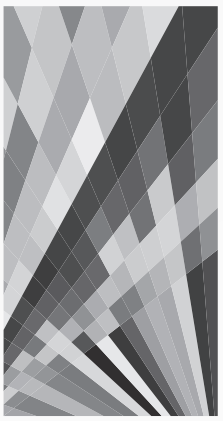
MAINSTREAMING CLIMATE-SMART AGRICULTURE INTO A BROADER LANDSCAPE APPROACH



MAINSTREAMING CLIMATE-SMART AGRICULTURE INTO A BROADER LANDSCAPE APPROACH

Background Paper for the

Second Global Conference on Agriculture, Food Security and Climate Change

Hanoi, Vietnam, 3-7 September 2012

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
2012

This paper is the outcome of a collaborative effort between the Natural Resources Management and Environment Department, the Economic and Social Development Department, the Agriculture and Consumer Protection Department and the Forestry Department of the Food and Agriculture Organization of the United Nations (FAO).The contributors include Matthias Reiche, Nadine Azzu, Anne Bogdanski, Susan Braatz, Sally Bunning, Vladimir Evtimov, Michelle Gauthier, Paolo Groppo, Thomas Hofer, Lisen Runsten, Christina Seeberg-Elverfeldt, Reuben Sessa, Marja Liisa Tapio-Bistrom, Babette Wehrmann, Alashiya Gordes and the kind assistance of Gordon Ramsay and Fabrizio Puzzilli.

The document was prepared as a technical input for the Hanoi Conference on Agriculture, Food Security and Climate Change, to be held 3 to 7 September 2012.

The contents and conclusions of this report are considered appropriate for the time of its preparation. They may be modified in the light of further knowledge gained at subsequent stages. The designations employed and the presentation of material in this information product do not imply the expression of any opinion whatsoever on the part of the Food and Agriculture Organization of the United Nations (FAO) concerning the legal or development status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.
The mention of specific companies or products of manufacturers, whether or not these have been patented, does not imply that these have been endorsed or recommended by FAO in preference to others of a similar nature that are not mentioned.
All rights reserved. Reproduction and dissemination of material in this information product for educational or other non-commercial purposes are authorized without any prior written permission from the copyright holders provided the source is fully acknowledged. Reproduction of material in this information product for resale or other commercial purposes is prohibited without written permission of the copyright holders.

Applications for such permission should be addressed to:
Chief Electronic Publishing Policy and Support Branch
Communication Division
FAO
Viale delle Terme di Caracalla, 00153 Rome, Italy
or by e-mail to:
copyright@fao.org
© FAO 2012

TABLE OF CONTENTS

ii Acronyms

iii Scope of paper

iii Key messages

2 1. Introduction
2 1.1 What is a 'landscape'?
2 1.2 The historical past of today's landscapes
3 1.3 Unsustainable management of natural resources
3 1.4 Growing demand and competition for natural resources
4 1.5 Climate change threatening ecosystems
4 1.6 Uniting forests and agriculture against climate change

5 2. The landscape approach
5 2.1 Definition
5 2.2 Identifying the area of a landscape
5 2.3 Managing ecosystem services at a landscape scale
6 2.4 Multidisciplinarity

8 3. Governance requirements for successful integrated land use management
8 3.1 Land tenure security
9 3.2 Sound Integrated Land Use Planning
11 3.3 Participation
11 3.4 Adaptive management
12 3.5 Capacity building

13 4. Addressing synergies and trade-offs of climate-smart agriculture in agricultural landscapes
13 4.1 Supporting rural livelihoods through the landscape approach
13 4.2 The landscape approach and climate change
16 4.3 Synergies and trade-offs among different land uses and elements of landscapes
16 4.3 The landscape approach supporting the adoption of climate smart agriculture (CSA)

18 5. Enhancing linkages between forestry and agriculture
18 5.1 The forestry – agriculture interface
19 5.2 REDD+ as a new instrument for climate change mitigation
20 5.3 Can REDD+ reconcile economic development with the protection of the natural resource base?
20 5.4. Intersectoral cooperation, coordination and policies

22 6. Conclusions

23 References

ACRONYMS

CCAFS	Climate Change, Agriculture and Food Security
CDM	Clean Development Mechanism (CDM)
CH_4	Methane
CIFOR	Centre for International Forestry Research
CO_2	Carbon Dioxide
CoE	Council of Europe
COP	Conference of the Parties
CSA	Climate-Smart Agriculture
CSD	Commission on Sustainable Development
ES	Ecosystem Services
FAI	Forest/Agriculture Interfaces
FAO	Food and Agriculture Organization of the United Nations
GEF	Global Environment Fund
GHG	Greenhouse Gases
GIAHS	Globally Important Agricultural Heritage Systems
GIZ	Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation; GTZ before 2011)
GTZ	Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation; GIZ since 2011)
HLPE	High-Level Panel of Experts on Food Security and Nutrition
ICT	Information and Communications Technology
IEA	International Energy Agency
ILUP	Integrated Land Use Planning
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
IWRM	Integrated Water Resources Management
LADA	Land Degradation Assessment in Drylands project
LPFN	Landscape for People, Food and Nature initiative
MEA	Millennium Ecosystem Assessment
MoANF	Ministry of Agriculture, Nature and Food quality of the Netherlands
NAMA	Nationally Appropriate Mitigation Actions
N_2O	Nitrous Oxide
NGO	Non-Governmental Organisation
PES	Payment for Ecosystem Services
PoA	Programme of Activities
REDD+	Reducing Emissions from Deforestation and Forest Degradation Plus
SCPI	Sustainable Crop Production Intensification
SLM	Sustainable Land Management
UCS	Union of Concerned Scientists
UNCSD	United Nations Conference on Sustainable Development
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollars
WAW	World Agricultural Watch initiative
WHC	World Heritage Centre
WOCAT	World Overview of Conservation Approaches and Techniques network
WWF	World Wildlife Fund

SCOPE OF PAPER

Today's large diversity of semi-natural and manmade landscapes is the result of centuries of human interventions. The management and use of natural resources and ecosystem services have provided for humanity's multiple needs for food, fibre, fodder, fuel, building materials, medicinal products and water. However, this has often been undertaken in an unsustainable manner causing the degradation of the natural resource base and loss of ecosystem services. Increasing pressure from population growth, changes in food consumption patterns, climate change and competition from other sectors is further weakening the viability of current systems. The triple challenges to simultaneously mitigate the effects of climate change, safeguard natural resources more efficiently and produce more food and ensure food security for future generations require effective policies and approaches. This paper examines how landscape approaches can be used in developing integrated multipurpose production systems that are environmentally and socially sustainable. The paper assesses the key policy, governance, financial and institutional interventions required, and looks at how a landscape approach can support the adoption of climate-smart agriculture and generate green growth. Finally, the paper considers how synergies between the agriculture and forestry sectors can be improved and how this can be facilitated through REDD+ implementation.

KEY MESSAGES

- To meet national food security objectives and the needs of different stakeholders in a given landscape, land use planning and management of natural resources needs to be coordinated across sectors and through a participative and consensus-based decision-making process.
- Achieving socio-ecologically sound landscape approaches will require building national and local capacity to develop responsible and inclusive governance arrangements. This will include improvements in tenure security and the recognition of the rights of individual and groups.
- Public policies regarding the sectors that have a significant impact on landscape dynamics need to be harmonized, and land use legislation needs to be enforced through strengthened national and local institutions and governance.
- National and international financing and lending (including payments for environmental services) should be designed to facilitate and encourage processes that promote landscape approaches.
- The implementation of REDD+ can play a catalytic role in promoting a landscape approach and strengthening the forest-agriculture nexus. REDD+ strategies should address all drivers of forest decline and work to lessen the competition for natural resources between different sectors by fostering cross-sectoral collaboration.
- Suitable tools and cost-effective indicators to measure ecological, social and economic processes are required. These tools and indicators must be sensitive enough to detect changes in the landscape, evaluate short- and long-term benefits and trade-offs, and allow for more accurate management and policy interventions.
- A common knowledge base needs to be developed on feasible concepts, techniques and methods to allow stakeholders to develop, implement and monitor landscape approaches. This includes improving the understanding of landscape dynamics and how particular policy and management interventions will affect the realization of environmental, economic and social objectives at differing spatial and temporal scales.

1. INTRODUCTION

1.1 What is a 'landscape'?

Formal definitions of landscapes abound. The Council of Europe, for example, defines landscapes as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors" (CoE, 2000). Cultural landscapes have been defined by the World Heritage Committee as "distinct geographical areas or properties uniquely representing the combined work of nature and of man, illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal." (WHC, 1996). Landscapes may be further defined as the concrete and characteristic products of the interaction between human societies and culture with the natural environment. Agricultural landscapes can be described in terms of the three elements: (i) structure – the interaction between environmental features, land use patterns and man-made objects, (ii) functions – the provision of landscape functions for farmers and for society (environmental services) and (iii) value – concerning the value the society places on agricultural landscape and the costs of maintaining and enhancing landscape provisions by agriculture (Jongman et.al. 2004). Because the underlying human and natural processes are subject to change and evolution, landscapes are dynamic systems (Washer et al, 1999).

1.2 The historical past of today's landscapes

People have managed the world's natural resources and landscapes for generations, providing for multiple needs for food, fibre, fodder, fuel, building materials, medicinal products and water. Farming, forestry and fisheries systems have evolved and adapted to variable environmental conditions and population pressures. They have also been influenced by other factors, such as settlement patterns (dispersed or concentrated, sedentary or mobile), tenure arrangements, labour and resource availability, and access to credit and markets. These complex interactions have generated today's huge diversity of natural, semi-natural and manmade landscapes, which contain a variety of differently sized livelihood systems.

BOX 1.1: GLOBALLY IMPORTANT AGRICULTURAL HERITAGE SYSTEMS (GIAHS)

Some of the most remarkable agricultural systems are being designated by the United Nations Food and Agriculture Organization (FAO) as Globally Important Agricultural Heritage Systems (GIAHS). Because of their importance for humanity, FAO is collaborating with member countries to support the continued evolution of GIAHS. Landscape or territorial protection is concerned with the characteristics and functions of a landscape, including its associated natural resources and the population's related socio-economic and cultural activities. Landscape protection also considers the forces and pressures transforming landscapes and the effects of such changes have on the values of the landscapes and the benefits different stakeholders derive from them.

1.3 Unsustainable management of natural resources

Farming, forestry and fishery systems have fed and provided goods and services to an expanding world population. However, this has often been achieved in an unsustainable manner, resulting in the degradation of landscapes and land and water resources, as well as the loss of biodiversity and other ecosystem services (such pest and disease control, pollination, resilience to shocks, and nutrient, hydrological and carbon cycling). This problem has been exacerbated by specialised market-driven approaches that tend to optimize the production derived from specific enterprises (such as crop or livestock production) that focus on single products and rely on subsidies, external compensation or support services, such as credit, input supply and marketing. Furthermore a number of systems are inefficient and unsustainable due to insufficient technical knowledge or a lack of access to resources and investments that could help avoid the degradation of the natural resource base and the encroachment of agriculture into other ecosystems.

1.4 Growing demand and competition for natural resources

Based on current trends, food supply will need to grow by 60 percent by 2050 to meet the demands of a larger, more prosperous and more urban global population. By 2050, the world's population is expected to reach 9 billion. Already, over half the global population live in cities, and increased levels of affluence will significantly change consumption patterns. Moreover, as expanding cities, infrastructure and human activities infringe on fertile lands, production systems increasingly have to compete with other sectors for resources. In addition, climate change will also have an impact on production systems and disrupt the functioning of ecosystems (see 1.5), further increasing the pressures on ecosystem services.

To ensure greater efficiency and more sustainable management of natural and processes in the landscape, a more integrated approach with the active participation of all stakeholders is required. Production systems must be integrated into landscapes so that these systems can capitalize on natural biological processes, recycle waste and residues and develop integrated mixed systems. This can reduce the pressure on the natural resource base and minimize the need for external inputs such as energy, chemicals and other management interventions.

BOX 1.2: WORLD AGRICULTURAL WATCH INITIATIVE (WAW)

In 2011, FAO and partners established the World Agricultural Watch initiative (WAW), a programme to assess the transformation of agricultural systems. WAW documents the drivers that have an impact on agricultural livelihoods, human well-being, food security and the environment. It facilitates a platform for generating and exchanging knowledge through a worldwide network of local observation centres in representative areas. WAW aims to promote an inclusive policy dialogue on the diversity of agricultural production systems, the structural changes affecting them and their implications for sustainable development.

1.5 Climate change threatening ecosystems

Diverse ecosystems are considered to be under threat from a variety of sources .The consequences of climate change, which will grow progressively more serious, will lead to additional environmental and socio-economic threats. Extreme weather events, such as droughts and floods, are predicted to become more frequent. According to IPCC reports, the impacts of climate change and associated costs will fall disproportionately on developing countries, threatening to undermine the achievement of the global goals of long-term poverty reduction and safeguarding food security (IPCC, 2001). The 2011 drought in the Horn of Africa is a recent example of such an extreme weather event. Because of this drought, 12 million people were threatened with malnutrition, disease and loss of their livelihoods. Such events will become more frequent, increasing the number of vulnerable or directly affected people.

1.6 Uniting forests and agriculture against climate change

Climate change will affect both the agriculture and forestry sectors. At the same time, the potential role of forests in reducing global greenhouse gas emissions and mitigating climate change is attracting considerable international interest. Current negotiations to establish an international climate regime acknowledge the critical function that forests and other sources of biomass play in the global carbon cycle. By integrating forests and agriculture in global efforts to address climate change, the REDD+ mechanism seeks to maintain and even increase forest carbon stocks. The mechanism seeks to stop the current trends in deforestation and forest degradation and address all the drivers that contribute to deforestation and forest degradation. One of the ways it does this is by improving and strengthening sustainable land use policies in both the forest and agricultural sector. Established in 2010, REDD+ is defined as an instrument that "encourages developing country Parties to contribute to mitigation actions in the forest sector by undertaking the following activities, as deemed appropriate by each Party and in accordance with their respective capabilities and national circumstances: (a) Reducing emissions from deforestation; (b) Reducing emissions from forest degradation; (c) Conservation of forest carbon stocks; (d) Sustainable management of forest; (e) Enhancement of forest carbon stocks" (paragraph 70, AWG/LCA UNFCCC/COP 16, Cancun 2010).

However, policies also need to take into account major ecosystem influences outside the forestry sector. Many of these influences are related to agriculture. Since achieving food and energy security for a growing population will remain the highest priority for individual households and national governments, the expansion of agricultural land is likely to continue. For this reason, an isolated sectoral approach focusing solely on forests cannot succeed in implementing REDD+ policies. The best way of tackling the parallel challenge of forest protection and ensuring food security lies in developing coherent national strategies embedded in a holistic landscape approach that recognize the full value of the multiple goods and services provided by forests and tree resources while at the same time maximizing the synergies between the sustainable intensification of agriculture and REDD+.

2. THE LANDSCAPE APPROACH

2.1 Definition

A landscape approach deals with large-scale processes in an integrated and multidisciplinary manner, combining natural resources management with environmental and livelihood considerations. It differs from ecosystem approaches in that it may include multiple ecosystems. The landscape approach also factors in human activities and their institutions, viewing them as an integral part of the system rather than as external agents. This approach recognizes that the root causes of problems may not be site-specific and that a development agenda requires multistakeholder interventions to negotiate and implement actions (see also 3.3). The landscape approach helps to identify and develop positive externalities (including ecosystem services) and reduce negative impacts, especially from individual land users. Placing human well-being and needs at the centre of the land use decision-making process, the rights and cultural values (including religion) of involved communities and minority groups are respected alongside their land use objectives. This involvement helps ensure local commitment to solutions and the long-term success of sustainable development initiatives (For additional information on landscape approaches see Farina 2006, World Bank 2008, IUCN and Ecoagriculture Partners 2008, Scheer and McNeely 2008, Schroth and McNeely 2011).

2.2 Identifying the landscape boundaries

The definition of what constitutes or delimits a landscape will vary depending on the stakeholders involved, the activities being undertaken in the landscape and the ecosystems that contribute services or are affected by human interventions. For this reason, the landscape is composed of a unique set of socio-economic and ecological characteristics and interactions. Importantly, landscape management projects must be large enough to allow for the wide-reaching management within the specified landscape, but small enough to allow all relevant stakeholders in the landscape to participate in decision-making and planning. To implement a landscape approach, stakeholders must clearly define and agree on the goals and desired objectives and outcomes of operating at a landscape level and then assess the current and future factors (including social and economic) that will influence the process. The clear delineation of the landscape boundaries requires an integrated multidisciplinary approach where trade-offs and synergies are carefully assessed and appropriate landscape-scale management interventions are identified.

2.3 Managing ecosystem services at a landscape scale

Considering the wide variety of services that ecosystems are expected to provide and the growing needs of society, it is evident that isolated sectoral approaches alone will not be able to efficiently manage the limited resource base. The management decisions made at farm level, concerning such issues as water use, soil management, production system choices and the use of landscape features such as hedgerows, have an impact on the surrounding landscape and the ecosystem services they provide. Importantly for the land user, they also profoundly influence the productive capacity of the land. Decisions how to use on-farm resources and common property resources in the surrounding landscape depend strongly on the socio-economic situation of the users, their tenure and labour security, their access to services and markets, as well as their education level and financial and organizational capacity (see section 3).

Various holistic approaches and technologies to manage farmland, rangelands and forests sustainably have emerged over the last decades. For example, integrated watershed and river basin management are approaches that address the mosaic of land uses in a catchment area, their effects on soil properties and erosion, the hydrological regime and water supply as well as biomass, energy and biodiversity. These approaches also consider the interactions between upstream and downstream land and water users. There is a range of sustainable production methodologies designed to enhance productivity (per unit of land, water and labour) while contributing to the protection and enhancement of ecosystem services. Examples of these approaches are sustainable crop production intensification (SCPI) (FAO, 2010 a), organic agriculture (Sanduh et al, 2009), conservation agriculture (Kassam et al, 2009), integrated crop-livestock management (Russelle, 2007), agroforestry (Jose, 2009), sustainable fisheries management (FAO, no date) sustainable forest management (FAO, 2003) and improved rangeland management, including silvo-pastoral systems (FAO, 2009 c). Key to the success of these different methodologies is an integrated landscape approach that pays particular attention to the spatial array of land uses, stakeholder needs, common management practices and their interactions.

BOX 2.1: SUSTAINABLE LAND MANAGEMENT (SLM)

Land and water management techniques and intervention approaches under specific biophysical and socio-economic conditions are being assessed worldwide. They are being documented in a global database on sustainable land management (SLM), which now contains some 470 technologies and 235 approaches. They are also being disseminated in national best/good practices publications through the World Overview of Conservation Approaches and Techniques (WOCAT) network (WOCAT, 2007). With support FAO's Land Degradation Assessment in Drylands project (LADA, 2011), the extent and effectiveness of SLM practices has also been mapped in several countries. The SLM assessment toolbox, developed for use at global, national and local levels, allows an estimation of the costs and benefits and the impacts of the SLM measures on livelihoods and ecosystem services, including biodiversity.

2.4 Multidisciplinarity

To realize the three pillars of sustainability (environmental, economic and social) it is necessary to adopt multidisciplinary and multistakeholder approaches that encompass technical, policy, legal and governance interventions. This requires innovative methods that are supported by cross-sectoral knowledge that includes indicators for articulating the value of the ecosystem services provided by the landscape and validating the suitability of different management practices. Section 3 will outline some of the key issues in developing and implementing landscape approaches.

BOX 2.2: LANDSCAPE FOR PEOPLE, FOOD AND NATURE (LPFN)

The Landscape for People, Food and Nature initiative (LPFN) emphasizes that sustainability requires not only a shift in farming practices, but a broader focus on the holistic management of rural land-use mosaics at a landscape scale to foster synergies between agricultural production, livelihoods and ecosystem services (EcoAgriculture Partners, 2012).

A Global Review (to be released in 2012) is assembling the evidence base for sustainable agriculture from different disciplines and sectoral perspectives. The Review covers innovations in production systems and conservation practices, costs and benefits under different circumstances, conditions leading to effective implementation, and their potential roles in addressing food security, climate change, species loss and ecosystem degradation.

3. GOVERNANCE REQUIREMENTS FOR SUCCESSFUL INTEGRATED LAND USE MANAGEMENT

Because they determine how access to, use of and control over resources are enforced, effective governance structures are essential to the success of landscape initiatives. Governance structures also shape the way in which competing resource interests are reconciled. In addition, good governance addresses the potential problems of power abuse, corruption and lack of transparency, and ensures that benefits reach the correct parties. Good governance structures provide the enabling environment for landscape programmes that are successful over the long term. To this end, relevant rules and processes should be instituted to formulate policies on natural resource management in a given territory. If possible, such guidelines should be built on existing statutory and customary institutions. An example is the FAO guidelines, *Upgrading the Profile of Agroforestry on the Policy Agenda: A guide for decision-makers*, which provide recommendations for policy action on how to integrate agroforestry systems into the wider landscape setting. In some cases, completely new structures may need to be developed (FAO, 2012b).

Governance mechanisms need to be flexible and adapted to local-level needs. Multidisciplinary and multistakeholder priority-setting processes are essential to formulate inclusive and appropriate mandates for such institutions (3.2 & 3.3). To implement a landscape approach, preparations must be made to build the capacity of its participants, making sure that actors at national, regional and local levels are aware of their rights, can negotiate competently for their own interests and manage the natural resources available to them to the best of their abilities (3.5).

BOX 3.1: THE LPFN INITATIVE'S ADVOCACY STRATEGY

Through a wide stakeholder process, the Landscapes for People, Food and Nature Initiative (LPFN) (see also Box 2.2) has produced a six-pronged action and advocacy strategy for scaling up effective integrated landscape management approaches. This strategy includes the development of a policy framework and a guide for promoting landscape approaches. The members of the LPFN Initiative coalition have called on leaders from government, civil society and the private sector, at local, national and international levels, to join them in catalyzing a global transition toward the sustainable development of integrated rural landscapes, by taking the following six critical actions:

1. strengthen selected multistakeholder landscape initiatives around the world;
2. implement national and subnational policies that support integrated landscapes;
3. encourage business leaders to incorporate integrated landscape approaches in their business models;
4. expand financing for integrated landscape investment;
5. advance science and knowledge systems to support integrated landscape initiatives; and
6. make key stakeholders aware of the benefits of integrated landscapes.

3.1 Land tenure security

Tenure security and the responsible governance of tenure are central to sustainable landscape management. Because long-term planning in an uncertain tenure environment can often be seen as futile, unclear or insecure tenure tends to encourage short-term profit-seeking. This fuels unsustainable land and resource management, such as unchecked deforestation. As it is already leading

to increased resource competition and disputes, climate change is heightening the importance of tenure security.

The complexity and coexistence of multiple tenure systems (e.g. statutory and customary) within a single landscape makes ensuring tenure security difficult. This challenge often overwhelms existing governance capacities. By seeking to define and allocate carbon rights with longer-term time horizons, climate-smart agriculture adds another layer of complexity to this situation. Attention to these complexities should be a priority in climate-smart landscape strategies, especially since stability is essential when attracting funding for climate-smart agriculture programmes. Recognizing the tenure rights of all stakeholders in a given landscape empowers them to apply land use planning decisions for themselves in that this recognition enables them to commit to long-term adaptation and mitigation objectives. This responsibility can then be rewarded by the equitable distribution of benefits among these stakeholders.

However, ensuring tenure security is time-consuming. In each context, key considerations need to be addressed. These include determining what the nature of the benefits should be and who should receive them through payment for environmental services schemes or the REDD+ mechanism. For instance, if a given initiative decides to define and allocate carbon rights, it needs to resolve at which scale and in connection with what other resource rights this allocation needs to be settled. Overall, time- and cost-effective land governance structures must be promoted to support the intended project process. Once such matters have been settled, the creation of formal registration systems for tenure rights is an additional time-consuming (and costly) exercise.

Registration systems need to be adapted to local contexts by experts who can take into account the complexities of existing land administration and tenure arrangements. The time-intensity of setting up a full-scale registration system may not be a feasible or desirable solution for a transformation of landscape management practices that aims to deliver some immediate benefits or at least secure continued long-term commitment on the part of stakeholders. In light of these constraints, simple recording methods provide an interim solution. Ideally, the institutions involved would not be entirely new. Instead, the capacities of existing systems would be enhanced to take on the necessary tasks. These tasks include demarcating and registering rights (at individual or group level, for carbon or land), updating and maintaining registries, resolving disputes and allocating payments where payment for environmental services schemes are applied. If possible, these efforts could feed into a thorough, full-scale system at a later stage.

Cost-effective, innovative certification methods that record group and community rights should be favoured. Tenure holders and resource users should be involved in this process through participatory consultations (3.3).

3.2 Sound Integrated Land Use Planning

> *"Land use planning is a systematic and iterative procedure carried out in order to create an enabling environment for sustainable development of land resources which meets people's needs and demands. It assesses the physical, socio-economic, institutional and legal potentials and constraints with respect to an optimal and sustainable use of land resources, and empowers people to make decisions about how to allocate those resources."*
>
> *(FAO/UNEP 1999)*

Participatory integrated land use planning (ILUP) has become a central prerequisite for any (spatial) development intervention that aims at social, ecological and economic sustainability. As a tool that mediates the interests of different user groups in a defined area, it plays a pivotal role in the landscape approach. There are often instances where the diverse interests of small-scale farmers, herdsmen, mining companies, large-scale agricultural investors and the populations of villages and small towns have to be satisfied in a given landscape, while respecting spaces for recreation and protected areas for nature and biodiversity. Land use planning actively involves the different interest and user groups to find compromises that allows for sustainable development collaboratively. "At the core of land use planning is the joint balancing of competing land uses by all stakeholders (users and those affected from (changes in) land uses) and the joint identification of those uses for which the highest consensus can be achieved – ideally for the purpose of sustainability" (GIZ 2011).

Alongside multistakholder approaches, ILUP recognizes that multidisciplinary solutions are pivotal to providing the best possible land use strategies for stakeholders and the environment in a given landscape. Such innovative, multisectoral solutions must encompass technical, policy, legal and governance interventions (see Box 3.2). They also need to propose relevant indicators to articulate the value of the ecosystem services provided by the landscape and to validate the suitability of different management practices.

BOX 3.2: VOLUNTARY GUIDELINES FOR TENURE

In June 2012, FAO member countries adopted the *Voluntary guidelines for responsible governance over the tenure of land, forestry and fisheries* which provide a forward-looking framework for countries to enhance tenure security and user and access rights over land and natural resources used in agriculture, forestry and fisheries sectors. The *Voluntary guidelines* also provide guidance on how to ensure principles such as transparency, equity, civic engagement, accountability, effectiveness, efficiency and sustainability can be upheld in land administration, management and policy formulation.

A major problem, however, is that existing capacities are often insufficient to carry such a planning process, and governance systems may be open to corruption. For example, the local land use planning authority may have no vehicle at its disposal and cannot send representatives to meet with people or verify if defined land uses are respected. This can lead to a lack of coordination and follow-through between different stakeholders. It is precisely this cooperation that is essential to ensure landscape-level projects are sustained and equitable. Other scenarios that can impede the successful management at landscape scale include a wealthy or influential person receiving a building permit in an area foreseen for environmental protection or a lack of knowledge at government level about participatory land use planning methods. A particularly important element of ILUP is its full recognition of all stakeholders' rights and its emphasis on providing the capacity development services necessary for all parties to participate in the planning process (see also section 3.5). ILUP particularly aims to enhance the capacities of weaker (often local) stakeholders, enabling them to negotiate capably on their own behalf on an equal footing with other participants (FAO, 2009a).

It is essential that ILUP is applied in landscape-scale initiatives. The FAO/UNEP *Guidelines for Integrated Land Resources Planning and Management* (1999) outlines the responsibilities of different stakeholders across various sectors from local to national levels and describes how to set up and implement a multistakeholder natural resources planning and management process.

3.3 Participation

To arrive at consensus decisions, it is essential to have a legitimate forum where negotiations can take place and conflicts resolved. All stakeholders should have fair representation in such a forum and be adequately informed to participate effectively. An adequate knowledge base, appropriate for the local setting, is crucial to the landscape approach planning process and should include an understanding of the problems, needs and objectives of all stakeholders, status and trends of land resources, appropriate technologies for improved productivity and reduction of environmental impacts, institutional and legal frameworks (e.g. land tenure, access to resources), economic/market conditions (e.g. prices, interest rates). The latest version of FAO methodology for agro-ecological zoning (2012 c) takes into account these various social and environmental considerations more fully.

BOX 3.3: THE TRANSBOUNDARY SANGHA RIVER LANDSCAPE PROJECT

The landscape project in the Tri-National de la Sangha park exemplifies how a multistakeholder natural resources planning and management process might be set up and implemented. The project operates along the Sangha River, which runs through Congo, Cameroon and the Central African Republic. The project focuses on a landscape that would be optimal for two contrasting objectives: improving livelihoods and conserving biodiversity in protected areas and production forests. A shared monitoring system with indicators for the assessment of 'better landscape' progress was developed to track changes in the landscape with a multistakeholder group. Government agencies, local and international non-governmental organizations (NGOs) and other organizations, including WWF, Center for International Forestry Research (CIFOR), the International Union for Conservation of Nature (IUCN) developed guidelines and principles for landscape approaches in the park. The following principles were designed to reflect the institutional, capacity and policy requirements guiding the implementation of a landscape approach (see IUCN, Sangha Guidelines, 2010):

Principle 1: Legal and policy frameworks must enable landscape-scale initiatives.

Principal 2: Stakeholder platforms are needed to enable governmental, non-governmental and civil society actors to negotiate and take decisions at a landscape scale.

Principle 3: The interests of all actors, especially the inhabitants of the landscape must be assured.

Principle 4: The capacity of institutions operating within the landscape will need to be strengthened.

Principle 5: The integrity and resilience of ecological systems within the landscape will be essential components of the landscape approach.

Principal 6: Environmental, social, technological and economic changes will present new opportunities and challenges for landscapes.

3.4 Adaptive management

Participatory fora require dynamic approaches and management. As trade-offs need to be negotiated and potential conflicts between different stakeholders need to be solved, successful outcomes hinge on behavioural changes (IUCN and EcoAgriculture Partners, 2008). To be able to adjust to changes flexibly, institutional arrangements, such as adaptive management, are required. Adaptive management allows individual components of any formulated plan to be amended or altered at any time in light of changing resource conditions, social values, improved data, or in response to moni-

toring (World Bank, 2008). Pre-existing institutions are rarely as dynamic at the outset of a project as the landscape approach needs (Folke *et al.* 2007). However, when guided by adaptive management, institutional evolution over time is possible (Shepherd, 2008).

3.5 Capacity building

To adopt a landscape approach and implement adaptive management, the participating stakeholders' capacities and skill-sets need to be broadened. As mentioned (3.2), ensuring that all participants are sufficiently informed about the situation and their own rights and responsibilities within the landscape is crucial to enabling equitable discussion. It also helps to foster a greater willingness to make compromises. Capacity building for landscape management is required at all levels to manage holistically natural and social systems. Access to information and knowledge management is important for all stakeholders. Additional training may be required to develop the capacities of participants so that they can engage in discussions and negotiations and resource management. This can involve learning about new tools and methods for landscape management, new approaches for individual or community land management, as well as about technologies and methods for agricultural and forestry activities. Different fora are available for capacity building and will differ depending on the level targeted. Extension services and farmer field schools have proven successful tools for community capacity building (see box 3.5).

BOX 3.4: THE VI AGROFORESTRY WESTERN KENYA CARBON PROJECT

Initiated in 2009, The Vi Agroforestry Western Kenya Carbon Project works through a well-established extension service covering 45 000 hectares and serving 60 000 farmers. These extension workers collaborate with local community groups, facilitating the training and implementation of sustainable, locally-adapted agricultural land management techniques. The project works with local institutions, building the capacities of local extensionists, field officers and farmers.

BOX 3.5: THE KAGERA TRANSBOUNDARY AGROECOSYSTEM MANAGEMENT PROJECT

Executed by FAO with the Governments of Burundi, Rwanda, Tanzania and Uganda, the Kagera Transboundary Agroecosystem Management Project (2004-2014) operated in the Kagera River Basin. The project works to build capacity at all levels for integrated landscape management. The project's goal is to improve agricultural productivity and strengthen livelihoods while reversing land degradation, sequestering carbon, conserving agricultural biodiversity, thereby bolstering food security and protecting the Kagera River Basin's international waters. Capacities are being built at all levels. At the farm and community level, strategies for catchment management are being conveyed (e.g. through farmer field schools). Technical and planning personnel at watershed and district level are being trained on how to plan for and maintain sustainable land management (SLM). Policy-makers and planners at the national level are being supported with improved information and decision-making tools. The lessons learned during the project will be exchanged with other projects supported by the Global Environment Fund (GEF) through the Terrafrica strategic investment programme for SLM in sub-Saharan Africa.

4. ADDRESSING SYNERGIES AND TRADE-OFFS OF CLIMATE-SMART AGRICULTURE IN AGRICULTURAL LANDSCAPES

4.1 Supporting rural livelihoods through the landscape approach

The landscape approach is a promising concept for managing natural resources on the one hand and promoting rural livelihoods and addressing poverty reduction on the other. Poverty does not only originate at farm level. It stems from a combination of different factors, such as access to land and water resources and rights of use over their use, the accessibility of markets and services, and policy constraints.

Making the sustainable livelihoods of local communities the centrepiece of each landscape intervention is crucial. Practical experience in the past 30 years indicates that land and forest management to protect natural resources needs to take the needs of local people into consideration. For example, efforts to manage forests for conservation are likely to fail if local people do not benefit (e.g. through ecotourism) and have no other livelihood options than to encroach on forest land and convert it to other uses.

A landscape approach should involve all relevant stakeholders in land use decision making (3.3). This includes all farmers and stakeholders that depend on their landscapes. This principle is at the core of sustainable livelihood approaches focusing on poverty reduction interventions that empower the poor to build on their own opportunities and support their access to assets which form part of the wider landscape. Such assets include (i) human capital with skills, knowledge, health and ability to work; (ii) social capital with social resources, including informal networks, membership of formalized groups and relationships of trust that facilitate co-operation; (iii) natural capital with natural resources such as land, soil, water, forests and fisheries; (iv) physical capital including basic infrastructure, such as roads, water and sanitation, schools, information and communication technology; (v) on-farm capital, including tools and equipment, and (vi) financial capital including savings, credit, and income from employment, trade and remittances.

People with more assets are more likely to have greater livelihood options and can pursue their goals. Policies and institutions can influence the access to such assets, helping rural communities to stabilize or even enhance their livelihoods. A strong asset base is particularly important when people and their livelihoods are exposed and become more vulnerable to shocks or seasonal changes, which are expected to increase with climate change.

4.2 Addressing climate change with a landscape approach

Increased droughts, floods, heavy rains or other adverse climatic conditions will have negative impacts on people's lives. A strong asset base helps to buffer these impacts. It is an essential prerequisite for establishing resilient livelihoods and strongly contributes to the adaptive capacity of rural communities. Adaptive capacity applies to both human systems (see 3.4) and natural ones, referring to "their ability to adapt, i.e. to adjust to climate change, including to climate variability and extremes; prevent or moderate potential damages; take advantage of opportunities; or cope with the consequences" (Kuriakose *et al.*, 2009, p.9). The greater biodiversity found in managed heterogeneous landscapes is better able to buffer disturbances and maintain ecosystem services.

Land use systems and landscapes need to protect and produce a variety of different ecosystem services simultaneously to be resilient and adapt to a changing climate.

BOX 4.1 POST-DISASTER RECONSTRUCTION IN PAKISTAN USING A WATERSHED MANAGEMENT APPROACH

After a major earthquake in 2005, the Pakistan Earthquake Reconstruction and Rehabilitation Authority executed, in collaboration with FAO and with funding from the Swedish International Development Agency, a multisectoral project to implement the livelihood component of the rehabilitation plan. The control of hydrogeological hazards through collaborative watershed management at the village level, which was carried out in 17 watersheds was a key activity of the project. In each watershed, project implementation followed a landscape approach that combined landslide stabilization, improved natural resources management (particularly forests and trees) and the enhancement of agricultural production. In each watershed, the steps followed in project implementation were: watershed delineation; damage assessment and Participatory Rural Appraisal; the establishment of an integrated watershed management and land use plan; the implementation of prioritized activities; and capacity building. Field interventions included slope stabilization through check dams, retaining walls and bioengineering; forest regeneration; the establishment of tree nurseries and fruit tree orchards; the repair of irrigation channels and agricultural terraces; the improvement of livestock health; and kitchen gardening. Institutional innovations were introduced and tested. Traditionally, District Forest Offices (DFOs) planned and implemented forestry-related interventions. Now Watershed Management Committees enable communities to plan and prioritize their activities while the DFOs and other line agencies provide support in implementation.

By following the landscape and participatory approach, the project has built local resilience to cope with the impacts of climate change and natural disasters. Although floods in July 2010 again created significant damage in the region, communities supported by the project were well prepared to cope. Flood damage in the project watersheds was comparatively low because of the protective function of the introduced forests and trees. Thanks to the project, the communities have gained confidence in their own ideas and skills and feel responsible for the positive changes in their environment, agricultural innovations and improvements in their livelihoods. Through the Watershed Management Committees, they are now organized and have a voice to request technical assistance and support from line agencies and donors.

By taking a landscape approach and applying climate-smart agriculture, there are many ways of increasing mitigation and adaptation opportunities on the farm, in the community and throughout the ecosystem while sustainably increasing and intensifying productivity. Below is a list of activities that can help accomplish this:

- Conserving valuable ecosystems, such as wetlands and peat lands, which perform important regulatory services and constitute very large carbon sinks, should be given special attention and integrated in a multifunctional landscape and land use system. Production systems and ecosystems with a high degree of agricultural biodiversity can produce more biomass compared to monocultures and increase carbon sequestration in biomass and soils (Tilman *et al.*

2006; Frison *et al.* 2011). The increased biomass can also enrich soil fertility and improved water retention, leading to greater resilience to climate extremes.

- The conservation and regeneration of trees and restoration of degraded forests will also increase carbon stocks and may reduce the pressure on adjacent natural ecosystems, leading to a decline in emissions. An increased diversity of trees allows for more overall biodiversity in the landscape. It also creates and favourable light and moisture conditions and contributes to the regeneration of soils nutrients which makes the forest more resilient.

- Similarly, trees on farms or agroforestry systems can contribute to mitigating climate change as they tend to sequester greater carbon quantities than agricultural systems without trees. The trees have important functions, including shading crops, erosion control and nutrient cycling and can prevent crop destruction act by acting as buffers against storms. By providing a means for diversifying incomes, the trees provide a type of insurance if there are crop failures.

- Similarly, holistic management of grassland ecosystems and controlled grazing allows for the regeneration of degraded vegetation and soils. This creates a significant opportunity to sequester carbon in the soils and increase biomass and biodiversity through perennial grasses, shrubs and trees. Well managed grasslands provide other important benefits, such as increased water infiltration and retention and improved nutrient cycling.

- At the farm level, there are opportunities to increase productivity and carbon sequestration through conservation agriculture. Conservation agriculture combines zero or minimum tillage with crop rotations and cover crops or mulch. It enhances biomass by integrating trees and shrubs in and around the fields. Conservation agriculture increases tolerance to changes in temperature and rainfall occasioned by extreme climate events such as droughts or flooding.

- Careful management in livestock systems, which involves such practices as the circulation of nutrients and manure management, can reduce greenhouse gas emissions. Composting solid manures can produce useful organic inputs to increase soil fertility.

- By integrating different energy production options , including fuel wood production, biogas and solar energy, into the farming system greenhouse gas emissions can be reduced and decrease pressure on forests. Integrated food-energy systems tend to be relatively well-adapted to climatic variability because of their diversity and flexibility, especially when soil and water conservation, water harvesting and agroforestry are integrated into the overall system.

- Integrated aquaculture-agriculture offers diversification that comes from integrating crops, vegetables, livestock, trees and fish and can impart stability in production, efficiency in resource use, lower energy use and conservation of the environment. This is achieved by the adoption of agro-industrial technologies (such as gasification or anaerobic digestion) that allows maximum utilization of all by-products, and encourages recycling and economic utilization of residues.

- The cumulative effects of many farms employing such practices across the landscape are significant.

4.3 Synergies and trade-offs among different land uses and elements of landscapes

There are many examples of concrete interactions between different elements within landscapes. Sustainably managed landscapes with a mosaic of different land uses can be the foundation of a well-functioning ecosystem with a high biosdiversity. In such landscapes, species are more likely to complement each other and better occupy the area over time and space (Loreau *et al.* 2003). The interaction and migration of species across different habitats and the spillover of organisms from undisturbed habitats, such as natural forests, to agricultural fields often has beneficial effects. For example, there is much evidence that in structurally complex landscapes natural pest control is higher and crop damage is lower than in less complex landscapes (Thies & Tscharntke,1999).

To optimize these multiple benefits, the trade-offs among different options must to be considered carefully. In many cases, the economic value of environmental services and external costs (environmental damages) and the direct or indirect benefit for land user groups tend to be underestimated. According to estimates, the vast array of ecosystem services that provide clean water for people have a net value of 4 500– 7 500 USD/ha/year in developed economies and 50–400 USD/ha/year in developing economies (Smith *et al.* 2006). Entrepreneurship and innovation can play an important role in tackling trade-offs between development and environment. They also generate positive externalities that can be employed to promote social empowerment. As such, private investment and entrepreneurship can ensure financial sustainability after upfront public sector investments have ended. For this reason, public-private partnerships are an important element in sustaining the social and cultural aspects of sustainability. Among other things, these partnerships can help return decision-making powers to farmers and contribute to 'green growth'. The concept of 'green economy', strongly advocated at the recent United Nations Conference on Sustainable Development in Rio de Janeiro (UNCSD, 2012), provides many options for the private sector to embark on initiatives that promote low-carbon growth and are based on an efficient use of natural resources and social inclusion (UNEP, 2011). With regards to agriculture, green growth involves increasing food security (in terms of availability, access, stability and utilization) while using less natural resources (FAO, 2011b).

4.4 The landscape approach supporting the adoption of climate-smart agriculture

The outcomes and messages of the Seventeenth Session of the Commission on Sustainable Development (CSD 17) of May 2009, the First Global Conference on Agriculture, Food Security and Climate Change in The Hague in November 2010 and the RIO+20 United Nations Conference on Sustainable Development in June 2012 (UNCSD, 2012) raised the profile of agriculture and related land uses in climate change discussions. The meetings acknowledged the special importance of the land-based sectors for increasing agricultural productivity; safeguarding important environmental services, such as water regulation, pollination and biodiversity and climate regulation, including reduced emissions and increased sequestration; and improving livelihoods and food security. To achieve the needed levels of growth an integrated landscape approach is required to manage the diversity of land uses across the landscape, as well as the interactions of the different land uses and components. Among the different land uses, there will be synergies and trade-offs and these need to be carefully evaluated and managed. Concerted efforts are required to manage the syner-

gies and trade-offs between building the resilience of the ecosystems and livelihoods and reducing greenhouse gas emissions and other environmental impacts. Climate-smart agriculture integrates efforts to increase food production sustainably and optimize productivity with efforts to strengthen the resilience to climate change and variability and reduce agriculture's contribution to climate change (FAO, 2011c). Numerous experiences and best practises that can contribute to reaching the objective of climate-smart agriculture already exist and are well tested and are mentioned in section 4.2. These practices are vital for producing food, feed, fibre and energy, supporting food security, building resilience to climate change and other shocks, and mitigating climate change. These practices, which tap into the synergies between mitigation and adaptation, and support and restore the multiple functions and dynamic nature of agricultural systems and landscapes, should be scaled up to landscape level and further replicated.

Climate-smart agriculture is applicable to multiple levels. It covers practices and technologies at the field and farm level and involves working with communities over a much wider area, such as watersheds and ecosystems. Although many examples already exist of successes and benefits of climate-smart practices, there is still work to be done to improve technologies, policies and institutions to move from single objective production to the implementation of the types of multiple objective systems needed today. The breakthrough towards a broad application of climate-smart natural resources management will require a change in our thinking about agricultural production and in the related institutional structures that will make this transformation a reality. Building and restoring the locally-adapted capacity for governance over resources and landscapes, enhancing social organization, and improving infrastructure and support services are among basic requirements for bringing about the desired results.

We already have a good understanding on how agriculture can be part of the solution to climate change and build the needs of adaptive capacity in agricultural systems and landscapes. The need for transition to climate-resilient, low-emitting production systems involves all land management systems in a given landscape. Climate-smart agricultural measures and policies have to be seen as key components of national regional and local climate change strategies. The recognition of the multiple dimensions and purposes of natural resource use and management and the interactions between human land use, management practices and natural resources require greater consistency across all land use sectors where implementation of climate-smart agriculture should play a critical role.

5. ENHANCING LINKAGES BETWEEN FORESTRY AND AGRICULTURE

5.1 The forestry – agriculture interface

Forest-agriculture interfaces are characterized by both, positive and negative interactions between forests/trees and cropland, livestock, aquaculture or mixed farming systems. These interactions take place at the farm level (e.g. through agroforestry and farm forestry), in forests (including forest-based agricultural systems), in wider farming systems, and within landscapes (e.g. watersheds). Forests and trees play a significant role in reducing the negative impacts of extreme events and in supporting food security in all its dimensions: food availability, food accessibility, food system stability. Trees outside forests, which are often not recognized as forest and are not included for protection in legal frameworks, are an important resource for rural people. Many farmers and other land users make no distinction between field trees and forest and recognize the close link and interactions between the two. Trees outside forests are found on agricultural land, (e.g. agroforestry systems, hedgerows, woodlots); in built-up areas, such as settlements and infrastructure (e.g. street trees, parks and other urban tree systems); and on bare land, such as dunes and former mining areas. They are an important for safeguarding income and food security and maintaining healthy environmental interactions (FAO, 2002).

BOX 5.1 ACACIA PROJECT SUPPORTS FOOD SECURITY, POVERTY ALLEVIATION AND SOIL DEGRADATION CONTROL IN SUB-SAHARAN AFRICAN COUNTRIES

On request from the Governments of Burkina Faso, Chad, Kenya, Niger, Senegal and Sudan, FAO, with funding from the Government of Italy through the Trust Fund for Food Safety and Food Security, supplied assistance for the execution of the Acacia Operation project. Acacia species not only produce gums, fodder and firewood, they also help ensure favourable conditions for agriculture by protecting crops against heavy rains and wind erosion. The project supported food security and rural development in the arid lands of sub-Saharan Africa countries that produce gums and resins. It represented the preparatory phase of a ten-year assistance programme to countries and to the regional networks established for the development of these sectors. With this long-term goal in mind, the project had the immediate objective of strengthening the analytical and operational capacity of six pilot countries. This work has allowed these countries to better address food security and desertification problems by improving agro-silvo-pastoral systems, diversifying and increasing household income sources and developing the gum and resin sectors in a sustainable manner. The project focused on the poorest and most vulnerable groups of rural society: women and children, the household members most often assigned to harvest and process gums and resins.

The multiple ways in which forests and trees on farms contribute to food security and nutrition is very often poorly understood. Their contribution is underestimated and inadequately reflected in many national development and food security strategies. Nevertheless, they are fundamental to many smallholder farmers, and particularly to forest dwellers, including many indigenous peoples. To maximize production and/or profitability, rural livelihood systems around the world combine agricultural and forest/tree management in an infinite number of ways, depending on the land and the availability of labour and capital. For most of the year, herders in arid and semi-arid lands depend on

trees in rangelands for their animals to browse. Many rural people rely heavily on forest resources for the well-being of their families. Forests yield a wealth of products, including medicines and wild foods, which can be gathered and sold. In many countries, women are also involved in the manufacture of non-wood forest products at home. Forests and trees play a key role in irrigated and rain-fed farming systems through their contribution to maintaining or restoring soil fertility. Systems containing forests are able to retain more of their ecosystem functions. These functions include helping to deliver clean water supplies by protecting watersheds and reducing soil erosion and related sediment loads in water courses. Another ecosystem services are carbon sequestration and the provision of habitats for predators and pollinators.

However, there is much concern that food production systems adjacent to forests in developing countries lead to undesirable clearing of forested lands and forest degradation (Graves *et al.* 2001). The tropics are witnessing significant conversion of forest land to agriculture. This includes commodity crops, such as soybean, oil palm or rubber, pasturelands for cattle and subsistence agricultural production (FAO, 2007a). Globally, agriculture is the greatest driver of deforestation. This is driven by various factors: population growth, urbanization, increased demand for foods due to changing consumption patterns and increased demand for bioenergy crops. From a global perspective, large-scale farming plays the most important role in the conversion of forest lands (UCS, 2011). This is compounded by a larger and increasingly connected global market that is spurring the demand for cultivation of commodities. In Latin America, deforestation is driven primarily by extensive cattle production and cultivation of soy bean. In the Asia-Pacific region, the drivers of deforestation are more diverse. However, palm oil production, which has doubled in the last decade (UCS, 2011), is particularly significant. In Africa, unsustainable land use practices of smallholders remains one of the key agricultural drivers of deforestation. The impacts of smallholder agriculture on clearing and degrading forests are largely tied to poverty, tenure insecurity, access rights and poor agricultural practices. One of the main causes for conversion of forests to agricultural uses, including biofuel production, are the high and relatively early financial returns, which are attractive to many farmers, as well as public and private investors. Without external incentives for conserving forests and delinking the growth of the agricultural sector from expanding the area under cultivation, economic pressures to clear forest land will most likely continue. The perspective of forest-dwelling communities must also be taken into account. Conversion and degradation of forests is often their only means to gain access to productive land for agricultural use. In addition, it is important to recognize that 2.5 billion people still rely on traditional biomass for their most basic energy needs (IEA, 2006). For example, according to FAO statistics, about 47 million tonnes of charcoal are produced per year (FAO, 2009b). Providing alternative incomes and employment, ensuring access to economic development, and increasing the availability of alternative fuel sources could create key opportunities to reduce the pressures on forests and on the lands at forest margins.

5.2 REDD+ as a new instrument for climate change mitigation

Over the last decade, around 13 million hectares of forests were either converted annually to other uses, mainly for agriculture activities, or lost through natural causes (FAO, 2010b). It is estimated that in the 1990s deforestation contributed approximately 5.8 gigatonnes of carbon dioxide each year to global greenhouse gas emissions. Although the figure is not known, it is evident that forest degradation is also a very significant source of greenhouse gas emissions. Since reducing and preventing deforestation is the mitigation option with the largest and most immediate carbon stock impact in the short term (UNFCCC, 2011), Parties to the United Nations Framework Convention on Climate

Change (UNFCCC) agreed at its 16th Conference in Cancun on an instrument known as REDD+. This instrument provides a potential opportunity to reverse the ongoing trend of deforestation and forest degradation and retain forest carbon stocks by promoting the sustainable management of forests and enhanced carbon sequestration (e.g. through afforestation, reforestation and forest restoration) in developing countries (UNFCCC, 2010). REDD+ provides developing countries substantial financial incentives to reduce deforestation and degradation rates. It also encourages policies and practices for the sustainable management of forests and the enhancement of forest carbon stocks.

5.3 Can REDD+ reconcile economic development with the protection of the natural resource base?

The Cancun Agreement clearly states that effective ways should be found to address the drivers of deforestation and reduce the human pressure on forests. Carrying out a comprehensive analysis of the drivers of deforestation and forest degradation is one of the first and most important prerequisites to ground a REDD+ readiness process, including the development of national REDD+ strategies. Drivers of deforestation and forest degradation are multifaceted, highly complex and vary from place to place. An analysis of these drivers must evaluate their impact at all levels, look beyond the forest sector and consider their relationship to all land use activities. Geist and Lambin (2002) have identified five broad clusters of underlying driving forces that include demographic, economic, technological, policy, institutional and cultural factors. These forces underpin the proximate causes of tropical deforestation, which are wood extraction, infrastructure expansion and agricultural expansion.

Measures to address the complex role of agriculture as a driver of deforestation and forest degradation have to take into account that achieving food and energy security will remain the highest priority for individual households and national governments. Additionally, climate change will have impacts on agriculture and forestry systems as well as on all the components of food security. Countries will increasingly have to grapple with competing land-uses and to explore measures to achieve a desirable balance among carbon storage in forests, increased agricultural productivity and the safeguarding of food security. For this reason, an isolated sectoral approach focusing solely on forests cannot succeed in implementing REDD+ policies (FAO, 2011a). Moreover, the contribution of forest and tree resources to food security should be recognized and efforts made to capture synergies between REDD+ and food security strategies and, where possible, limit the tradeoffs. There is potential to promote high carbon stock land uses in forests and in agricultural areas, and to achieve the best possible balance among a range of different development objectives, including enhanced agricultural productivity and improved livelihoods, climate change adaptation and environmental conservation. This would contribute to halting both deforestation and forest degradation while meeting future demands for food and nutrition.

5.4 Intersectoral cooperation, coordination and policies

The success of REDD+ could well depend on how successfully its interface with agriculture is managed and how well the interests of local and national stakeholders are met. Coordinated policy interventions and intersectoral cooperation are required at national and local levels to address climate change in both agriculture and forestry. National policies in agricultural development and REDD+ actions have to be adapted and aligned to broader low-carbon strategies and comprehensive national climate change action plans (Meridian Institute 2011). Strengthening the coordination and collabora-

tion between the different ministries working on national adaptation and mitigation strategies and action plans is key to building linkages between REDD+ and agriculture in policy frameworks. At the local level, integrated agriculture and REDD+ strategies need to promote sustainable farming practices that increase incomes and alleviate rural poverty and at the same time establish regulatory mechanisms to prevent deforestation and forest degradation. For this to be successful, an understanding is needed of the different dynamics and interactions within a landscape, including the drivers of deforestation. Not all drivers and factors of deforestation are under control of countries (e.g. instabilities in agricultural commodity export prices) (Butler *et al.* 2009) and not all profitable land-use options will be able to be compensated by a future REDD+ (carbon fund/market) system (e.g. oil palm plantation) (Motel et al. 2009). Complementary measures, such as the provision of alternative income and employment, should be taken into account to prevent from further pressures on natural resources. The landscape approach offers a practical approach for achieving these goals. For example, many projects in Africa give evidence how participatory community-based forest management can generate alternative income for farmers from sustainably produced forest products. In Panama, the establishment of nurseries and the promotion of economically attractive vegetable farming in the margins of national parks succeeded in protecting the parks from encroachment from traditional pasture systems (GTZ 2003). In Nepal, forest protection was coupled with a savings and credit programme that allowed the poor and landless to start up their own economic activities. In addition, an agroforestry programme provided alternative sources of firewood and construction timber, and new sources of income (GTZ 2008). In Viet Nam different development tools such as participatory land-use planning, forest land allocation, afforestation activities and small-scale financial assistance have been used to improve local livelihoods and contribute to reducing pressure on the natural resources of national parks.

REDD+ strategies offer great opportunities to promote climate-smart agricultural practises, delink agricultural growth from area expansion and encourage sound cross-sectoral land-use solutions. They can help to ensure that existing agricultural policies and strategies do not lead to perverse incentives that would increase the conversion of forest lands to agriculture. Similarly, it will be important to ensure that REDD+ strategies do not lead to limiting the agricultural growth that is needed to achieve food security.

Appropriate national and local incentives to promote optimal land use that are in line with the country's development goals and climate change strategies can be supplemented by international incentives. Targeted tax regimes and regulations could be as effective to improve the 'enabling conditions' for harmonized land use policies as sound governance and strengthened law enforcement. The private sector should play an important role for achieving common targets. Existing instruments and initiatives could be used to trigger private financial investments in agricultural value chains and sustainable forest management, provide upfront finance for more efficient agricultural technologies, subsidize transaction costs connected with climate change mitigation activities, and make loan guaranties available to attract more large-scale and foreign investment in sustainable agriculture and forestry. Integrated landscape approaches should be included in the activities covered under different climate finance funds and mechanisms, such as the Green Climate Fund, the Climate Investment Fund, Programme of Activities (PoA) in the Clean Development Mechanism (CDM), as well as nationally appropriate mitigation actions (NAMAs) in developing countries. Other funds, such as the Forest Carbon Partnership Facility and the UN-REDD Programme have been designed especially to support REDD+ activities, but they will need to address more clearly the place of agriculture and other relevant sectors for the management of multi-objective landscapes.

6. CONCLUSIONS

By allowing for the sustainable management of the natural resources base, preserving and increasing ecosystem services and building resilience to shocks and disturbances, the landscape approach can greatly support the needs of a diverse stakeholder groups. However, the successful implementation of this approach requires strong governance and participatory mechanisms involving all stakeholders. It also demands a multidisciplinary understanding of the environmental, social and economic dynamics within the landscape. In particular, considerable work needs to be undertaken to understand the drivers and agents of agricultural expansion and deforestation so that appropriate policy and finance interventions can be identified. This is particularly important in tropical countries where deforestation, driven by a number of factors, is causing widespread land degradation, contributing to greenhouse gas emissions and accelerating the loss of biodiversity. Improving agricultural practices and increasing yields per hectare on existing land is not sufficient to lowers costs, to increase profits and thereby curb deforestation. In addition, greater access to global markets and the diversification of food and non-food production (including biofuels) drives up demand and maintains 'pressure' to expand agricultural land. Country and location specific cross-sectoral policies, targeted financing mechanisms (including REDD+) and governance and regulatory infrastructures need to be devised to reduce the drivers of deforestation, safeguard forests from agricultural encroachment and better reconcile the diverse sustainable land use objectives in landscapes.

REFERENCES

Butler, et al. 2009. Butler Rhett, A; Pin Koh Lian; Ghazoul, Jaboury. *REDD in the red: palm oil could undermine carbon payment schemes*; Conservation letters 2 (2009) 67-73 ETH Zurich

CCAFS 2011. Wollenberg et al. *Actions needed to halt deforestation and promote climate-smart agriculture.* Policy brief 4

Ecoagriculture Partners. 2012. *Landscape for People Food and Nature. The Vision, The Evidence and Next Steps, Landscapes for People Food and Nature Initiative*, Washinghton

Ecological Society of America/ Union of Concerned Scientists (ESA/UCS). no date. *Revealing secrets about natural water purification. Water purification: An Essential Ecosystem Service. Water purification Fact Sheet*, ESA, Washington

FAO. no date. *Sustainable Fisheries Management. FAO and the global environment*. FAO, Rome, accessed online June 20th 2012 at ftp://ftp.fao.org/docrep/fao/011/aj982e/aj982e09.pdf

FAO/UNEP. 1999. *The Future of Our Land. Facing the Challenge. Guidelines for integrated Planning for Sustainable Management of Land Resources*. Rome.

FAO 2003: *Sustainable Forest Management and the Ecosystem Approach: Two concepts, one goal*, by Loyche Wilkie, M., Holmgren, P. And Castaneda, F, Forest Resources Development Service, Rome

FAO. 2007a. *The Agriculture-Forest interface*, COAG briefing note 2007/Inf.13, FAO Rome.

FAO. 2007b. *Adaptation to climate change in agriculture, forestry and fisheries*; Interdepartmental Working Group on Climate Change, FAO Rome,

FAO. 2007c. *Interdepartmental working group on climate change: Adaptation to climate change in agriculture, forestry and fisheries*, Rome 2007

FAO. 2009a. *Dialogue, Consensus and Vision*, FAO- Land Tenure Working Paper 12, Rome 2009

FAO. 2009b. *FAOStat*. Rome, Italy

FAO. 2009c. *Review of evidence on drylands pastoral systems and climate change - Implications and opportunities for mitigation and adaptation*, by Neely, C., Bunning, S. and Wilkes, A.,

FAO. 2010a. *An ecosystem approach to Sustainable Crop Intensification. A conceptual framework*. Accessed June 8th 2012 at http://www.fao.org/fileadmin/templates/agphome/scpi/ SCPI_Compendium/SCPIConceptual_framework.pdf

FAO. 2010b. *Global Forest Resources Assessment 2010 Main Report*- FAO Forestry Paper 163, Rome

FAO. 2010c. *"Climate-Smart" Agriculture. Policies, Practices and Financing for Food Security, Adaptation and Mitigation*. FAO, Rome, 41 p.

FAO. 2011a. *Building Bridges between REDD+ and Sustainable Agriculture: Addressing Agriculture's Role as a Driver of Deforestation*, CSA Policy Brief , Rome 2011

FAO. 2011b. *Linking Climate Change Financing and Sustainability – Implications for Agricul-*

ture", Natural Resources Management and Environment Department, Rome, Italy

FAO. 2011c. *Climate-Smart Agriculture: Managing Ecosystems for Sustainable Livelihoods*, http://www.fao.org/docrep/015/an177e/an177e00.pdf

FAO. 2012a. *The State of Land and Water Resources (SOLAW) - Managing systems at risk.* FAO, Rome and Earthscan, London.

FAO. 2012b. *"Raising the Profile of Agroforestry on the Policy Agenda: A guide for decision-makers"*. Volume 1: Guidelines; volume 2: Compilation of case studies. Rome, Italy. [forthcoming]

FAO. 2012c. *GAEZ Global Agro-Ecological Zones User's Guide*, May 2012, http://www.fao.org/nr/gaez/en/

Farina D.A. 2006. *Principles and Methods in Landscape Ecology: Towards a Science of the Landscape*, Berlin Springer

Folke et al. 2007. Folke. C, Pritschard, L ., Berkes, F., Colding, J., and Svedin,U. 2007. *The Problem of Fit between Ecosystems andInstitutions: Ten Years Later.* Ecology and Society Vol 12(1):30. URL:http://www.ecologyandsociety.org/vol12/iss1/art30/

Frison et al. 2011: Frison EA, Cherfas J, Hodgkin T. *Agricultural Biodiversity Is Essential for a Sustainable Improvement in Food and Nutrition Security*. Sustainability 2011, 3:238-253.

Geist, H.J. and Lambin E.F. 2002. *Proximate Causes and Underlying Driving Forces of Tropical Deforestation*. Bio Science. Vol.52 ,No 2, pp 16732-16737

GIZ. 2011. *Land Use Planning – Concept, Tools and Applications*. Eschborn.

Schroth and McNeely. 2011. Götz Schroth and Jeffry A. McNeely. *Biodiversity Conservation, Ecosystem Services and Livelihoods in Tropical Landscapes: Towards a Common Agenda*, Environmental Management (2011) 48:229–236 (DOI 10.1007/s00267-011-9708-2)

Graves et al. 2001. A.; Matthews, R; Waldie K ; Bhurtel, R; Quashie-Sam, J. , 2001. *Review of technologies being evaluated for the Forest/Agriculture Interface* , Cranfield University , Silsoe UK

GTZ 2003. GTZ-consultants working group "Forests", *"People and Forests"*, Eschborn 2003

GTZ. 2008. *Protecting and managing community forests in Eastern Nepal*, GTZ-Poster 2008

HLPE. 2011. *Land tenure and international investments in agriculture*. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2011

ICRAF. 2011. "*Políticas Públicas para o Desenvolvimento Agroflorestal no Brasil"*. Roberto Porro e Andrew Miccolis (organizadores). ICRAF, Belém (PA, Brasil), 2011, 80p. ISBN: 978-92-9059-308-9.

IEA. 2006. *World Energy Outlook 2006*. Paris, France

IPCC. 2001. *An Assessment of the Intergovernmental Panel on Climate Change*; Synthesis Report – Summary for policymakers

IUCN and EcoAgriculture Partners. 2008. *Learning from Landscapes*, Arborvitae Special, http://www.ecoagriculture.org/documents/files/doc_126.pdf

Jongman et al. 2004. *The new dimension of the European landscape*, Dordrecht 2004

Jose. 2009. Jose, S. *Agroforestry for ecosystem services and environmental benefits: an overview.* Agroforestry Systems 2009, 76:1–10.

Kassam et al. 2009. Kassam A, Friedrich T, Shaxson F, Pretty J. *The spread of Conservation Agriculture: justification, sustainability and uptake*. International Journal of Agricultural Sustainability 2009, 7:292–320.

Kuriakose et al. 2009. Kuriakose AT, Bizikova, Livia, Bachofen, Carina A. *Assessing sustainability and adaptive capacity to climate risks*. Washington, United States: World Bank; 2009

Klein et al. Klein A-M, Vaissière BE, Cane JH, Steffan-Dewenter I, Cunningham SA, Kremen C, Tscharntke T. *Importance of pollinators in changing landscapes for world crops*, Proc. R.. Soc. B 2007 274: 303-313

Lanly. J. P. 1997. *World forest resources: Situation and prospects* (briefing notes for the XI. World Forestry Congress)

Loreau et al. 2003. Loreau M, Mouquet N, Gonzalez A. *Biodiversity as spatial insurance in heterogeneous landscapes*. PNAS 2003, 100:12765–12770.

Meridian Institute. 2011. *Climate Change and Agriculture Scoping Report*. Washington DC

MEA. 2005. Millennium Ecosystem Assessment (MEA). *Ecosystems and Human Well-Being: Synthesis*. Island Press, Washington. 2005. 155pp.

MoANF. 2010. Ministry of Agriculture, Nature and Food quality of the Netherlands: *Chair's Summary of the 1. Global Conference on Agriculture, Food Security and Climate Change* in The Hague, Netherlands from 31 October to 5 November 2010

Motel et al. 2009. Motel Combes P. ; Pirard R.; Combes J.-L. *A methodology to estimate impacts of domestic policies on deforestation: Compensated Successful Efforts for "avoided deforestation" (REDD)* . Ecological Economics 68 (2009) 680-691 www.sciencedirect.com

Place, F., Ajayi, O. C., Torquebiau, E., Detlefsen, G., Gauthier, M. Buttoud, G. 2012. *"Improved policies for facilitating the adoption of agroforestry"* in In-Tech, 2012. (Forthcoming)

Russelle et al. 2007. Russelle MP, Entz MH, Franzluebbers AJ *Reconsidering Integrated Crop–Livestock Systems in North America.* Agronomy Journal 2007, 99:325.

Sandhu et al. 2010. Sandhu HS, Wratten SD, Cullen R. *Organic agriculture and ecosystem services.* Environmental Science & Policy 2010, 13:1–7.

Scheer, S. J. And McNeely, J.A. 2008. *Biodiversity conservation and agricultural sustainability: towards a new paradigm of 'ecoagriculture' landscapes*. PNAS 2008, 363: 477-494

Smith et al. 2006. M. de Groot, D., Perrot-Maitre D. and Bergkamp, G. *Pay - establishing payments for watershed services*. IUCN - The World Conservation Union, Gland. 2006.

Tilman et al. 2006. Tilman D, Reich PB, Knops JMH. *Biodiversity and ecosystem stability in a*

decade-long grassland experiment. Nature 2006, 441:629-632.

The Rock and Partners et al. 2011. *Forest Carbon in Ghana: The Legal framework and the role of Community Resource Management Areas (CREMAs)* , Forest Trends 2011

Thies et al. 1999. Thies C, Tscharntke T. *Landscape Structure and Biological Control in Agroecosystems*. Science 1999, 285:893–895.

UCS. 2011. *The root of the problem - What is driving tropical deforestation today?* Union of concerned scientists

UNCSD. 2012. *The future we want*, Outcome Document of the United Nations Conference on Sustainable Development Rio+20, Rio de Janeiro June 2012

UNEP. 2011. *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, www.unep.org/greeneconomy

UNFCCC. 2010. *Decision 1/CP 16 The Cancun Agreements*; Outcome of the work of the Ad Hoc Working Group on long-term Cooperative Action under the Convention.

UNFCCC. 2011. Factsheet : *Reducing emissions from deforestation in developing countries: approaches to stimulate action*.

Wageningen University. 2008. *Course material: Introduction to landscape approach*, https:\\portals.wi.wur.nl

Wascher et al. 1999. Wascher, D. M. Múgica, M. Gulinck, H. 1999. *Establishing targets to assess agricultural impacts on European landscapes*. Chapter: 6, CABI ebooks.

WHC. 1996. *World Heritage Committee*, Information Document Glossary of World Heritage Terms, WHC-96/CONF.201/INF.21, Paris 1996

WOCAT. 2007. *Where the land is greener -- case studies and analysis of soil and water conservation initiatives worldwide*. Editors: Hanspeter Liniger and William Critchley

World Bank. 2008. Chapter 4: *Optimizing Forest Functions in a Landscape*, in: Forests sourcebook: practical guidance for sustaining forests in development cooperation, http://siteresources.worldbank.org/EXTFORSOUBOOK/Resources/completeforestsourcebookapril2008.pdf

Zomer, R.J., Trabucco, A., Coe, R., and Place, F. 2009. *"Trees on farm: Analysis of global extent and geographical patterns of agroforestry"*. ICRAF, Working Paper no. 89. Nairobi, Kenya, ICRAF. 63 p.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Viale delle Terme di Caracalla
00153 Rome, Italy
www.fao.org/climatechange
climate-change@fao.org