood pathway recognizes that farm-grown trees enrich the asset base of poor households. Trees are investments whose value rises over time. This is exemplified in the global expansion of smallholder timber-production systems and tree crop systems based on cacoa, fruit, coconut and coffee agroforestry. The Centre is working to broaden the range and diversity of trees that can be integrated into farming systems and so significantly expand their product range, all the while analyzing the tradeoffs. Tree assets often produce higher income per unit of area than do annual crops and are more resilient to drought. They require less labour investment, which is particularly important in the poor, labour-constrained households that are often headed by women.

The second pathway for smallholders out of poverty is through maximizing the productivity of agroforestry systems and enhancing the complementarities that trees contribute to the productivity of crops and livestock. A core focus of the Centre has been to improve the productivity of agroforestry systems through improved tree germplasm, integrated soil fertility and the enhanced supply of high-quality tree fodder resources.

The third livelihood pathway focuses on improving the income of poor households by facilitating their access to markets. Many agroforestry species have the potential to produce high-value fruits, oils, cash crops and medicines that can be supplied

to expanding urban markets across the tropics. However, the marketing system for these products is often underdeveloped, particularly for forest products that are not traditional but have the potential to be domesticated. Centre scientists view this pathway as particularly important to stabilizing land-use change in areas such as the forest margins, as well as to increasing farmers' investment in agroforestry trees and systems throughout tropical agroecosystems.

These three pathways reinforce one another, with markets being a particularly important driver. However, agroforestry systems also have important roles to play in areas where market development is difficult but pressure on natural ecosystems is high.

The Centre foresees two pathways to improving the sustainability and productivity of agricultural landscapes, particularly those with high rates of rural poverty, as in sub-Saharan Africa, South Asia and upland areas of Southeast Asia.

The first of these pathways is to enhance the multifunctionality of agricultural landscapes by balancing improved productivity with the sustainable management of the natural resource base. This is addressed by focusing on the agricultural landscapes that experience the greatest environmental stress. In Southeast Asia, the focus is on stabilizing the forest margins by converting slash-and-burn systems into agroforests. In South Asia, the focus is on enhancing the role of agroforestry in improved watershed management, especially groundwater recharge. In sub-Saharan Africa, the focus is largely on improving land productivity by investing in the soil resource base. Agroforestry provides a mechanism to move toward conservation agriculture systems while enhancing levels of nutrient cycling and soil organic matter. In African

agricultural landscapes, a particular focus is on rehabilitating degraded agricultural land, both on farms and in common property arrangements.

The second pathway focuses on enhancing the supply of ecosystem services in agricultural landscapes, particularly regarding water, soil health, carbon sequestration and biodiversity. The potential role of agroforestry in both mitigating climate change and insulating smallholder farmers and agricultural landscapes against the negative impacts of extreme weather events is substantial. This includes important opportunities to develop the organizational and technical systems needed for carbon sequestration in smallholder farming systems and for linking them to carbon-trading markets. Managing trees in agricultural landscapes will prove critical to improved hydrology. It is essential to enhance stream flows in Africa in the dry season, given the region's dependence on surface water supplies, and to increase groundwater recharge in South Asia. Equally important will be the role of trees in moderating the damage done by extreme weather events to agricultural systems. Sustaining biodiversity and habitat is important at the interface between smallholder agricultural landscapes and conservation areas. Achieving such outcomes depends on farmer organizations supported by appropriate incentives for investment in agroforestry systems. This may include reward systems or other types of institutional and policy innovations to enhance ecosystem services, particularly for carbon and water.

Global Research Priorities

3.1 Developing the Strategy

The process of developing strategic priorities for the Centre included a number of steps:

- the identification and prioritization of globally relevant problems or challenges that agroforestry can address (see www.worldagroforestry.org/af1/index.php?id=79 for more details regarding the priority setting process as well as other relevant documentation);
- two externally facilitated workshops for staff to develop a new mission statement and develop strategic priorities using a framework that included:
  1. clarification of the Centre's role, niche and strategic advantage;
  2. a definition of strategic priorities for linking agroforestry research for development to the development challenges formulated by the CGIAR;
  3. clarification of major research thrusts and outcomes associated with the strategic priorities; and
  4. mechanisms for ensuring an integrated approach to generating knowledge and innovations at scales ranging from local to global;
- the use of four criteria to determine areas of intervention: salience (global importance of the problem and its likely impact on poverty, hunger and environmental degradation), credibility (trustworthiness of our knowledge and capability to deliver), legitimacy (comparative advantage), and fundability (potential to generate research funding relative to the problem);
- external consultation with partners and investors, and further deliberation with regard to a set of consolidated research priorities based on the development challenges;
- regular consultation and communication among staff and the Board of Trustees throughout the strategy process;
- approval of the strategy in April 2008 by the Board of Trustees; and
- the preparation of an implementation plan.

3.2 Output-Outcome-Impact Pathways

The process of strategy formulation resulted in a set of six coherent Global Research Priorities (GRPs) and corresponding projects around which our research is organized. These are designed to produce generic outputs that represent improvements in knowledge, understanding, market strategies, capacity or skills, or technology availability. The promotion and active dissemination of these outputs to users is a vital aspect of our agenda. Individual scientists and research teams produce specific deliverables that fall within each GRP but could also constitute the combined results from several GRPs. These deliverables or outputs drive our annual work programme and budget.

The main GRP outputs are intended to lead to one or more changes in:
1. farmer or community action or attitudes;
2. trader behaviour or value-chain function;
3. landscape governance and environmental condition;
4. institutional behaviour and competencies;
5. policy enablement.

These in turn contribute to development outcomes, described in Chapter 2 and shown in Figure 2, that bring about the impacts the Centre aims to achieve.

IMPACTS

Livelihoods

- Poverty alleviation
- Food security
- Good health
- Sustainable energy supply
- Social, gender and political equity

Landscapes

- Biodiversity conservation
- Habitat and land rehabilitation
- Climate change adaptation and mitigation

OUTCOMES

| Increasing the asset base of poor households through trees | Maximizing the productivity of agroforestry systems and the complementarities trees contribute to the productivity of crops and livestock | Improving the income of poor households by better linking them to markets | Expanding the multifunctionality of agricultural landscapes by balancing enhanced productivity with the sustainable management of the natural resource base | Maintaining or enhancing ecosystem services in agricultural landscapes, particularly regarding water, soil health, carbon sequestration and biodiversity |

OUTPUTS

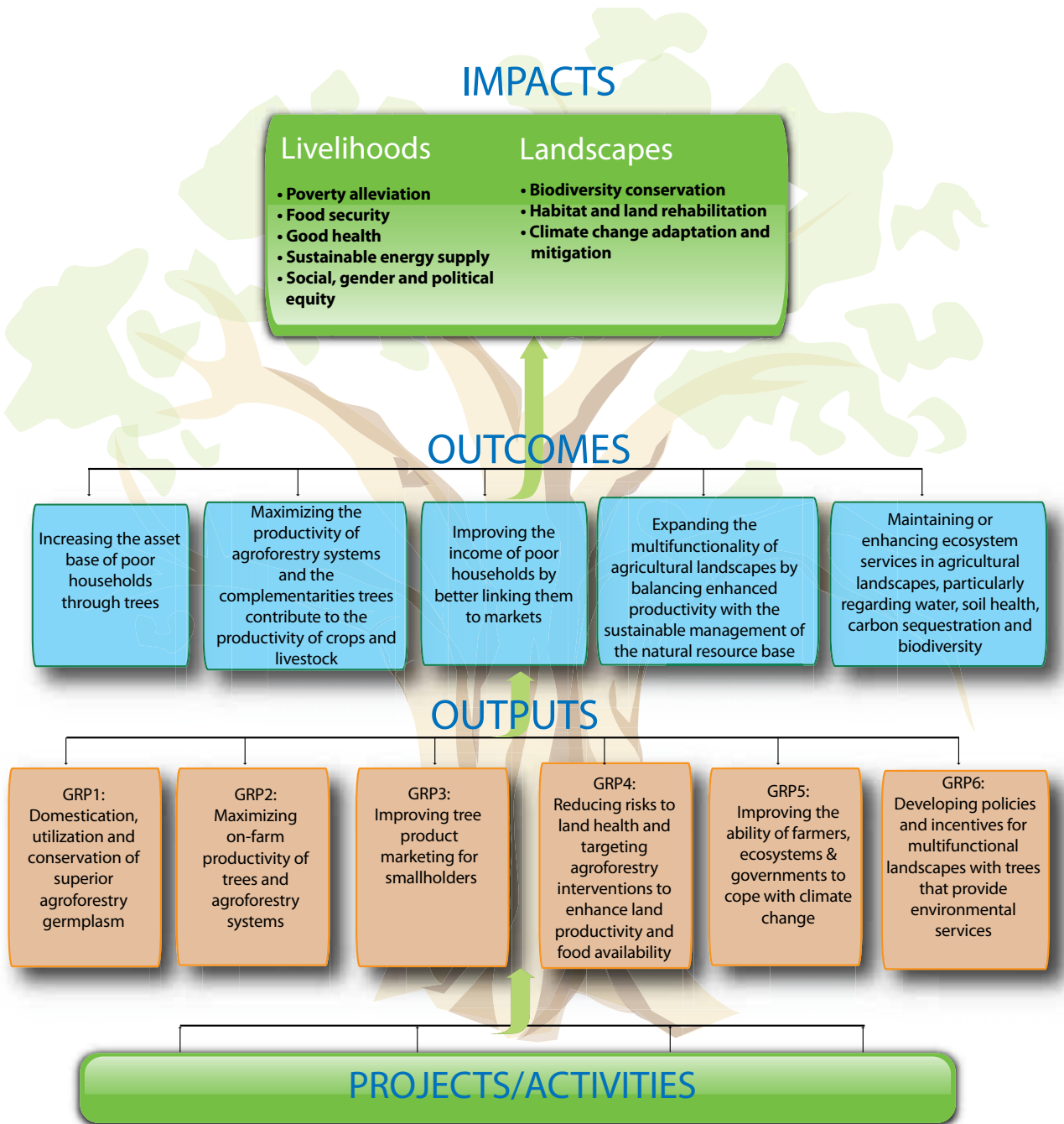| GRP1: Domestication, utilization and conservation of superior agroforestry germplasm | GRP2: Maximizing on-farm productivity of trees and agroforestry systems | GRP3: Improving tree product marketing for smallholders | GRP4: Reducing risks to land health and targeting agroforestry interventions to enhance land productivity and food availability | GRP5: Improving the ability of farmers, ecosystems & governments to cope with climate change | GRP6: Developing policies and incentives for multifunctional landscapes with trees that provide environmental services |

PROJECTS/ACTIVITIES

Figure 2. Output-outcome-impact pathways.

3.3 Global Research Priorities (GRPs)

The six GRPs are not standalone structures but the means of organizing our science and staff. An individual scientist is a member of two to three GRP teams, on average, as well as of regional teams. The regional teams link to collective action approaches in the CGIAR and with other international agricultural research centres. The several elements that cut across all GRPs include impact assessment, research methods, data management and capacity building. The interlinked work undertaken by GRPs ensures that they are interdependent. Achieving desired outcomes occurs by integrating GRP outputs. Our organizational structure, planning frameworks, effective partnerships and ex ante impact assessments ensure our credibility and legitimacy.

While much of our research has specific sociopolitical and geographic contexts, we use common methods, designs and principles to strengthen the large-scale validity and relevance of our outputs. This approach enhances the international public good (IPG) nature of the knowledge, policies and genetic materials we generate. Furthermore, it makes these international public goods more readily transferable as regional and national public goods. The coherence and integration of the six global research priorities at the outcome level provide opportunities for meta-analyses of crosscutting problems.

Global Research Priority 1: Domestication, utilization and conservation of superior agroforestry germplasm

1. Specific problems addressed

Tropical agroforestry systems are characterized by great diversity among and within tree species found in contrasting biological and complex niches. They inherently have immense value to farmers, institutions and markets. The diversity of species and agroforestry systems poses major challenges in developing generic models and principles of germplasm management. Owing to the vast range of taxa, their unique biological characteristics, lack of quality germplasm and lack of market integration, much variation remains untapped to improve livelihoods and environments. The problems that constrain the productivity of agroforestry systems include the:

- limited number of genetic improvement programmes for smallholder tree species and the scarcity of innovative tools and practices for on-farm tree propagation and management;
- over-centralization of tree seed supply nationally and scarcity of information for stakeholders on the availability, management and use of agroforestry tree species;
- scarcity of well-documented, characterized and comprehensive tree germplasm collections for domestication, conservation and understanding of invasiveness;
- absence of minimum populations of most on-farm tree species necessary for viable intergenerational sustainability; and
- inadequate national and international programmes to conserve agroforestry tree germplasm.

2. Objective

Opportunities exist to improve and optimize the productivity of agroforestry systems through improved germplasm. The objective of GRP1 is to increase access to improved germplasm of priority tree species and ensure better functioning of systems that supply tree seed and seedlings.

3. Sub-projects

GRP1 has two sub-projects:

GRP1.1. Develop improved tree germplasm and associated information through appropriate methods

GRP1.2. Develop sustainable systems of tree seed and seedling supply while promoting conservation with partners

4. Key research questions

The Centre seeks to provide answers to the following questions:

1. Taking into consideration emerging challenges and opportunities arising from global warming, urbanization, increased international trade, biotechnology, hidden hunger and land degradation, what innovative approaches can be developed and used to domesticate, promote and conserve high-value tree species in partnership with smallholder farmers?
2. What are the most appropriate technologies for characterizing and selecting genetic variation in agroforestry trees, taking into consideration cost effectiveness, adoption potential and tradeoffs?
3. What are the optimum ex situ, circa and in situ conservation strategies appropriate for managing and utilizing agroforestry tree genetic resources in light of current and emerging global challenges and opportunities?
4. What are the most appropriate models for supplying tree germplasm to farmers, taking into account cost effectiveness, incentives, and quality and quantity considerations at the farm and landscape levels?
5. What are the best systems and methodologies for procuring, storing, producing and distributing high-quality germplasm of priority tree species? What types of incentives are needed?

5. Intended deliverables

GRP1 will use innovative, scientific methodologies to deliver the following outputs:
- germplasm of key agroforestry species well characterized both genotypically and phenotypically;
- advanced knowledge and understanding of the desirable traits of priority species for different ecologies;
- designs for national and international conservation programmes for tree germplasm;
- sustainable models of seed- and seedling-supply systems for agroforestry tree species;
- sound tree improvement including participatory tree domestication models (tree propagation and multiplication practices and guidelines) for fruit, timber, medicine, biofuel, fodder and oil species;
- stronger networks of institutions specializing in tree genetic resources built in Africa and Asia and between them; and
- options for stronger private sector involvement in commercial practices to promote tree seed and seedling markets.

6. Approaches

GRP1 will collaborate with sister CGIAR centres such as Bioversity International, advanced research institutes, national agricultural research institutes and universities in nutrient evaluation, quantitative analyses of nutritional benefits, integrated pest management, phytochemical characterization, and quantitative analyses of health benefits covering multiple disciplines in the social and biophysical sciences. We will focus on maintaining working germplasm collections in genebanks for research and pilot developmental programmes. Long term conservation efforts will be undertaken with external genebanks, e.g., Svalbard and Kunming.

The GRP will contribute to the *ex situ* and *in situ* conservation of key agroforestry species through recommendations of technologies made to stakeholders and their use of them. An important part of the knowledge-to-action programme will be changes in policies and options for the promotion of existing and new domesticated species through regulatory frameworks, guidelines and training programmes, with small-scale entrepreneurs playing major roles in producing, procuring and distributing reproductive material.

7. GRP linkages and impact pathways

GRP1 provides input for the evaluation work conducted in GRP2 and the intervention testing undertaken in GRP4. GRP1 will evaluate the value of different species in terms of carbon sequestration and will research how climate change affects seed sources and tree ecology, thereby providing input into GRP5. Other GRPs links include work in intraspecific biodiversity conservation (with GRP2 and GRP6) and biofuel research to address tradeoffs (with GRP2, GRP3 and GRP5).

GRP1 will contribute to the sustainable use and management of tree genetic resources by working with development agencies and policymakers advocating the use of participatory tree-domestication techniques. It will collaborate with development partners and smallholder farmers taking up improved propagation methods in the multiplication of agroforestry species. The GRP will contribute to impacts by providing government services, nongovernmental organizations (NGOs) and development implementers with improved tools and knowledge that will enable them to make informed choices when selecting quality tree germplasm for enriching poor households' assets, maximizing the productivity of agroforestry systems, and ultimately maintaining and enhancing the supply of ecosystem services in agricultural landscapes.

Global Research Priority 2: Maximizing on-farm productivity of trees and agroforestry systems

1. Specific problems addressed

Smallholder farmers in the tropics have enjoyed few livelihood improvements because agricultural productivity has stagnated, prices for basic necessities have climbed and input costs have risen faster than the farmgate prices of major staple crops. Production risks are high, and farmers are poorly integrated into local and regional markets. Most farmers are not insured and operate in an environment of high uncertainty. Climate change, rainfall variability, and the degradation of ecosystem services and land have perpetuated low agricultural productivity.

This GRP focuses on the productivity gaps that can be filled through agroforestry systems that function better and are more profitable. Inadequate knowledge on the management of tree species and poor targeting of agroforestry interventions and practices inhibits on-farm productivity. The scarcity of sustainable local supplies of energy contributes to the difficulties that smallholder farmers face.

2. Objective

The objective of GRP2 is to develop better understanding of and approaches for enhancing on-farm productivity through improved agroforestry systems. This includes nutrient cycling among trees, animals and crops; using local ecological knowledge to develop improved agroforestry management principles; expanding tree species diversity; developing coping mechanisms for climate variability; and considering tree-soil interactions to match species to sites and systems.

3. Sub-projects

GRP2 has two sub-projects:

GRP2.1. Enhancing understanding of the costs, benefits and risks of agroforestry technologies and systems under varying conditions

GRP2.2. Developing principles, methods and practices for improved tree and agroforestry management

4. Key research questions

The Centre seeks to provide answers to the following questions:

1. What are the appropriate agroforestry-management options and their economic and ecological impacts on farming systems and household welfare?
2. How can multi-strata agroforestry systems best be managed for diversity, productivity, profitability and stability?
3. How are the costs and benefits of tree systems distributed among household members and social groups?
4. How can the ecosystem services, social utility and economic profitability of trees best be incorporated into mixed agroforestry systems?
5. What tools are required for identifying the right tree for the right place or smallholder populace? What tree integration models can optimize space and interactions among trees, crops and livestock?
6. What is the impact of land-tenure policies and practices on the development and spread of mixed agroforestry systems?
7. What are the impacts of external policies and institutional change on the adoptability, management and stability of agroforestry systems (e.g., technical recommendations, land and tree tenure, markets and policy)?

5. Intended deliverables

The deliverables envisaged by GRP2 include the following:

- strategies developed for improved water-use efficiency, productivity and conservation at the farm level;
- appropriate approaches and tools formulated for realizing rainwater harvesting potential;
- spatial, economic and ecological impacts of various agroforestry technologies, approaches and systems evaluated;
- tree-management guidelines and options developed on spacing, pruning, watering, fertilizing and harvesting, including a global database on the performance of different technologies in different contexts;
- suitability domains derived for various agroforestry technologies, including bioenergy species and high-value timber species on smallholder farms;
- outlooks developed for the scoping, targeting and design of interventions for tree products and economic analyses of their production;
- widened portfolio of options developed for species diversity, abundance and management in agroforestry systems;
- knowledge generated on the gender, social and cultural implications of agroforestry technologies;
- preferential approaches, tools and policies identified to help women and other disadvantaged smallholder farmers improve their livelihoods and sustainable environment;
- negotiation-support toolkits developed that allow the transfer of agroforestry technologies to other contexts; and
- management options and guidelines provided for high-value tree crops and indigenous fruit trees.

6. Approaches

GRP2 will collaborate with advanced research institutes, other CGIAR centres, national agricultural research institutions and development organizations. Partners will provide expertise in evaluating the impacts and tradeoffs of farming systems for improved food security, looking at the issues of nutrient cycling, soil fertility and water productivity; tree diversity on farms and the conservation of agro-biodiversity; livestock systems on farms; and how to facilitate action research in different contexts. Policy work will include analyses of the effects of tenure security to inform debates on access and usage rights to land, water and tree resources. The Centre's scientists will work closely with national researchers to establish on-farm research and demonstration sites and scale up best practices. The emerging issues that this GRP will consider include biofuels in agroforestry systems in Asia and in West and Central Africa, as well as watersheds' partitioning of rainwater into 'blue water' flows through streams or groundwater channels and 'green water', which is moisture held in the soil and used by plants.

7. GRP linkages and impact pathways

GRP2 links with GRP1 regarding germplasm quality issues, germplasm selection and work in participatory tree domestication. It links with GRP3 in market forecasting and market chain analysis, including certification systems, and with GRP4 on the dynamics and drivers of land-use change and rehabilitating degraded lands. Adaptation and vulnerability to climate change is a crosscutting area in GRP5 that will be closely linked to GRP2 as a part of the context for agroforestry systems research. The work conducted in GRP6 on policies and environmental services will be informed by GRP2 outputs. The attainment of deliverables will result in changes at the levels of the farmer and community that will contribute to enhanced productivity and

environmental services by integrating trees on farms, thereby creating more diverse production systems and generating income through such high-value tree products as fruits, timber, energy, medicines, fibres, fodder, oils and nuts. Our research will target smallholder farmers and their support agencies to generate the knowledge needed to improve livelihood options through the appropriate intensification and diversification of farming systems. In short, we seek the right tree for the right place.

Global Research Priority 3: Improving tree product marketing for smallholders

1. Specific problems addressed

We address problems faced by two different sets of actors. First, small-scale farmers and entrepreneurs lack business skills, have limited access to markets for agroforestry tree products, and receive little information on market demand. They are poorly organized and lack assured and stable markets. It is therefore not surprising that they face high marketing risks and costs and earn low returns from marketing their tree products.

The second set of actors is governmental and nongovernmental organizations seeking to facilitate smallholder marketing, who also face critical problems. Few tools are available to assess market opportunities or help farmers exploit available opportunities like adding value to products from the farm. These facilitating organizations find that there are few assessments of market demand or models for business investment in tree products.

To make matters worse, both sets of actors face problems in the enabling environment. Inadequate institutional support for marketing (e.g., providing market information and

credit) and skewed policies create barriers and disincentives that frustrate smallholders' marketing of their production. Certification standards are absent, as are associated premiums for agroforestry tree products. Trade in some products is overregulated (e.g., on-farm timber) and in others underregulated (e.g., herbal medicines). Many policymakers still view private traders as a parasitic class rather than as a resource that can generate wealth in rural areas. Also, they rarely perceive the potential of tree products to generate significant incomes for smallholder farmers.

2. Objective

GRP3 aims to expand smallholders' access to value chains for agroforestry tree products and to improve marketing strategies and market performance to enhance incomes and livelihoods.

3. Sub-projects

GRP3 has two sub-projects:

GRP3.1. Developing approaches for expanding smallholders' access to tree product value chains.

GRP3.2. Improving marketing strategies to enhance the performance of tree product value chains and smallholder livelihoods

4. Research questions

The Centre seeks to provide answers to the following questions:
1. Under which circumstances is it better to help farmers capture a bigger portion of the value chain or, alternatively, to more effectively link them to traders and agribusinesses for marketing their production?
2. How and under what circumstances can certification help the poor? How can the poor gain better access to certified markets?

3. How can collective action (e.g., Landcare[2]) improve farmers' access to markets, enhance livelihoods and help market performance (e.g., outgrower schemes)? What are the drivers and triggers, and how can barriers be overcome?
4. What key factors contribute to effective linkages between farmers and the private sector? How do they vary over space, time and product type?
5. Can vouchers[3] and other innovations help strengthen private seed and seedling markets? Under what circumstances are they most effective?
6. What are the best practices for equitable and effective farmer enterprises, considering issues of social stratification, gender and economic differentiation?
7. How can organizations and entrepreneurs decide which enterprises are most viable in their area? How can models be used to assess the ex ante feasibility and profitability of such enterprises?

5. Deliverables

The deliverables envisaged for GRP3 include the following:
• rapid appraisals and detailed analyses to characterize markets and quantify critical parameters of sub-sectors and value chains for assessing opportunities and constraints;
• a conceptual framework and decision-support tools for guiding different types of partnerships, such as public-private partnerships, and assessing tradeoffs among options;

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[2] Landcare is a voluntary, community-driven conservation phenomenon that originated in Australia to address biodiversity loss and soil and water degradation. It is being replicated in other countries in the tropics.

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[3] In a voucher system, farmers present a ticket to a private nursery in exchange for a free or subsidized seedling, instead of simply receiving free or subsidized seedlings from a project nursery. Vouchers help strengthen private nursery enterprises because they, and not project nurseries, produce the seedlings and farmers get used to obtaining seedlings from the private nursery, instead of from a project nursery.

- a guide to facilitating collective action and identifying best institutional innovations for collective marketing and certification;
- a decision-support tool to help decide whether and how certification schemes can help the poor;
- innovative approaches for marketing tree seed and seedlings;
- models for assessing the viability of a new enterprise;
- approaches developed to 'incubate' small-scale business and help facilitate the development of new types of tree product enterprises; and
- a synthesis of farmer enterprise impacts on the social and economic structures of communities and strategies to benefit women, the poor and other marginalized groups.

6. Approaches

We seek to strengthen the science and practice of marketing agroforestry tree products based on guidance from a Centre-commissioned external review on marketing and the Centre's third external programme and management review. We envision strengthening our teams by working more closely with partners. We have already initiated partnerships with national public institutions in southern Africa and South Asia. Internationally, we will work with certification bodies, advanced research institutions and international NGOs (e.g., Landcare and Technoserve). Our main CGIAR partners are the International Food Policy Research Institute (IFPRI), International Centre for Tropical Agriculture (CIAT by its Spanish abbreviation), African Highlands Initiative, and Collective Action and Property Rights Initiative. Nationally and locally, we work with national agricultural research systems (NARS), universities, and such NGOs as micro-finance institutions, community-based organizations, private businesses and farmer associations.

Key users of our research outputs include national and local policymakers, cooperatives, farmer organizations, NGOs, NARS, other members of the research community and government extension services. Regarding multinational companies, we work with Unilever and Mars, Inc., and expect other private sector actors and policymakers to use our tools for improving linkages with farmers and certification bodies, as well as adopt recommendations for improving smallholder access.

7. GRP linkages and impact pathways

We will assist GRP1 in setting priorities among species for domestication based on market potential, assessing tradeoffs between using trees to produce biofuels and other uses, and identifying the best systems of germplasm supply and distribution under different circumstances. Market forecasting and market chain analysis will be conducted with GRP2. GRP3 will help identify market opportunities for the most productive tree systems emerging from GRP2 research. With GRP5, we will help determine the most suitable species for adapting to climate change based on market values. With GRP6, we will examine the costs and benefits of ecocertification schemes and the appropriateness of vouchers in different situations.

Our main outcomes include stronger linkages between smallholders and the private sector, improved policies to support smallholder marketing and enterprises, more effective farmer organizations, more numerous and profitable farmer enterprises, and greater smallholder access to markets, especially for the poor and women. Other outcomes include improved representation for smallholder associations in policymaking, strengthening of the private sector in marketing seed and seedlings, greater diversification of income sources for smallholders, better targeting of certification interventions, and

capacity building to enhance entrepreneurial skills among partner organizations such as NGOs and government extension services.

Global Research Priority 4: Reducing risks to land health and targeting agroforestry interventions to enhance land productivity.

1. Specific problems addressed

Land degradation is a global threat to habitats, economies and societies. It is the overarching environmental issue of concern in Africa, threatening food security, ecosystems and livelihoods. Fertility decline and soil degradation are major concerns for food security in developing countries. However, current measurement and information systems on land degradation in developing countries are grossly inadequate for the task of planning and evaluating land health[4] and agroforestry policy and practice. In particular, there is a lack of systematic data on land health risks to enable the efficient targeting of land management and agroforestry interventions[5] or to answer questions such as these:

- What are the socioeconomic and biophysical determinants of land degradation (land health risks) and how are they geographically distributed?
- How much land degradation can be avoided or reversed through targeted action to reduce risks?
- How cost efficient are preventative and rehabilitation agroforestry interventions under different conditions?

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4 Land health is the capacity of land to sustain the delivery of essential ecosystem services, as defined by the MEA.

5 'Intervention' means any promotional, preventive, curative or rehabilitative activity for which the primary intent is to improve land health and human well-being. GRP4 focuses on targeting and evaluations of programmatic interventions, as distinct from individual technology interventions.

2. Objective

GRP4's objectives are to (1) develop multi-scale and widely usable methods of land health surveillance that can provide information on where land problems exist and where the major risks are; (2) quantify and map these major risks to land health in the tropics, target land management and agroforestry interventions to reduce and reverse these risks at different scales, and evaluate the cost-effectiveness and outcomes of intervention programmes; and (3) develop national capacity to use the methods and tools of operational land health surveillance.
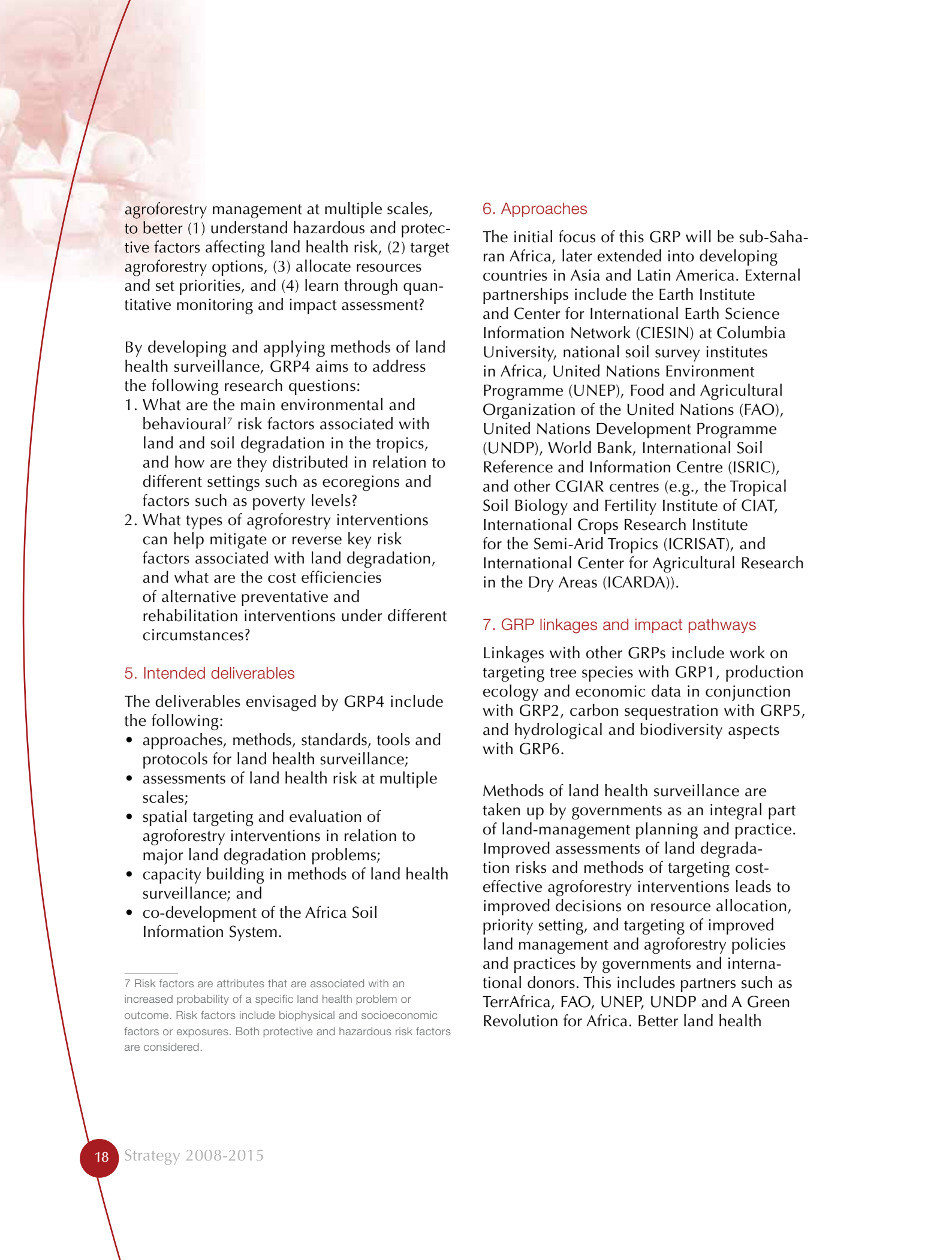
3. Sub-projects

GRP4 has two sub-projects:

GRP4.1. Developing effective methods of land health surveillance

GRP4.2. Assessing risks to land health and targeting agroforestry interventions to reduce and reverse land degradation

4. Key research questions

Recent advances in World Agroforestry Centre research on land health surveillance[6] are based on principles adapted from public health surveillance, where the accurate measuring and monitoring of improvements and other changes in the health of populations is closely integrated with statistical methods to form the scientific bases for policy development, priority setting and management. GRP4 builds on these advances and tackles the key methodological question: How can systems of land health surveillance deploy modern science and technology to strengthen evidence-based decision-making on land and

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6 Land health surveillance is the systematic collection, analysis and interpretation of data essential to the planning, implementation and evaluation of land management policy and practice, and the application of these data to the promotion, protection and rehabilitation of land and ecosystem health. A surveillance system includes a functional capacity for data collection, analysis and dissemination linked to land health programmes.

agroforestry management at multiple scales, to better (1) understand hazardous and protective factors affecting land health risk, (2) target agroforestry options, (3) allocate resources and set priorities, and (4) learn through quantitative monitoring and impact assessment?

By developing and applying methods of land health surveillance, GRP4 aims to address the following research questions:
1. What are the main environmental and behavioural[7] risk factors associated with land and soil degradation in the tropics, and how are they distributed in relation to different settings such as ecoregions and factors such as poverty levels?
2. What types of agroforestry interventions can help mitigate or reverse key risk factors associated with land degradation, and what are the cost efficiencies of alternative preventative and rehabilitation interventions under different circumstances?

5. Intended deliverables

The deliverables envisaged by GRP4 include the following:
• approaches, methods, standards, tools and protocols for land health surveillance;
• assessments of land health risk at multiple scales;
• spatial targeting and evaluation of agroforestry interventions in relation to major land degradation problems;
• capacity building in methods of land health surveillance; and
• co-development of the Africa Soil Information System.

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7 Risk factors are attributes that are associated with an increased probability of a specific land health problem or outcome. Risk factors include biophysical and socioeconomic factors or exposures. Both protective and hazardous risk factors are considered.

6. Approaches

The initial focus of this GRP will be sub-Saharan Africa, later extended into developing countries in Asia and Latin America. External partnerships include the Earth Institute and Center for International Earth Science Information Network (CIESIN) at Columbia University, national soil survey institutes in Africa, United Nations Environment Programme (UNEP), Food and Agricultural Organization of the United Nations (FAO), United Nations Development Programme (UNDP), World Bank, International Soil Reference and Information Centre (ISRIC), and other CGIAR centres (e.g., the Tropical Soil Biology and Fertility Institute of CIAT, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), and International Center for Agricultural Research in the Dry Areas (ICARDA)).

7. GRP linkages and impact pathways

Linkages with other GRPs include work on targeting tree species with GRP1, production ecology and economic data in conjunction with GRP2, carbon sequestration with GRP5, and hydrological and biodiversity aspects with GRP6.

Methods of land health surveillance are taken up by governments as an integral part of land-management planning and practice. Improved assessments of land degradation risks and methods of targeting cost-effective agroforestry interventions leads to improved decisions on resource allocation, priority setting, and targeting of improved land management and agroforestry policies and practices by governments and international donors. This includes partners such as TerrAfrica, FAO, UNEP, UNDP and A Green Revolution for Africa. Better land health

policy and management brings in turn health-ier ecosystems through the enhancement of environmental services for the landscape and improved rural livelihoods in developing countries through the sustainable and produc-tive management of agricultural landscapes.

Global Research Priority 5: Improving the ability of farmers, ecosystems and governments to cope with climate change

1. Specific problems addressed

Developing countries will bear the brunt of climate change and suffer most from its negative impacts. Mitigation efforts will only partly soften the effects of climate change. Local climates and terrestrial ecosystems will change, threatening biota and human liveli-hoods. Yet, even as the climate changes, food and fibre production, environmental services, and rural livelihoods must improve, not just be maintained.

In many poor rural landscapes, where access to inputs such as fertilizer is limited, farming communities have met the food demands of growing populations by making agriculture more extensive rather than more intensive. Cultivating marginal lands is risky in the best of times. Climate change is increas-ing inter-annual rainfall variability and the frequency of extreme events, accelerating the degradation of the soil and water resources upon which farming communities depend for their livelihoods. The agricultural systems most vulnerable to climate change are those already affected by unsustainable manage-ment and land and resource degradation.

2. Objective

The objective of GRP5 is to improve the stability of the farming systems and livelihood strategies of smallholder farmers in the face of current climate variability and long-term climate change. This will be achieved through farmers' increased use of trees for intensifying, diversifying and buffering farm systems.[8] Four areas will be considered: vulnerability assessments; the impact of climate change on agroforestry systems; adaptation to climate change; and synergies in agroforestry systems between climate change adaptation and mitigation.

3. Sub-projects

GRP5 has two sub-projects:

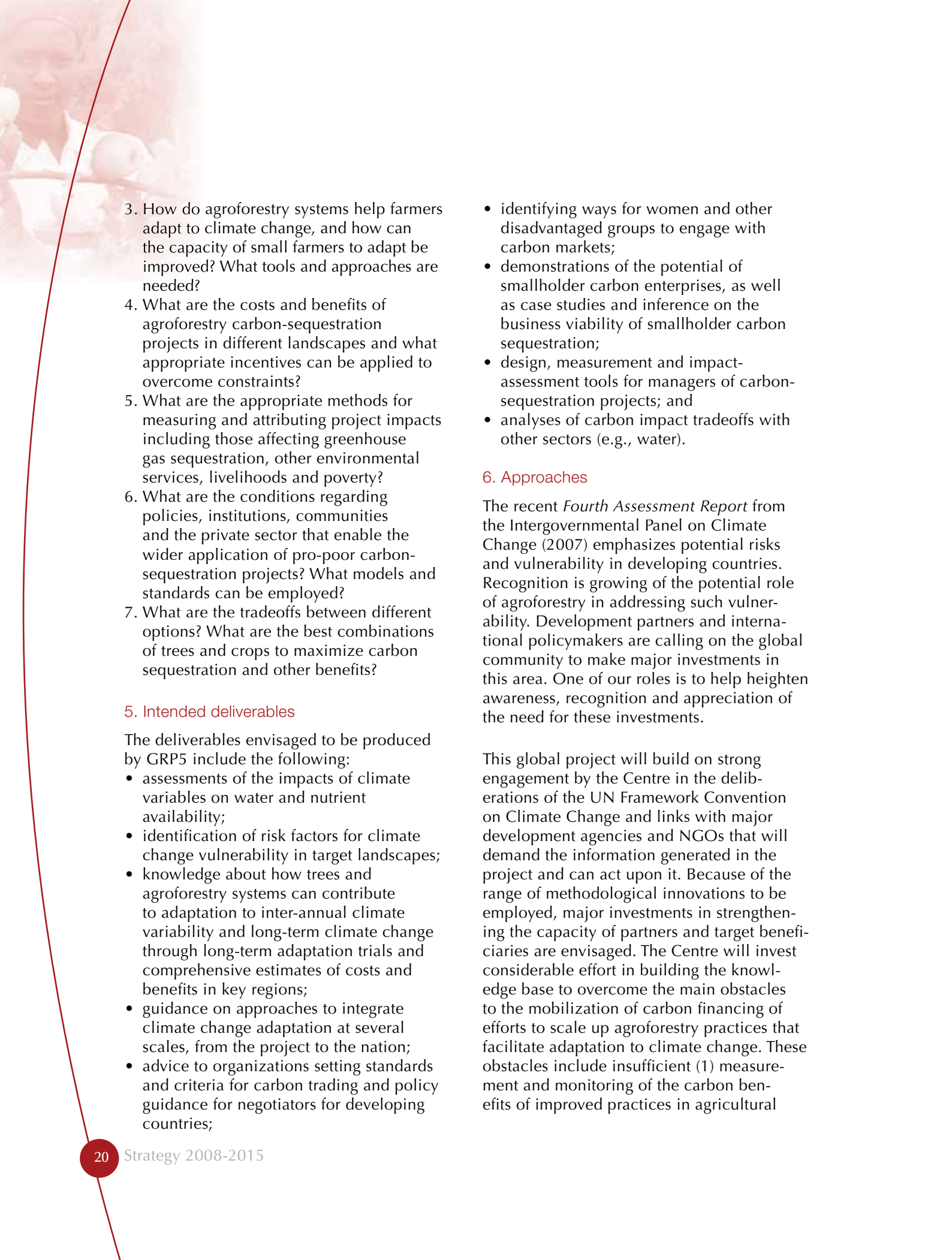GRP5.1. Vulnerability and adaptation of agroforestry systems to climate variability and change

GRP5.2. Advancing carbon sequestration through agroforestry to enhance livelihoods while mitigating climate change

4. Key research questions

The Centre seeks to provide answers to the following questions:
1. Regarding vulnerability and adaptation, how will climate change affect water and nutrient availability and seasonal patterns, and how will these changes affect the productivity and stability of agroforestry systems at different scales (trees, farms, landscapes and river basins)?
2. Where are the most vulnerable places and peoples in the agroforestry landscape?

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8 This is based on the hypotheses that (1) trees are deep rooted and possess large reserves and are thus less susceptible than annual crops to inter-annual variability or short-lived extreme events like droughts and floods and that (2) trees, as perennials, offer diversification options that can improve incomes and reduce production risks associated with shocks related to climate change. The task for GRP5 is to evaluate these two hypotheses in different farming systems, cultural contexts and landscapes.

3. How do agroforestry systems help farmers adapt to climate change, and how can the capacity of small farmers to adapt be improved? What tools and approaches are needed?
4. What are the costs and benefits of agroforestry carbon-sequestration projects in different landscapes and what appropriate incentives can be applied to overcome constraints?
5. What are the appropriate methods for measuring and attributing project impacts including those affecting greenhouse gas sequestration, other environmental services, livelihoods and poverty?
6. What are the conditions regarding policies, institutions, communities and the private sector that enable the wider application of pro-poor carbon-sequestration projects? What models and standards can be employed?
7. What are the tradeoffs between different options? What are the best combinations of trees and crops to maximize carbon sequestration and other benefits?

5. Intended deliverables

The deliverables envisaged to be produced by GRP5 include the following:
• assessments of the impacts of climate variables on water and nutrient availability;
• identification of risk factors for climate change vulnerability in target landscapes;
• knowledge about how trees and agroforestry systems can contribute to adaptation to inter-annual climate variability and long-term climate change through long-term adaptation trials and comprehensive estimates of costs and benefits in key regions;
• guidance on approaches to integrate climate change adaptation at several scales, from the project to the nation;
• advice to organizations setting standards and criteria for carbon trading and policy guidance for negotiators for developing countries;

• identifying ways for women and other disadvantaged groups to engage with carbon markets;
• demonstrations of the potential of smallholder carbon enterprises, as well as case studies and inference on the business viability of smallholder carbon sequestration;
• design, measurement and impact-assessment tools for managers of carbon-sequestration projects; and
• analyses of carbon impact tradeoffs with other sectors (e.g., water).

6. Approaches

The recent *Fourth Assessment Report* from the Intergovernmental Panel on Climate Change (2007) emphasizes potential risks and vulnerability in developing countries. Recognition is growing of the potential role of agroforestry in addressing such vulnerability. Development partners and international policymakers are calling on the global community to make major investments in this area. One of our roles is to help heighten awareness, recognition and appreciation of the need for these investments.

This global project will build on strong engagement by the Centre in the deliberations of the UN Framework Convention on Climate Change and links with major development agencies and NGOs that will demand the information generated in the project and can act upon it. Because of the range of methodological innovations to be employed, major investments in strengthening the capacity of partners and target beneficiaries are envisaged. The Centre will invest considerable effort in building the knowledge base to overcome the main obstacles to the mobilization of carbon financing of efforts to scale up agroforestry practices that facilitate adaptation to climate change. These obstacles include insufficient (1) measurement and monitoring of the carbon benefits of improved practices in agricultural

landscapes, (2) investor confidence, and (3) policy and institutional links between small farmers and carbon markets.

7. GRP linkages and impact pathways

GRP5 research on climate change is a crosscutting issue for all of the GRPs. GRP1 and GRP2 are closely linked through work on germplasm and agroforestry systems to climate change adaptation research. Carbon markets will be among the options that GRP3 and GRP6 will consider. GRP6 will draw on the work in GRP5 to inform the policy debate on climate change, and the work of GRP4 to target agroforestry interventions must be informed by the adaptive capacity of tree systems to climate change.

Improved and sustained agroecosystem productivity in the face of climate change, as well as enhanced income generation from smallholder carbon-sequestration projects, are the targeted impacts of this global project. These impacts will be achieved through the following outcomes:

- stakeholders use knowledge to enhance the capacity of smallholder farmers in developing countries to adapt to climate change;
- social science knowledge is utilized on the role of agroforestry and natural resource management to better enable smallholder farmers to adapt to current and future climate change;
- knowledge and decision-support tools such as a toolbox for project managers are made operational for investment in smallholder carbon-sequestration projects; and
- agroforestry knowledge is mainstreamed in initiatives in the areas of agriculture, environment and forestry to mitigate and adapt to climate change.

The advent of carbon markets over the past decade creates new and significant opportunities for financing sustainable rural development and scaling up agroforestry practices
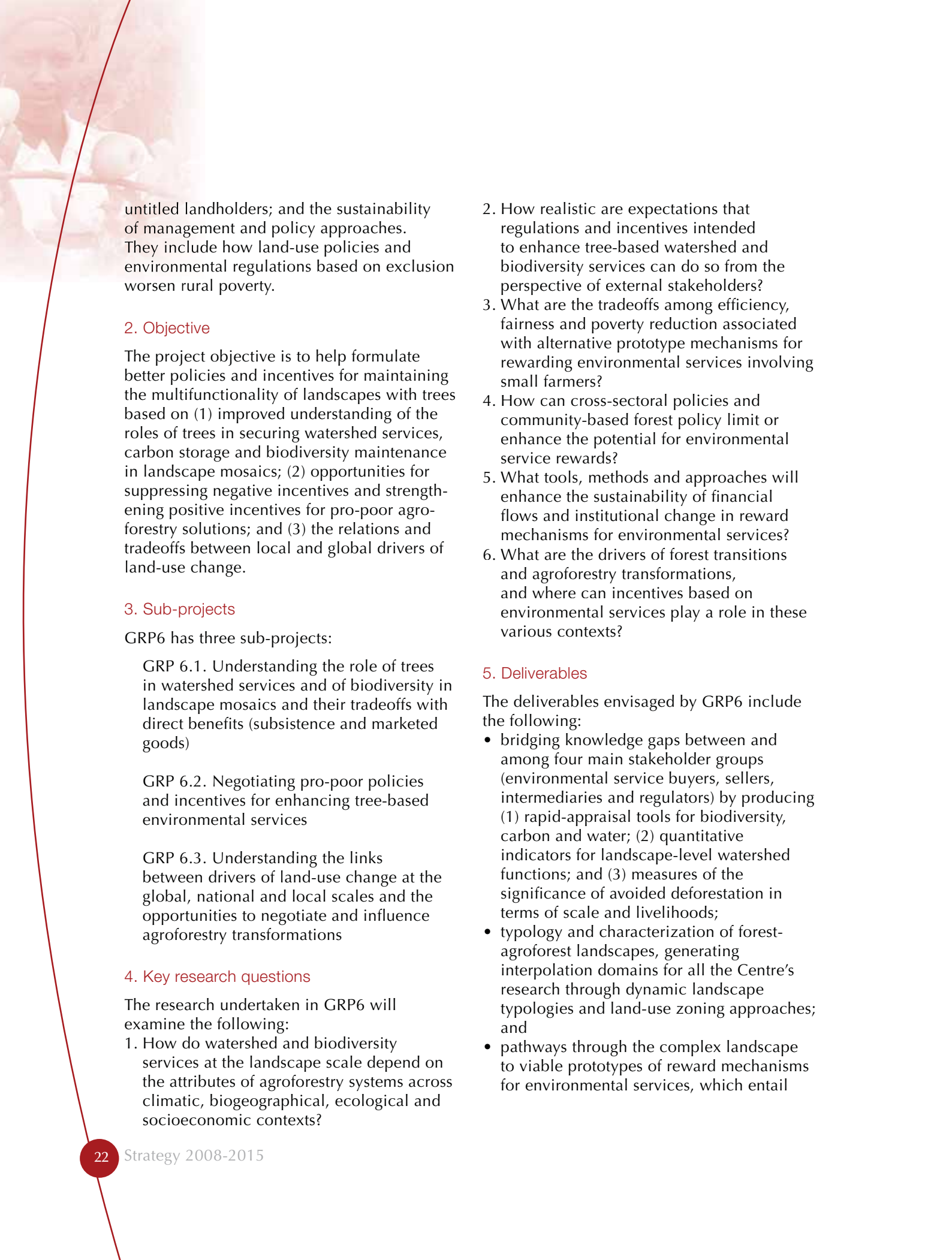
for climate change adaptation and sustainable land management. The Centre considers these carbon markets, which are projected to exceed $1 trillion by 2025, to be primary impact pathways for its research.

Global Research Priority 6: Developing policies and incentives for multifunctional landscapes with trees that provide environmental services

1. Specific problems addressed

More than at any other time in our history, we are challenged to maintain or strengthen ecosystem services regarding water, soil health and biodiversity that will continue to support both human needs and the functioning of natural ecosystems, even under changing climates. Trees may be the oldest, largest and most provisioning organisms in existence, but increasingly conflicts and dilemmas bedevil questions that compare tree plantations, natural forests and trees on farms. We lack cost-effective approaches with which to appraise integrated natural resource management in landscapes. Few valuation tools exist to estimate the cost and value of environmental services and local goods, relative to marketable goods. The management of these multifunctional landscapes requires mechanisms to balance (1) goods and services; (2) short, medium and long-term objectives; and (3) efficiency and equity in the pursuit of sustainable development.

The role of trees in providing environmental services needs to be realistically assessed so that appropriate incentives and regulatory approaches can be negotiated among stakeholders and updated through learning. The specific problems relate to efficiency; fairness to the poor, women and

untitled landholders; and the sustainability of management and policy approaches. They include how land-use policies and environmental regulations based on exclusion worsen rural poverty.

2. Objective

The project objective is to help formulate better policies and incentives for maintaining the multifunctionality of landscapes with trees based on (1) improved understanding of the roles of trees in securing watershed services, carbon storage and biodiversity maintenance in landscape mosaics; (2) opportunities for suppressing negative incentives and strength-ening positive incentives for pro-poor agro-forestry solutions; and (3) the relations and tradeoffs between local and global drivers of land-use change.

3. Sub-projects

GRP6 has three sub-projects:

GRP 6.1. Understanding the role of trees in watershed services and of biodiversity in landscape mosaics and their tradeoffs with direct benefits (subsistence and marketed goods)

GRP 6.2. Negotiating pro-poor policies and incentives for enhancing tree-based environmental services

GRP 6.3. Understanding the links between drivers of land-use change at the global, national and local scales and the opportunities to negotiate and influence agroforestry transformations

4. Key research questions

The research undertaken in GRP6 will examine the following:
1. How do watershed and biodiversity services at the landscape scale depend on the attributes of agroforestry systems across climatic, biogeographical, ecological and socioeconomic contexts?

2. How realistic are expectations that regulations and incentives intended to enhance tree-based watershed and biodiversity services can do so from the perspective of external stakeholders?
3. What are the tradeoffs among efficiency, fairness and poverty reduction associated with alternative prototype mechanisms for rewarding environmental services involving small farmers?
4. How can cross-sectoral policies and community-based forest policy limit or enhance the potential for environmental service rewards?
5. What tools, methods and approaches will enhance the sustainability of financial flows and institutional change in reward mechanisms for environmental services?
6. What are the drivers of forest transitions and agroforestry transformations, and where can incentives based on environmental services play a role in these various contexts?

5. Deliverables

The deliverables envisaged by GRP6 include the following:
- bridging knowledge gaps between and among four main stakeholder groups (environmental service buyers, sellers, intermediaries and regulators) by producing (1) rapid-appraisal tools for biodiversity, carbon and water; (2) quantitative indicators for landscape-level watershed functions; and (3) measures of the significance of avoided deforestation in terms of scale and livelihoods;
- typology and characterization of forest-agroforest landscapes, generating interpolation domains for all the Centre's research through dynamic landscape typologies and land-use zoning approaches; and
- pathways through the complex landscape to viable prototypes of reward mechanisms for environmental services, which entail

(1) identifying conditional incentives for environmental service provision, (2) tools for fairly negotiating land and tree property rights, (3) demonstrating sustainable environmental reward mechanisms, and (4) case studies on the role of agroforestry in community-based resource management.

6. Approaches

The research in this GRP builds on a decade of research on the biophysical and economic tradeoffs in natural resource management, especially in the humid and sub-humid tropics. It also builds on efforts in the past 5 years to design and learn from investigations toward providing efficient and fair incentive mechanisms, while reforming perverse policies. Current strength and experience rests in Southeast Asia and East Africa. The lessons learnt and approaches taken will be expanded to other regions and contexts, building the capacity of national partners and international supporters. Support will be given to national negotiators to improve the efficiency and fairness of drivers and incentives for land-use change.

7. GRP linkages and impact pathways

The questions in GRP6 require a synthesis of the components addressed in the five other GRPs to jointly understand the landscape-scale issues. These are aptly demonstrated for watershed services, biodiversity and climate change. The four main stakeholder groups (buyers, sellers, intermediaries and regulators) will all need to be engaged before the knowledge generated with them can lead to action for enhanced livelihoods and environmental services. The prototypes and syntheses from benchmark sites, and the identification of good practices and standards for realistic, conditional, voluntary and pro-poor mechanisms to reward environmental service, will contribute to changes in landscape governance and environmental conditions.

The ASB Partnership for the Tropical Forest Margins (ASB)

ASB Partnership for the Tropical Forest Margins is a Systemwide programme of the CGIAR hosted and coordinated by the World Agroforestry Centre. The core of ASB is formed by its five CGIAR partners (CIAT, CIFOR, IFPRI, International Institute of Tropical Agriculture (IITA) and World Agroforestry Centre) and lead agricultural research organizations in Peru, Brazil, Cameroon, Indonesia, Philippines and Thailand. ASB explores options for shaping land use at forest-agriculture interfaces in the humid tropics with the goal of raising the productivity and income of rural households without worsening deforestation or undermining essential environmental services. ASB's work is grounded in benchmark sites located in these six tropical forest countries, emphasizing drivers of land-use change; tradeoffs associated with different land uses; and the roles of markets, regulation, property rights and rewards in shaping farmers' practices and land-use decisions. ASB was founded in 1994 and celebrated with the CGIAR Science Award for Outstanding Partnership in 2005.

ASB's medium-term research and communication strategy focuses on policy issues emerging nationally, regionally and internationally. Climate change mitigation is the dominant policy issue at all of these levels, particularly driven by worldwide interest in the potential to reduce global emissions of greenhouse gases through avoided deforestation. The ASB partnership is uniquely positioned to undertake analyses of the opportunities for achieving avoided deforestation with sustainable benefits. The results are directly relevant to ongoing debates on reducing emissions from deforestation and degradation (REDD) in developing countries within the UN Framework Convention on Climate Change.

ASB's work is now positioned to contribute to shaping the post-2012 climate change regime. ASB aims to make a significant contribution

to evaluating mechanisms that translate international agreements into instruments that will help change the behaviour of the people at the 'coal face', while making the most of the potential to improve their livelihoods and the local resource base upon which they depend.

3.4 Inter-GRP Linkages

We are strengthening two key innovations in the way we conduct agroforestry research. First, we are fostering greater integration and coherence as a key principle in implementing the global research priorities (figure 3). This will involve facilitating an end-to-end systems approach that includes the information decision-makers need, ensures the integration of scale from farm to landscape to globe, uses generic designs and frameworks for global projects, establishes clear interfaces between global projects, and elucidates value chains and strong links to the private sector.

Secondly, we will emphasize synthesis and cross-regional learning as a priority for generating international public goods. These efforts will underpin the use of common conceptual frameworks for GRPs, greater synthesis at multiple levels, a sharper focus on global conceptualization and theory building, enhanced multi-scale research in agroecosystems, conscientious testing of the assumptions surrounding the benefits of agroforestry, and the global testing of principles.

The Centre will aim for coherence between problems addressed and approaches used in different regions to (1) rapidly learn from lessons and methods developed in one region and apply them to other regions where commonalities and extrapolation or interpolation domains are clearly established and (2) enhance cross-regional activities and syntheses leading to principles and solutions that can be generalized globally. The Centre's global science advisor (a new position) will be responsible for spearheading these developments.
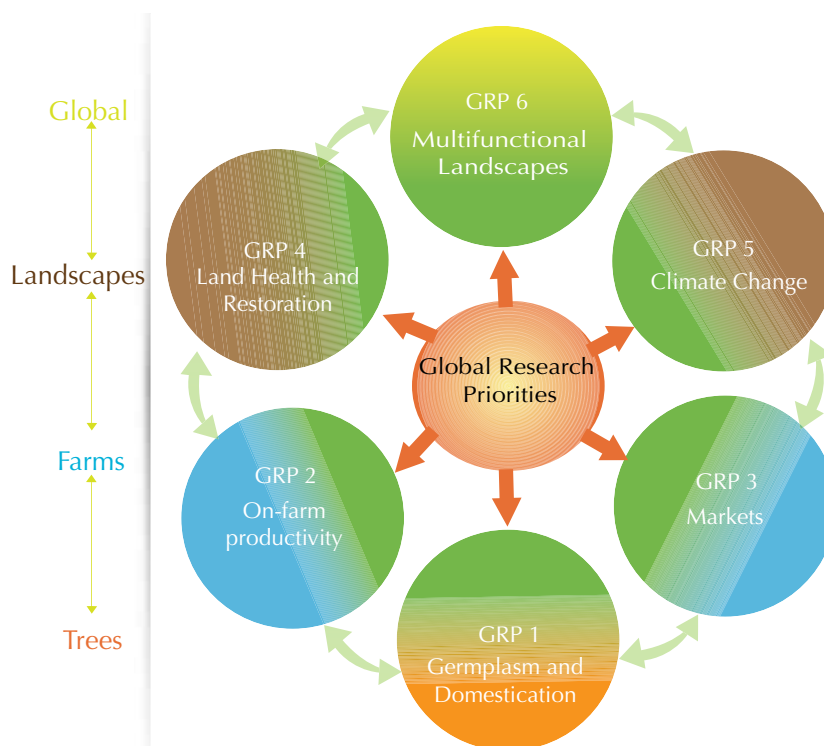

Figure 3. Interlinkages and scale of our six Global Research Priorities

3.5 Regional Context

Historically, the World Agroforestry Centre has implemented its research in six ecoregions across sub-Saharan Africa (eastern, southern, and west and central) South and Southeast Asia, and Latin America. These regions experience the interconnected problems of poverty, hunger and environmental degradation to varying degrees and offer opportunities for agroforestry interventions. We will continue to work in these regions through our global research projects and ecoregional initiatives.

However, we recognize that large differences exist in the challenges and opportunities for agricultural development among regions, as well as in the differing roles that agroforestry can play to meet those challenges. Broadly speaking, the three tropical regions of the world in Africa, Asia and Latin America operate at different stages of economic growth and structural transformation. Economies can be categorized as agrarian in Africa, transforming in Asia and urbanized in Latin America. The Centre's strategy for each region aligns with its predominant development needs.

Agrarian Economies of Africa. Most economies in Africa are agrarian and highly dependent on agriculture for employment and exports. The average gross domestic product per capita is under $400, and rates of rural poverty range from 40% to 70%. Many African countries endure weak governance, civil strife and conflict. As a group, they represent the principal global development challenge of the next half century.

In African economies, the most critical need is to generate smallholder-based agricultural growth that is rapid enough to trigger significant reductions in rural poverty and stimulate growth in the larger economy. Most of the poor are concentrated in areas of the continent with relatively high potential. Rural population densities in these areas approach those of tropical Asia. But, unlike in Asia, these agroecosystems depend almost entirely on rainfed agriculture.

Up to 70% of smallholders in Kenya and Malawi, for example, are currently net buyers of food staples and lack the land, labour or capital to become major participants in staple food production. Intensification and enterprise diversification are critical pathways to raising income in these systems.

Agricultural land expansion continues to be the predominant way to increase food production. Cultivation is continually expanding into marginal areas, putting further stress on other land uses critical to ecosystem services and the maintenance of biodiversity.

Sub-Saharan Africa suffers from serious soil degradation and nutrient depletion. It has the lowest rate of fertilizer use in the world, averaging about 5 kg per hectare. Integrated nutrient-management approaches are urgently needed, with a particular focus on improving soil organic matter and soil structure. Land use has been a critical factor affecting hydrology. Innovations such as better land management, greater tree cover and rainwater harvesting will be critical to adapting African agriculture to climate change. The Centre currently allocates 75% of its investments in Africa and will continue to focus the dominant share of its resources there.

Agriculture in East Africa is highly diverse because of the heterogeneity of its landscapes, altitudes and rainfall regimes. The agriculture sector has significant opportunities for demand-led growth both within the region and abroad. Internal food markets are growing rapidly, and markets in the Middle East and South Asia offer further opportunities. Our work in East Africa will focus on the densely

populated and often degraded highlands and Western Kenya where agroforestry innovations offer opportunities for improving sustainable crop and livestock production, for diversifying smallholder farms, and for enhancing ecosystem resilience in the face of climate change. The Centre will emphasize agroforestry innovations that will help smallholders improve the productivity of their limited assets and allow their farming systems to move along a path of sustainable intensification.

Southern Africa is particularly vulnerable to land degradation and the ravages of climate change. Agroforestry innovations will help to improve land quality for sustainable crop production and diversify smallholder farms, particularly toward tree fruits that can reduce childhood malnutrition (the prevalence of which is 35% in Africa) and enhance ecosystem resiliency in the face of climate change. Southern Africa will face the most critical water shortages, followed by East Africa and the semi-arid Sahel.

Our research in West and Central Africa, which is conducted in both the humid forest ecosystems and the semi-arid Sahel, will continue to focus on agroforestry innovations that optimize smallholder land use in the tropical forest margins and, in the Sahel, reduce the vulnerability of smallholder farmers to land degradation and climate change.

Transforming Economies of Asia. Asia was at the centre of the globalization processes of the 1990s, building on agricultural growth achieved during the 1970s and 1980s. Services and labour-intensive manufacturing, principally for export, became the major contributors to growth, reinforced by inflows of capital and foreign investment. These countries achieved sustained economic growth rates of 6-8% per year. Today, agriculture accounts for less than 7% of Asian GDP growth. The incidence of poverty fell from more than 50% in the 1970s to 18% in 2004.

However, the task of eliminating poverty is far from complete, as 600 million Asians still live on less than $1 per day, principally in South Asia.

The challenge is not, as with agrarian economies, to generate growth, because that has been successfully achieved. It is rather to manage the structural transformation and growth process to ensure continued poverty reduction in conjunction with environmental sustainability. Both poverty and the environment will be addressed principally in rural areas.

East Asia has large pockets of poverty, principally in the uplands of Vietnam, Thailand and southern China; Indonesia; and the interior of northern China. Our research in Southeast Asia will focus specifically on the issues of environmental services in the uplands and forest margins, because land-use rights in the uplands are linked to concerns over the maintenance of watershed functions, and biodiversity values there are extremely high. This research will emphasize agroforestry in multifunctional landscapes to sustain production and enhance watershed management.

South Asia has a well-established system of agroforestry research for development that is capable of generating international public goods. Rapidly rising urban populations are accelerating demand for resources, while, on the supply side, highly constrained land and water resources are creating significant tradeoffs in the ability of the agricultural sector to maintain food security, reduce rural poverty and improve environmental sustainability. The Centre will leverage the relatively strong infrastructure of agroforestry research in South Asia to focus on regionally and internationally relevant methods and solutions that address key issues in environmental resilience. We will develop a bridge in research and capacity-building between South Asia and Africa to create synergies between them toward addressing common problems.

Urbanizing Economies of Latin America.
Latin America's unique history of agricultural development reflects inequitable land distribution, a consequence of unequal power relations and extreme concentrations of wealth. Contemporary Latin America also features dynamic grassroots and social movements that contest inequality and raise their voices against the degradation of forests and natural resources. Factors that have contributed to the degradation of natural resources — poor pasture management, unsustainable slash-and-burn agriculture, large-scale commercial agriculture and logging — have intensified in recent decades. The Amazon contributes to climate change especially through slash-and-burn agriculture. The region will be affected by heat and drought as the effects of climate change intensify. Growing crops for biofuels intensifies pressure on the land and represents a new and powerful threat to the Amazon.

Our work in Latin America is focused through the CGIAR Amazon Initiative Ecoregional Programme. It aims to develop land-management systems that provide profitable and sustainable agroforestry alternatives to forest conversion in the Amazon. This work builds on the pan-tropical spillover benefits of the CGIAR's Systemwide Partnership for the Tropical Forest Margins, which the Centre coordinates.

Poverty in the region is linked to undeveloped market chains, insufficient financial mechanisms for the poor, conflicts over resource access, and weak policy foundations and institutional capacity. As a member of the Amazon Initiative, we work toward identifying, developing and disseminating sustainable land-use systems that avoid further deforestation. Our work also supports local governments and civil society in pursuing goals related to human welfare, environmental services and improved governance.
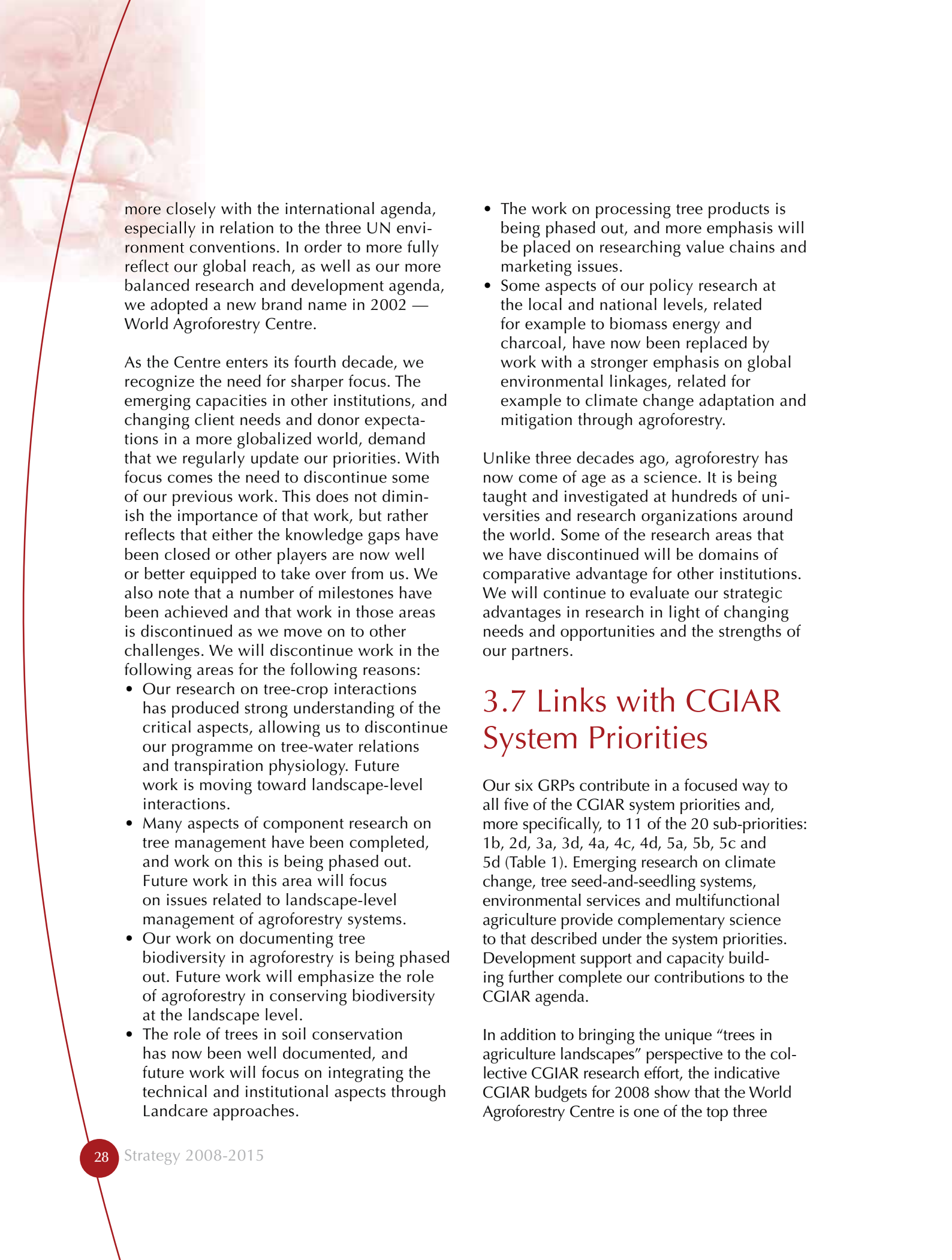
3.6 Changes to Our Research Agenda

When the Centre was set up 3 decades ago as the International Council for Research in Agroforestry, its main objectives were to provide much needed information on agro-forestry and advocacy for it. Achievements included the development of the journal *Agroforestry Systems*, the citation index *Agroforestry Abstracts* and the creation of new dissemination networks.

During a second phase of the Centre's evolution in the 1980s, its focus shifted to developing scientific methods and on-station experimentation. We established four sub-regional agroforestry research networks in Africa with many national partners. We then began to evolve a scientific research agenda to underpin agroforestry. This led to the Council's joining the CGIAR in 1991, renamed the International Centre for Research in Agroforestry.

During the 1990s, the Centre focused its work on testing a dozen key scientific hypotheses on agroforestry and expanded its collaborative work in Africa, Southeast Asia and Latin America through regional and country programmes. This phase saw the expansion of the Centre's work into environ-mental problems beyond the productivity aspects of agroforestry systems and included the enlargement of training and education activities. We expanded on-farm experi-mentation and watershed studies, as well as work on tree domestication and marketing research for tree products.

The new millennium saw many aspects of the Centre's science achieving impact on larger scales, building on past research that completed major proof-of-concept studies. This phase saw the Centre connecting its work at the plot, farm and watershed level

more closely with the international agenda, especially in relation to the three UN environment conventions. In order to more fully reflect our global reach, as well as our more balanced research and development agenda, we adopted a new brand name in 2002 — World Agroforestry Centre.

As the Centre enters its fourth decade, we recognize the need for sharper focus. The emerging capacities in other institutions, and changing client needs and donor expectations in a more globalized world, demand that we regularly update our priorities. With focus comes the need to discontinue some of our previous work. This does not diminish the importance of that work, but rather reflects that either the knowledge gaps have been closed or other players are now well or better equipped to take over from us. We also note that a number of milestones have been achieved and that work in those areas is discontinued as we move on to other challenges. We will discontinue work in the following areas for the following reasons:

- Our research on tree-crop interactions has produced strong understanding of the critical aspects, allowing us to discontinue our programme on tree-water relations and transpiration physiology. Future work is moving toward landscape-level interactions.
- Many aspects of component research on tree management have been completed, and work on this is being phased out. Future work in this area will focus on issues related to landscape-level management of agroforestry systems.
- Our work on documenting tree biodiversity in agroforestry is being phased out. Future work will emphasize the role of agroforestry in conserving biodiversity at the landscape level.
- The role of trees in soil conservation has now been well documented, and future work will focus on integrating the technical and institutional aspects through Landcare approaches.

- The work on processing tree products is being phased out, and more emphasis will be placed on researching value chains and marketing issues.
- Some aspects of our policy research at the local and national levels, related for example to biomass energy and charcoal, have now been replaced by work with a stronger emphasis on global environmental linkages, related for example to climate change adaptation and mitigation through agroforestry.

Unlike three decades ago, agroforestry has now come of age as a science. It is being taught and investigated at hundreds of universities and research organizations around the world. Some of the research areas that we have discontinued will be domains of comparative advantage for other institutions. We will continue to evaluate our strategic advantages in research in light of changing needs and opportunities and the strengths of our partners.

3.7 Links with CGIAR System Priorities

Our six GRPs contribute in a focused way to all five of the CGIAR system priorities and, more specifically, to 11 of the 20 sub-priorities: 1b, 2d, 3a, 3d, 4a, 4c, 4d, 5a, 5b, 5c and 5d (Table 1). Emerging research on climate change, tree seed-and-seedling systems, environmental services and multifunctional agriculture provide complementary science to that described under the system priorities. Development support and capacity building further complete our contributions to the CGIAR agenda.

In addition to bringing the unique "trees in agriculture landscapes" perspective to the collective CGIAR research effort, the indicative CGIAR budgets for 2008 show that the World Agroforestry Centre is one of the top three

centres for investments in sub-priorities 3a, 3d, 4d, 5b and 5c, as well as providing the primary financial investment in sub-priorities 2d and 4a.

We look forward to developing the agro-forestry-inclusive framework plans for the sub-priorities with other CGIAR centres and the Science Council to better connect our work to the collective CGIAR effort. We bring private sector and national-level part-nerships that are innovative and new to the CGIAR System. We are cognizant of the need to articulate the longer timeframes involved when working with trees, while stressing that impacts are often more lasting. The outcome pathways and knowledge-to-action (K2A) framework described for our GRPs provide useful insights into the scientific and developmental utility of outputs focused on natural resource management that may more broadly help the CGIAR better describe its overall research-to-development linkages.

Table 1: World Agroforestry Centre GRPs' linkage with CGIAR system priorities

	Global research priority	GRP1 Domestication, utilization and conservation of superior agroforestry germplasm	GRP2 Maximizing on-farm productivity of trees and agroforestry systems	GRP3 Improving tree product marketing for smallholders	GRP4 Reducing risks to land health and targeting agroforestry interventions to enhance land productivity	GRP5 Improving the ability of farmers, ecosystems and governments to cope with climate change	GRP6 Developing policies and incentives for multifunctional landscapes with trees that provide environmental services
	CGIAR system sub-priority						
1b	Conservation and characterization of underutilized PGR	■					
2d	Genetic enhancement of selected species to increase incomes	■	■				
3a	Increasing income from fruit and vegetables	■		■			
3d	Sustainable income from forests and trees	■	■				■
4a	Integrated land, water and forest management	■	■		■	■	
4c	Improved water productivity		■		■	■	■
4d	Sustainable agroecological intensification in low- and high-potential areas		■		■	■	■
5a	Science and technology policies and institutions					■	■
5b	Making international and domestic markets work for the poor			■		■	■
5c	Rural institutions and their governance					■	■
5d	Improving R&D options to reduce rural poverty and vulnerability	■				■	

CGIAR = Consultative Group on International Agricultural Research, GRP = global research priority, PGR = plant genetic resources, R&D = research and development.

Executing the Strategy

Four priority areas will create a foundation for executing the Centre's new strategy: (1) accelerating the use and impact of our research, (2) enhancing science quality, (3) strengthening partnerships and (4) enhancing operational efficiency.

4.1 Accelerating the Use and Impact of Our Research

To achieve positive outcomes and impact, Centre scientists will use a Knowledge to Action (K2A) framework to better understand the context of their work, conduct effective research and ensure that research results are communicated in appropriate formats to intended users. As an institution committed to the generation and use of knowledge, the Centre will emphasize a two-way linkage for deriving knowledge from action and using this knowledge to support further action. The objective is to accelerate the use and impact of research.

To that end, knowledge generated must satisfy three criteria before it can be deployed. First, it must be matched to a problem that requires solving. That is, it should have impact potential or be salient. Second, it must achieve a high standard of credibility either according to existing paradigms or by challenging those paradigms

with new information. In addition, credible knowledge may not be used by researchers and decision-makers if it is not perceived as legitimate, or having been obtained from knowledgeable and trustworthy individuals.

The scientific tradition of research aligned with existing theory and generating scientific publications will be blended with experiential learning derived from an array of stakeholders — including farmers, the private sector and government agencies — to generate new knowledge that leads to outcomes and impact.

The primary relationship between the Centre's research and impact in the field depends upon the context and mechanisms through which innovations interact to generate outcomes (see section 4.2 as well). Local and public/policy forms of knowledge provide the context and the focus on desirable outcomes. Scientific knowledge, in turn, will provide a strong link to emerging process-based knowledge. Local outcomes for poverty reduction and enhanced environmental services through the appropriate use of trees will depend upon local learning and negotiations between stakeholders.

However, our research should produce more broadly applicable knowledge drawn from local success stories. The term 'boundary objects' refers to the many ways that knowledge could be packaged for use by different stakeholders (e.g., visuals,

audio-visuals, tabulated results, models, policy briefs, extension manuals, lecture notes, cost-effective appraisal methods and negotiation support). Our communication strategy provides further detail on the approach taken and the ways that national, regional and global users of agroforestry knowledge will be served.

The Centre also recognizes that existing K2A processes in agroforestry require strengthening and additional development. Issues that require urgent attention include the development of incentives for the poor (e.g., property right rules that are pro-poor), the improvement of inadequate information systems (e.g., African extension systems), better access to inputs (e.g., seed systems expanded beyond forestry departments) and the strengthening of weak institutional structures that inhibit adequate access to inputs. Hence, a key role for the Centre will be to work with stakeholders to identify and improve K2A processes. This, in turn, should lead to more salient outputs and greater outcomes and impacts.

Supporting and Influencing Innovative Policies. The Centre recognizes that the impact of its work under any of its designated strategic priorities requires a supportive policy environment. We have found that policies based on negotiations among interested parties that are founded on sound information can bring changes that benefit large numbers of the rural poor.

Engagement in global and regional policy fora is essential in ensuring that agroforestry knowledge can be mainstreamed into decisions and practices that affect the poor. For example, agroforestry is increasingly recognized as a productive land-use system that contributes directly and synergistically to the objectives of at least three international conventions (climate change, biodiversity and desertification). Similarly, the Centre

connects its work to regional and national policy fora through engagement with relevant government agencies and ministries.

The Centre therefore aims to strengthen its engagement with policy processes and decision-makers at all levels, from local to international, to influence the development and implementation of policies founded on evidence-based results derived from our work.

Communicating Effectively to Enhance Impact. To achieve influence and impact, the World Agroforestry Centre must ensure that its research results are communicated to key constituents in a timely and credible manner. The development of a more effective communications strategy will thus help the Centre target and reach larger numbers of policymakers, opinion leaders, researchers, educators, development workers and investors.

The Centre will use an array of communication channels for this effort, starting with a more aggressive programme of scientific publishing but including more effective and innovative use of the Internet and a greater reliance on policy briefs, media, special events and field visits. The objective is to ensure that the outputs of our research reach vastly larger numbers of people than ever before in our priority audience groups and, in the process, support the transformation of lives and landscapes.

Because publication is key to advancing science and improving its quality, we will encourage our scientists to expand their publication of articles in more prestigious refereed journals. Specifically, we will support the production of high-quality, peer-reviewed institutional publications that provide global synthesis, cross-country analyses, methodology development and new perspectives on key issues of agroforestry research.

We are keen to promote the accessibility of our science to partners in developing countries, many of whom cannot afford journal subscriptions. Therefore, we will also promote publishing in peer-reviewed journals that are freely accessible on the Internet. Conversely, we will discourage the production of papers that are not peer-reviewed or have limited shelf life.

We anticipate that the Internet will provide new and vastly expanded opportunities for communicating and making our knowledge resources more easily accessible. Accordingly, the Web will be our principle vehicle for dissemination and outreach. All of our publications, training materials, databases and other information resources will be made available in this manner.

To communicate with policymakers and opinion leaders about our research and the importance of agroforestry to meeting livelihood and environmental challenges, we intend to expand our use of the mass media and newly emerging channels through Web-based media. This effort will be carried out in collaboration with the CGIAR's Information and Corporate Communications team and similar units of other investment and development partners.

Selected events in the international development and environment calendars offer significant opportunities for reaching key audiences and will be pursued more aggressively and systematically. We will support, for example, the participation of our scientists in major global fora such as the United Nations Framework Convention on Climate Change (UNFCCC), Convention on Biological Diversity (CBD) and United Nations Convention to Combat Desertification (UNCCD), as well as such professional conferences as the World Congress for Agroforestry and the International Union of Forest Research Organizations Congress. To backstop

these efforts we will organize side events, publication displays and other activities to increase the visibility of the Centre and showcase the work of our scientists. We will continue to play a lead role in organizing the World Congress for Agroforestry.

Building and Strengthening Capacity. To accelerate the use and impact of our work, we will focus on building and strengthening capacity in areas where we have a clear comparative advantage and that address the evolving needs of our partners.

Our approach, consistent with the recommendations of a recent CGIAR study (Stern et al. 2006),will focus on continued training and promotion of learning compatible with our research priorities and on strengthening and sustaining NARS partnerships. This effort will additionally emphasize appropriate quality-assurance protocols, enhance inter-centre collaboration, and exploit advances in information and communication technology for e-learning.

Our capacity-building and strengthening work will contribute actively to our GRPs. To that end, we will develop strategies that address identified and prioritized learning needs and opportunities. A key component of this work will be to support the GRPs in resource mobilization for learning, assessing learning needs, curriculum design and developing learning resources for open education. As in the past, emphasis will continue to be directed to individual learning, effective planning and coordination, the facilitation and implementation of short events for group learning, and impact assessments.

As many of our researchers do not have the knowledge, skills or time to contribute to capacity building and the strengthening of our partners and beneficiaries, we will carry out learning research, leading to the

development, adaptation and adoption of innovative learning approaches, methods and tools for adult learning. The objective is to help the Centre conduct high-quality training and education activities that adhere to international standards. Advances in information and communications technology for e-learning will play a major role in this effort. We will seek close collaboration in this area with the learning departments of other CGIAR centres.

Further, we will monitor and evaluate our learning events and assess their contribution to the use and impact of Centre research. This will involve collecting and collating information and data on our training and education activities with a view to informing those in need of these services. Learning from experience will be documented in case studies that highlight these efforts, thus allowing the Centre to increasingly become a 'learning organization'.

4.2 Enhancing Science Quality

Our criteria for science quality combine the traditions of academic research (aligned with existing theory and generating scientific publications) with those of development practitioners (who employ stakeholder analyses to target outcomes that contribute to impact). In achieving science quality, we acknowledge the centrality of the Centre's staff, and we work to create and maintain conditions that attract world class scientists.

Our principles of science quality span the three aspects of context/legitimacy, mechanisms/credibility and outcomes/salience. The principles of science quality, for which we will develop specific criteria to ensure adherence of our research, are enumerated below.

Regarding context and legitimacy:

1. The local context in which agroforestry systems exist is understood best from a multidisciplinary perspective, including geographic, environmental, biological, social, economic and policy determinants. Added to these are regional and global contexts, historical developments, and options for the future.
2. Our research is responsive to local and national needs; informs global debates; addresses critical uncertainties; and acknowledges multiple stakeholders and their knowledge, expectations, ambitions and interests.
3. The boundaries of the systems we study are clear, with emphasis on interactions within the system and recognition of the importance of external factors for drawing lessons from multiple cases.
4. Our data is maintained in databases in the public domain, which allows our work to be widely applied and improved.

Regarding mechanism and credibility:

5. Long-term research goals to enhance knowledge drive our work beyond short-term project objectives and planned deliverables.
6. The processes we study are applicable in multiple contexts and relevant to system-level understanding.
7. Our research is driven by a clear conceptual framework that defines the temporary boundaries and focus of exploration, problem definition, hypotheses, models and research questions.
8. Our research challenges current understanding, as derived from literature reviews, and explores new contexts for testing mechanisms and contributing to new thinking.
9. We employ methodological rigour in our work. This includes setting up clear protocols, conducting peer reviews, using robust and well-documented methods and appropriate statistical analyses, and producing meta-analysis and syntheses of results.

Regarding outcome orientation and salience:

10. We identify priority medium-term outcomes, define a strategy for reaching them and align research projects toward their achievement.
11. Our research results and publications contribute to the state of agroforestry knowledge and are relevant to our stakeholders, with a clear communication strategy to ensure that results reach target audiences in appropriate forms.
12. Our research and publications are relevant to policy at different scales, from local to global, including global policy targets such as the Millennium Development Goals and those addressing biodiversity (CBD), desertification (UNCCD) and climate change (UNFCCC).

Monitoring, evaluation and impact assessment. The World Agroforestry Centre's efforts in monitoring and evaluation and in impact assessment serve both accounting and learning functions. Accounting is mainly to demonstrate to investors and the general public the ability of the Centre to deliver its promised outputs and outcomes. In doing so, we learn about successes and failures in our scientific endeavours and, most importantly, aim to improve our effectiveness and efficiency in achieving intended deliverables.

Impact assessment aims to measure the longer-term effects of the research on livelihoods (e.g., poverty, income and consumption) and landscapes (e.g., soil health, biodiversity and hydrological cycles). The Centre does this through different temporal and spatial lenses because the impacts of agroforestry systems and other innovations can vary markedly over different time periods and land areas. Ex post assessments of agroforestry innovations are important to understanding the scope and scale of actual impacts, processes under which they occurred, and conditioning factors that affect their magnitude and

distribution. Ex ante assessments use ex post assessments to build models that predict the impacts of agroforestry innovations under different scenarios and thus contribute to setting priorities. Ex post impact assessment can be costly, and we aim to select a limited but rich diversity of contexts and innovations to scrutinize and learn from. The Centre also strives to improve its methods of monitoring and evaluation and of impact assessment by applying more rigorous and comparable approaches throughout its research programmes; continuing to test participatory approaches; learning from other major research and development organizations; and incorporating parameters important to policymakers, investors and other stakeholders.

4.3 Strengthening Partnerships

Agroforestry straddles a range of disciplines, including agriculture, natural resources, and forestry, and social and environmental sciences. Two decades ago, agroforestry lacked a clear niche in national policy, institutional or educational establishments. Consequently, the Centre has put substantial emphasis on building capacity for agroforestry research and education in a wide range of institutions. These efforts have helped create important research, education and development networks that have the capacity to work with us as equal partners in advancing agroforestry science for development.

Strategic partnerships are based on a clear recognition of the value added in working jointly with partners and sharing strengths to achieve specific outcomes. As the Centre is a relatively small player in the global effort to make science work for development, we strive toward a focused research agenda to mobilize partnership and financial resources

and so deliver concrete results. The selection of partners is based on, among other things, the convergence of missions, interests and agendas in specific programme areas and geographic regions.

The pathway to impact will be streamlined and made operational through the recognition of intermediary institutions that can transform research results into development practices and reinforce the capacity of policymakers and end users.

Strategic partnering will enable us to
• achieve critical mass in relevant areas of our agenda;
• complete the research chain from needs analysis to technology development, testing, adoption and scaling up to achieve impact;
• support the active participation of local institutions in advancing agroforestry, thereby incorporating local ecological knowledge and expertise in our work; and
• support policy and institutional transformations conducive to agroforestry.

Our Partnerships Office will guide and strengthen the establishment, management, monitoring and evaluation of partnerships at all levels. With a focus on improving expertise, effectiveness and efficiency, the office will promote capacity building and mentoring for staff as well as for partner scientists and institutions.

The Centre intends to implement a substantial proportion of its research agenda with its partners, using mechanisms that reinforce synergy, complementarity and coordination. Partners will participate in setting the research agenda, planning, resource mobilization, implementation, publishing and disseminating research results. A fair sharing of resources, workloads

and attribution of credit will be observed at all stages. In such collaborative work, the Centre and its partners will seek to achieve a good balance of international, regional and national public goods.

We are further strengthening our partnerships with advanced research institutes, including sister CGIAR centres and universities, to deploy cutting-edge science, tools and methods. We will encourage partnership with the private sector where it helps to fulfil the overall mission of the Centre, in particular its mission to benefit poor farming communities.

Partnership with CIFOR. The World Agroforestry Centre is primarily an agricultural research institute that focuses on integrating trees into farms for livelihood and environmental benefits. In contrast, the Center for International Forestry Research (CIFOR) works mostly to influence policies that affect forests and the people who depend on them.

The two centres have a strong history of partnership in many areas, including joint biodiversity research, leadership of the ASB systemwide programme, joint projects in West Africa, the Amazon Initiative, joint events and publications, cross-representation on our boards of trustees, and shared office space. In 2005, the centres' board chairs commissioned a study to explore further opportunities for partnership.

As the two centres embark on their new strategies, they are committed to exploring opportunities for stronger partnerships and building on each others' comparative advantage to achieve their common goals of enhancing the livelihoods of the poor and protecting the environment. In so doing, both centres aim to minimize transaction costs,

improve effectiveness and efficiency, and add value to each others' research agenda.
Both centres envision alliance in many areas, which include:

- joint planning and regular interaction to explore opportunities for collaborative research between the World Agroforestry Centre's six GRPs and CIFOR's six research domains;
- enhancing such current joint activities as ASB, Amazon Initiative and Joint Biodiversity Platform to build upon the comparative advantage of each centre;
- exploring new areas of research collaboration such as climate change;
- joint fund raising for collaborative work;
- coordinated outreach and communications on key issues of common concern;
- sharing regional and project offices; and
- sharing research support services.

Both centres will ensure that their commitment to work together is transparent and clearly communicated to all key stakeholders.

Alliance with ILRI. In 2007, the International Livestock Research Institute (ILRI) and the World Agroforestry Centre embarked on a successful alignment exercise that has resulted in the creation of our joint Research Methods Group and Information and Communication Technology Service Unit. We will continue our joint efforts to streamline procedures and systems in financial services, human resources and procurement. We will also cooperate closely in communications and knowledge-management activities.

4.4 Enhancing Operational Efficiency

All of our policies and procedures will be reviewed and updated to ensure that they comply with the Centre's strategic objectives. In implementing the strategy, we will adopt effective and efficient operational processes that are closely linked with priority setting, resource allocation, planning, and monitoring and evaluation processes. In addition, we will align our internal processes with CGIAR planning and reporting requirements, particularly as regards developing the medium-term plan (figure 4) and informing the Performance Measurement System, to take full advantage of the data collected for these exercises and minimize unnecessary duplication of effort.

Human resources. Our staff is our most valuable resource in realizing the vision set out in the strategy. Each of our GRPs will be led by at least one world class scientist, supported by a substantial number of senior scientists and post-doctoral fellows. We will encourage creative staffing arrangements, including full employment, secondment, part-time engagement, fellowships and joint appointments with partner institutions. Staff diversity and gender balance are critical elements of a healthy and vibrant research culture. To achieve our gender and diversity goals, we will continually update and review our gender-and-diversity strategic plan, solicit full support from middle managers, ensure the full participation of our human resources unit in the process of gender-and-diversity planning and execution, conduct

exit interviews, and take measures to mitigate risk factors as they are identified. We will take specific measures to open up opportunities for women scientists to join the Centre, particularly through our new Women's Post-Doctoral Fellowship Programme.

Internal communications. The Centre will strengthen its formal and informal processes to facilitate internal communications and enhance teamwork and collegiality among staff. Formal annual meetings such as Science Week, which brings together a large number of staff from various locations for reviewing and planning, will be conducted using modern tools and approaches to facilitate knowledge sharing and networking.

Information and communication technology. The Centre will enhance its information technology infrastructure at headquarters and regional offices to take advantage of contemporary Web-based tools for information sharing, knowledge management, communications and streamlining workflows. We will develop and support information systems for human resources; resource mobilization; and managing projects, documents and research data. We will expand the use of cost-effective Web-based communications tools for video and teleconferencing to catalyze interaction among dispersed teams while reducing the time and money spent on international travel.

Monitoring and reporting. We will undertake independent evaluations and ongoing, structured process checks to obtain reasonable assurance that internal controls are functioning well, objectives are being achieved and risks are being managed effectively. These will be achieved through Centre-commissioned external reviews and internal audits.
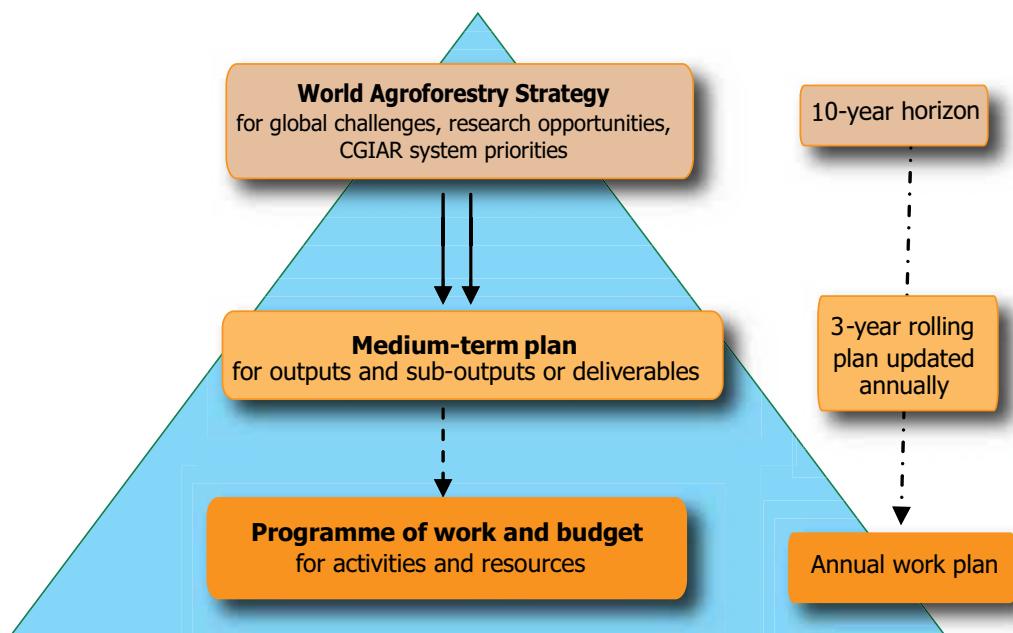

Figure 4. Planning framework

We will also undertake annual reviews of the GRPs and regional programmes to ensure that they remain focused on the strategic objectives of the Centre, and that the plans, as set out in the medium-term plan, are fully implemented. Internal audit will regularly review the financial and management systems at headquarters and in our regional operations.

Risk management. We will continue to sustain an effective process of risk management to identify and manage major risks to the Centre and its staff. An annual statement on risk management to donors, sponsors, partners and other stakeholders will be issued, and risk-management processes will be reviewed annually. We will continually assess the operating environment and propose changes to the risk profile.

Resource mobilization. The Centre will reinforce its current framework and strategy for resource mobilization, emphasizing a proactive approach. In particular, we will seek to achieve a more advantageous balance between unrestricted and restricted funding, and we will work to ensure prudence in the costing of projects with restricted funding. This will require an increasingly efficient approach to managing traditional and other sources of funding. To that end, the Centre will strengthen its culture of communicating with core donors through direct and indirect interactions that focus on our progress and challenges, while seeking guidance on emerging opportunities. For competitive and targeted fundraising, the Centre will sharpen its capacity and processes for developing high-quality proposals that are fully supported to ease the burden on unrestricted funding.

In addition to traditional sources of funding (mainly bilateral and multilateral donors), we will expand our new funding opportunities from major foundations and private and corporate philanthropies. The Centre will increasingly leverage greater funding opportunities through our strategic partnerships built around major priorities and global projects.

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