National integrated mitigation planning in agriculture: A review paper

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MITIGATION OF CLIMATE CHANGE IN AGRICULTURE SERIES 7

National integrated mitigation planning in agriculture: A review paper

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Contents

Acronyms and key terms

Annex 1 countries	OECD countries and economies in transition that are signatory to Annex 1 of the UNFCCC which commits them to emission reductions
BAU	Business as usual
CCAFS	Climate Change, Agriculture and Food Security program of the CGIAR
CDM	Clean Development Mechanism
CIC	Climate Innovation Centres
CO_2	Carbon dioxide
CO_2eq	Carbon dioxide equivalent
DFID	Department for International Development (United Kingdom)
FAO	Food and Agriculture Organization of the United Nations
FYR Macedonia	The Former Yugoslav Republic of Macedonia
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GDP	Gross domestic product
GTP	Growth and Transformation Plan (Ethiopia)
HLPE	High Level Panel of Experts on Food Security and Nutrition
IDB	Inter-American Development Bank
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate change
IRENA	International Renewable Energy Agency
KfW	Kreditanstalt für Wiederaufbau
LEDS	Low emission development strategies
MAPS	Mitigation Action Plans and Scenarios
MACC	Marginal abatement cost curve
MRV	Measuring, reporting and verification
NAMAs	Nationally Appropriate Mitigation Actions
NAPAs	National Adaptation Plans of Action
NAPs	National Adaptation Plans

NAPCC	National Action Programme on Climate Change (Mongolia)
NDS	National development strategy
NEFCO	Nordic Environment Finance Corporation
NGOs	Non-governmental Organizations
Non-Annex 1 countries	Developing countries that are not signatory to Annex 1 of the UNFCCC.
OECD	Organisation for Economic Co-operation and Development
REDD+	Reducing Emissions from Deforestation and Forest Degradation (including enhancement of forest carbon stocks)
RPP	Readiness Preparation Proposals
SBSTA	Subsidiary Body for Scientific and Technological Advice
SD-PAM	Sustainable development policies and measures
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar

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Summary

Purpose and scope of the review: This review of national greenhouse gas (GHG) mitigation planning in the agriculture sector has two objectives: (i) to provide national policy makers and others in the agriculture sector with an overview of national mitigation planning processes and aid then in identifying the relevance of these processes for promoting agricultural development; (ii) to provide policy makers and advisors involved in low-emission development planning processes with an overview of mitigation planning in the agriculture sector and in particular to highlight the relevance of agriculture to national mitigation plans and actions.

The review provides an overview of agreements under the United Nations Framework Convention on Climate Change (UNFCCC) on GHG mitigation in developing countries (Section 1.2). It distinguishes between low-emission development strategies (LEDS), which aim to guide a transition to a low-emission development pathway, and Nationally Appropriate Mitigation Actions (NAMAs), which are mitigation policies and measures undertaken in line with national development strategies. Chapter 2 reviews 32 LEDS from 18 developing countries. It provides summary analysis of the planning processes, the types of plans that have been produced and the contents of these plans. Chapter 2 also analyses the alignment of these LEDS with other policy goals and enabling conditions for planning, and summarizes lessons that have been gained from experience. Chapter 3 reviews 62 NAMAs in the agriculture sectors of 30 countries. It describes the status of development of the NAMAs, the agricultural activities proposed and the alignment of the NAMAs with other policies and policy goals. Chapter 3 also identifies key elements that support the development of the conception, design and implementation of NAMAs. Chapter 4 summarizes the status of and trends in national agricultural mitigation planning, the barriers and risks involved, and the opportunities and potentials for agricultural NAMAs. It also suggests an approach to NAMA development in the agriculture sector based on 12 basic building blocks.

Key findings

Agricultural mitigation is an objective in many developing countries: The report reviews 32 low-emission development plans in developing countries. Twenty-one of these consider GHG mitigation in the agriculture sector. Of the 55 countries that have submitted NAMA statements to the UNFCCC, 21 propose NAMAs in the agriculture sector. A number of NAMAs are also under development but have not been officially communicated to the UNFCCC. A total of 62 agricultural NAMAs from 30 countries have been identified. Those NAMAs that have quantified emission reduction targets or mitigation potentials indicate significant mitigation potential in the agriculture sector.

Synergies with other development objectives: Countries have prioritized agricultural mitigation based on the contribution of agriculture to current GHG emissions and future projections. They have also considered the synergies between agricultural mitigation and a range of other development objectives, including increased food security; reduced deforestation; improved efficiency and trade competitiveness; the promotion of rural energy access; reduced water pollution; and heightened adaptation to climate change.

Policy alignment: LEDS align with broader national development strategies. Where LEDS exist, they provide the policy framework for agricultural NAMAs. Most countries do not have a LEDS, but alignment with national development strategies is often a criterion for the selection of specific actions as NAMAs. Explicit links between agricultural NAMAs and agriculture sector development plans are less commonly stated. Several NAMAs also relate to national REDD+ objectives, but REDD+ readiness proposals tend to elaborate very little on agricultural abatement measures. Policy integration and coordination is a challenge in agricultural mitigation planning.

Costs and financing: Planning processes have identified cost-negative, low-cost, and high-cost agricultural interventions. Most costs occur upfront. Those NAMAs that have cost estimates indicate that the full costs of implementation are significant. Some emerging countries are able to draw on domestic resources to finance agricultural mitigation actions, but the majority of countries have identified their LEDS and NAMAs with the intention of seeking international support. International public climate finance mostly focuses on supporting readiness, demonstrations and investments

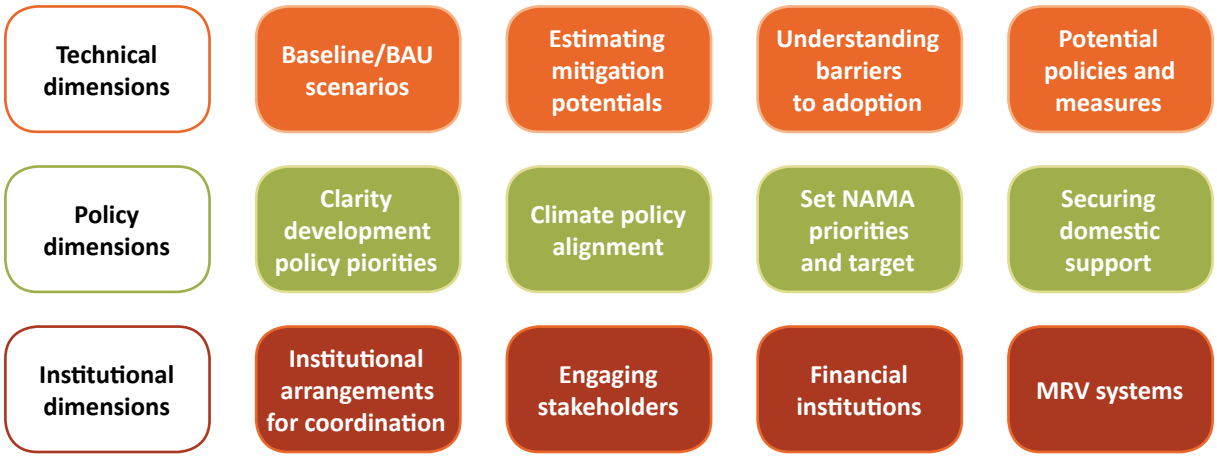
with transformational impacts. Most of this financing comes in the form of loans. Public finance will therefore have to be used to leverage private finance for the implementation of many mitigation plans and actions. Agriculture receives a very small proportion of international climate financing.

Barriers and risks in agricultural mitigation planning: About 40 percent of NAMA submissions include agricultural activities, but agriculture has only received a very small proportion of climate financing. Relatively few agricultural NAMAs have progressed beyond statements of intent towards implementation. Constraints on agricultural NAMA development include: obstacles in the domestic policy processes; insufficient readiness within the agriculture sector; the lack of agricultural expertise in climate finance institutions; and the slow pace of development of NAMA requirements and procedures at the international level.

Opportunities and potentials for agricultural NAMAs: At least 30 developing countries have expressed interest in implementing agricultural NAMAs. To date, results of planning processes indicate significant mitigation potential, often at relatively low cost, with considerable sustainable development benefits. Progress in developing agricultural NAMAs has been most rapid in some emerging and middle-income countries (e.g. Brazil, Colombia, Mongolia) and a number of lower-income countries (e.g. Ethiopia, Rwanda). Besides domestic political processes, the availability of domestic and international financing has been a facilitating factor.

Agricultural mitigation planning processes: There is no single process that must be followed to make progress in planning mitigation policies and measures. Rather, the NAMA development process consists of a range of key elements, or 'building blocks', that describe key aspects of the technical, policy and institutional dimensions of mitigation planning. Examples of low-emission/NAMA development processes in the agriculture sector suggest a phased approach to NAMA development is appropriate. Such an approach would enable a country to address gaps and needs incrementally. Of particular importance in the agriculture sector is the need to understand barriers to adoption by smallholders, as this will be critical in the design of effective implementation measures.

Key elements ('building blocks') in the NAMA process



1. Introduction

1.1 The purpose and focus of this report

The effect of human activities on atmospheric concentrations of GHGs has become a central feature of international cooperation on sustainable development (UN, 2012). Although easily forgotten in technical discussions on GHG management measures, the UNFCCC, the main international convention governing international cooperation to manage GHG concentrations, places the obligations of its Parties in the context of national sustainable development. Article 2 of the Convention stresses that GHG concentration levels that prevent dangerous impacts on the climate system should be achieved "to enable economic development to proceed in a sustainable manner". Article 3.4 confirms the right of Parties to sustainable development and states that "policies and measures…appropriate to the specific conditions of each Party…should be integrated with national development programs, taking into account that economic development is essential for adopting measures to address climate change". While the Convention places obligations on developed countries to reduce GHG emissions, awareness of the increasing contribution of developing countries to total emissions (IEA, 2011), has brought attention to the relationship between economic development and climate protection.

The core issue is how development pathways that deliver the range of economic, social and environmental outcomes that have been defined by countries can be made compatible with climate change adaptation and mitigation needs. In general, climate adaptation and GHG mitigation outcomes of economic development policies may be seen as a side-effect of development policies; may be considered in formulating development policies; or may be closely integrated into the development policy process (Román, 2012). Many economic development plans are adopted for reasons other than climate concerns and may either increase or decrease GHG emissions. For example, plans and policies in the energy sector designed to increase access to energy resources may also reduce GHG emissions. Irrigation plans may aim primarily to increase yields and improve food supply, but they may also recognize the benefits of irrigation for coping with variability or longer-term declines in rainfall. More recently, however, some national plans are being developed with the explicit intention of reducing GHG emissions while also achieving other objectives, such as economic growth or adaptation to climate change.

Currently 870 million people remain chronically undernourished, mostly in developing countries (FAO, 2012a). There are serious concerns about the implications of growing populations on global food security and how increasing incomes in developing countries will heighten the future demand for food (FAO, 2009). In addition the impacts of climate change on future food production and availability are the object of urgent debate (Beddington *et al.*, 2012). All of these considerations have pushed the role of agriculture in sustainable development to the fore.

Agriculture makes key contributions to rural development, including ensuring food security and generating employment. It also delivers other social and environmental services critical to sustainable development (FAO, 2012b). In 2005, agriculture contributed an estimated 10-12 percent of global GHG emissions (IPCC, 2007). This figure does not include the contributions of food production to emissions in other sectors such as energy or transport. In addition, agriculture is a driver of deforestation and other land use changes that contribute a estimated 17 percent of total global emissions (IPCC, 2007). Despite its central role in sustainable development (Tubiello, 2011) and its contribution to GHG emissions, agriculture has received little explicit attention in the UNFCCC process. Recent discussions on how to treat agriculture within the UNFCCC, which have focused on whether to establish a dedicated work programme on agriculture, have been inconclusive.[1] For many developing countries, the primary concerns regarding agriculture relate to food security, economic development and adaptation to the impacts of climate change.[2] For many Parties, mitigation in

[1] The outcome at Doha was: "the SBSTA Chair ruled that there was no consensus amongst Parties to refer this matter to the COP for further consideration. The SBSTA Chair proposed and the meeting agreed that...SBSTA would continue its consideration of this agenda item at its thirty-eighth session." See http://unfccc.int/meetings/doha_nov_2012/session/7052.php

[2] See for example submissions of Parties on agriculture, FCCC/SBSTA/2012/MISC.6

the agriculture sector is not a priority. Some Parties have even opposed discussion in the UNFCCC context on the issue. However, agriculture is an important driver of climate change (HLPE, 2012), and without adopting low-emission growth strategies across a range of sectors, emission trends leading to 4°C warming within the century are plausible (World Bank, 2012). In the agriculture sector, mitigating GHG emissions and reducing the intensity of GHG emissions per unit output have significant synergies with other agricultural and economic objectives, such as the restoration of degraded lands and increasing the efficiency of resource use as agricultural activities increase in scale (Burney *et al.,* 2010). In 2010, in response to the invitation in the Copenhagen Accord, 35 countries submitted NAMAs to the UNFCCC. Fifteen of these NAMAs specified actions in the agriculture sector (FAO, 2010), A synthesis of technology needs assessments in non-Annex 1 countries has found that agriculture and forestry is the second most common sector with technology needs relating to mitigation and it is the most common sector with technology needs relating to adaptation.[3] The importance of addressing agriculture as a driver of deforestation is becoming increasingly recognized (Boucher *et al., 2011;* Kissinger *et al.,* 2012).

As developing countries work to define low-emission development pathways and specific mitigation actions suited to their national conditions, how has agriculture been considered? Where it is considered, how are the multiple objectives of agricultural activities aligned with mitigation objectives? What planning approaches and tools have been used to identify low-emission strategies and mitigation actions in the agriculture sector? What relation has mitigation planning in the agriculture sector had with national development planning and GHG mitigation planning in other sectors? And what are the linkages between national planning processes and international processes under the UNFCCC? These are the issues addressed in this report.[4] The descriptions of initiatives undertaken to date and the analysis of these issues contained in this report are intended for two audiences:

(i) National policy makers and others (e.g. non-governmental organizations (NGOs), farmer organizations) working in the agriculture sector, to provide them with an overview of national mitigation planning processes and related international processes and mechanisms in order to aid them in identifying the relevance of these processes for promoting nationally appropriate agricultural development;

(ii) Policy makers and their advisors involved in low-emission development planning and NAMA processes (e.g. Environment Ministry staff, staff in donor agencies responsible for mitigation and NAMA work, many of whom typically focus on energy-environment issues), to provide them with an overview of the relevance of mitigation plans and actions in the agriculture sector, in order to aid them in identifying the relevance of agriculture to the development of national mitigation plans and actions.

Since the UNFCCC provides the main international context for mitigation of GHGs, the remainder of this section summarizes agreements within the UNFCCC process on mitigation in developing countries. Chapter 2 describes existing low-emission planning initiatives in developing countries, with a focus on understanding the relationship between these initiatives and national development planning processes. It also highlights national planning initiatives that have considered the agriculture sector. Chapter 3 focuses on mitigation planning in the agriculture sector and describes some key elements of the NAMA development process with examples from the agriculture sector. Chapter 4 discusses the implications of the review's findings for mitigation planning in the agriculture sector. It makes specific recommendations regarding research, policy and action, for donors and international or intergovernmental agricultural organizations.

1.2 GHG mitigation by developing countries within the UNFCCC process

The UNFCCC provides a key part of the international context for GHG mitigation planning. Pursuant to Articles 3.4 and 4.7 of the UNFCCC, developing countries have been encouraged, but not obliged, to implement mitigation actions. Until around 2009, development policies and measures

[3] FCCC/SBSTA/2009/INF.1

[4] Project-level agricultural mitigation initiatives have been reviewed elsewhere (Seeberg-Everfeldt and Tapio-Biström 2010) and are not addressed in this report.

in the context of developing country economic development were commonly discussed in terms of "sustainable development policies and measures" (SD-PAMs) (Winkler *et al.,* 2002; Bradley *et al.,* 2005; Winkler *et al.,* 2008; Ellis *et al.,* 2009). The Bali Action Plan, adopted at UNFCCC COP13 in 2007, called for "nationally appropriate mitigation actions by developing country Parties in the context of sustainable development, supported and enabled by technology, financing and capacity building, in a measurable, reportable and verifiable manner". The 2009 Copenhagen Accord,[5] recognizing that "social and economic development and poverty eradication are the first and overriding priorities of developing countries and that a low-emission development strategy is indispensable to sustainable development", encouraged developing countries to "implement mitigation actions… in the context of sustainable development". The Copenhagen Accord continued to use the term "nationally appropriate mitigation actions" (NAMAs) and also referred to incentives for developing countries "to continue to develop on a low-emission pathway". The 2010 Cancun Agreements confirmed Annex-1 Parties' pledges to provide 'fast-start' finance of USD 30 billion for the period 2010-2012 and long-term funds for mitigation activities to reach USD 100 billion per year as of 2020.[6] These commitments are seen as providing an essential basis for incentivizing and enabling low-emission development planning and scaled-up implementation of mitigation action in developing countries.

After COP15 in Copenhagen in 2009, non-Annex 1 Parties were invited to submit NAMAs to the UNFCCC. By April 2010, 35 non-Annex 1 Parties had responded, submitting commitments or statements of intention to implement mitigation actions or achieve specified mitigation targets. Analysis (FAO, 2010) identified that 15 out of the 35 submissions stated intentions to implement mitigation actions in the agriculture sector. Additional NAMA submissions were made after COP16 in Cancun (December 2010) and COP17 in Durban (December 2011). To date, 55 countries have submitted NAMAs to the UNFCCC. At least 21 of these submissions refer to mitigation actions in the agriculture sector.

The Copenhagen Accord did not specify the amount of detail required for NAMA submissions. As a result, the NAMAs submitted to the UNFCCC vary in scope. Some submissions state emission reduction targets, others specify actions with or without specifying the expected GHG emission reductions, and some simply state priority areas for mitigation action. Some NAMAs have been put forward as unilateral domestic actions, while others propose actions for which international support would be requested. Considerations regarding the requirements for measurement, reporting and verification (MRV) of domestic and supported actions have given rise to much discussion over what constitutes a NAMA. The UNFCCC itself has resisted requests to provide detailed guidance (C. Forner, 2012), insisting that NAMAs are to be determined by Parties themselves on the basis of national circumstances. The UNFCCC (prototype) NAMA registry,[7] initiated in 2011, provides options for Parties to submit NAMAs seeking support for preparation, NAMAs seeking support for implementation, and NAMAs seeking recognition without support. The template for submission requires, among other details, a title, a brief description of the action, estimates of timeframe and costs, an estimate of emission reductions and information on sustainable development benefits. The template offers options for a national or sectoral goal, a strategy, a national or sectoral programme, a project, or 'other' form of action. Beyond these indications, NAMAs remain undefined in formal international agreements.

LEDS intuitively refer to a strategy that promotes economic growth while keeping GHG emissions lower than without the strategy (van Tilburg *et al.,* 2011). However, as is the case with NAMAs, there has been no clear international guidance on what constitutes a LEDS. The terms LEDS and NAMAs are sometimes used interchangably. This may also be seen in the (prototype) NAMA Registry, where the option of 'strategy' is given as a type of NAMA. Both LEDS and NAMAs can be designed at national, regional or sectoral levels, and both may be eligible for fast-start finance support. Figure 1 provides some clarification on the relationship between national development plans, LEDS and NAMAs.

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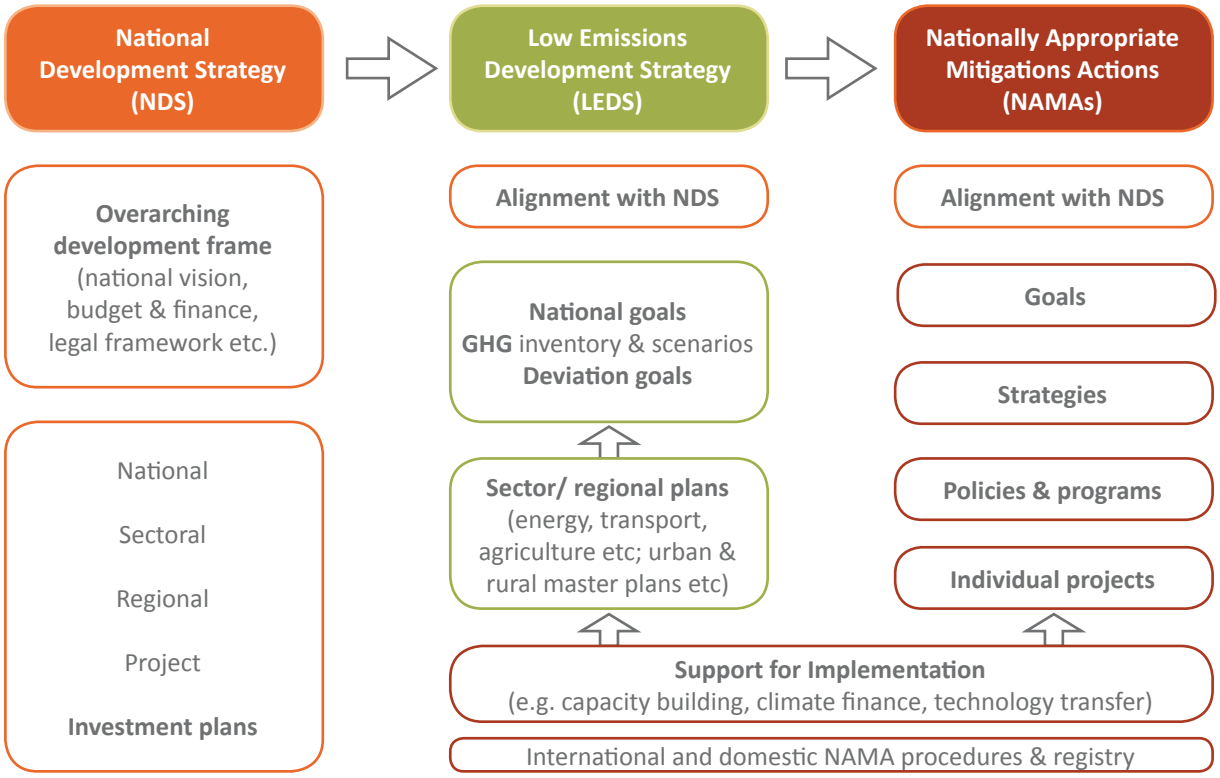
[5] The Copenhagen Accord was "noted" but not adopted by the UNFCCC; the 2010 Cancun Agreements were formally adopted.

[6] Summaries of individual countries' pledges and commitments can be found at http://www3.unfccc.int/pls/apex/f?p=116:9:826803083463213::NO:::

[7] http://unfccc.int/cooperation_support/nama/items/6945.php

Figure 1: Relationship between national development plans, LEDS and NAMAs



Source: Adapted from UNEP, 2012

LEDS generally refer to national, regional or sectoral strategies and plans intended to guide a transition to a low-emission development pathway, where implementation of the strategy is to be done through specific policies and measures. Rather than setting new priorities *de novo*, LEDS are generally oriented around existing long-term national, sectoral or regional development plans. In the report that follows, we describe existing initiatives to introduce mitigation planning into national development strategies, including those that are explicitly labeled as LEDS, as well as some that use different terminology. NAMAs, on the other hand, are mitigation policies and measures that are in line with national development priorities. As such, NAMAs may be elaborated independently of LEDS, or LEDS may form the strategic context for the identification of NAMAs, or developing a LEDS may be a NAMA. NAMAs share much in common with more general SD-PAMs. However, with the evolution of NAMA-specific funding windows in the UNFCCC process, the term NAMA increasingly refers only to those mitigation policies and measures that have been identified as NAMAs in relation to the UNFCCC process. It is worth bearing in mind that the vast majority of developing country mitigation actions are neither referred to as LEDS nor NAMAs. They are fully integrated into their national development policy context. They have little articulation with the UNFCCC process, but are sometimes mentioned in national UNFCCC communications. In this report, these actions are referred to as national mitigation policies and measures.

2. Overview of national mitigation planning processes

2.1 Planning perspectives

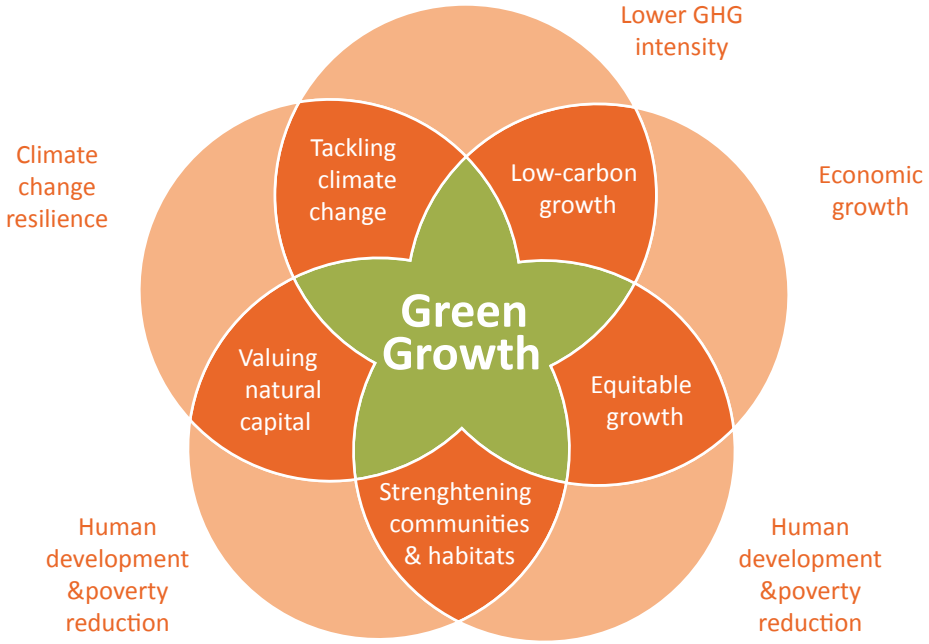
In government planning activities, climate change has evolved from being the concern solely of ministries with specific mandates for environmental issues to being recognized as an issue to be addressed as an integral part of national development planning (van Tilburg and Wuertenberger, 2012). As can be seen from priorities stated in national climate change action plans and other policy documents,[8] for many developing countries, economic and social development, disaster risk management, adaptation to climate change and a host of other country-specific policy objectives are accorded higher priority than actions to mitigate climate change. For some developing countries, actions that mitigate climate change are in line with other policy objectives, such as increasing access to energy, reducing energy costs or addressing environmental pollution (see Figure 2). Thus, there are many approaches for planning to meet these multiple and often competing policy objectives in the context of climate change. Various labels have been given to planning perspectives that address mitigation in relation to other national development priorities. Examples include 'green growth' (OECD, 2011a), 'climate-compatible development' (Mitchell and Maxwell, 2010) or 'low-carbon climate-resilient development' (OECD, 2011b) plans, as well as the more ubiquitous 'national climate action plan'. All these approaches have in common the integration of GHG emission reduction into the development planning process.

The particular perspective that guides planning processes depends on national circumstances, such as national policy priorities, and, in some cases, the international funding environment (e.g. fast-start finance, REDD+ funding). Many developing countries' national climate change action plans explicitly state that mitigation is not a priority. They focus on identifying adaptation priorities that are consistent with their development needs. In other countries, national climate change plans, 'green growth' plans or 'low-carbon climate-resilient development' plans address both climate change adaptation and mitigation, as well as other development objectives. Similarly, 'low-carbon development' plans, while justifying the promotion of some specific measures because of their quantified contribution to emissions reductions, also commonly justify prioritization of these actions in relation to other national needs, such as access to energy resources, affordability of energy, energy security and employment creation. 'Green growth' perspectives tend to focus more generally on the balance between attaining economic growth and development and maintaining environmental resources. In all these perspectives, actions that reduce or avoid GHG emissions may be relevant. 'Climate-compatible' development seeks to promote economic development while also addressing climate change adaptation and mitigation. In all cases, the mitigation component of planning seeks to reduce emissions compared to a business-as-usual strategy and to leverage the co-benefits of GHG mitigation for other policy goals.

'Transformational' is another term increasingly used to describe low-emission development plans. Transformational actions are generally characterized as those that represent a fundamental shift towards a more sustainable pathway. These actions promote widely replicable behavioural change in a sector or country, or measures that can be significantly scaled-up to bring about fundamental change in a sector's GHG emissions pathway. While there has been little systematization to date of what constitutes and what enables transformative change as opposed to incremental change in low-emission development planning (Mersmann, 2012), the term is increasingly visible in statements by institutions financing low-emission development in developing countries.

[8] See also specific statements on agriculture in FCCC/SBSTA/2012/MISC.6

Figure 2: Potential outcome areas for a 'green economy'



Source: Low, 2011

2.2 Overview of national low-emission development plans

Table 1 provides a summary of a number of LEDS in developing countries. All the plans in the table were selected because they pay explicit attention to GHG mitigation. Plans were only included if the planning process is complete and the planning document could be accessed. In addition to those plans listed in the table, a number of other national low-emission planning initiatives are ongoing.[9] The table does not include a number of sectoral low-emission development plans, which commonly focus explicitly on the energy sector[10] and other sectors, such as transport.[11] Although not focused on the agriculture sector, these plans are likely to relate to the food sector. However, from these plans it was not possible to identify any that specifically related to the food sector, since energy, transport and construction relate to many more actors than those involved with agriculture and food. Also not included in the table are a number of countries' climate policy statements, some of which provide mandates to initiate the plans included in the table, some of which follow from the plans.

[9] See, for example, information at www.mitigationpartnership.net, www.lowemissiondevelopment.org, http://en.openei.org/wiki/Gateway:Coordinated_Low_Emissions_Assistance_Network_(CLEAN). Green Economy scoping studies are currently being conducted with UNEP support in Armenia, Azerbaijan, Barbados, Brazil, China, Ghana, Indonesia, Jordan, Kenya, Mexico, Moldova, Montenegro, Morocco, Namibia, Nepal, Peru, Philippines, Republic of Korea, Russian Federation, Serbia, South Africa and Ukraine (see http://www.unep.org/greeneconomy/AdvisoryServices/Overview/tabid/101805/language/en-US/Default.aspx).

[10] E.g. http://www.sepa-americas.net/index.php

[11] E.g. http://www.transport2012.org/, http://www.transferproject.org/, http://www.slocat.net/.

Table 1: Selected mitigation plans in developing countries

Vision strategies						
Country	**Year**	**Plan**	Is mitigation included?	Is mitigation in agriculture included?	Is adaptation included?	Is adaptation in agri-culture included?
Costa Rica	2005	Peace with Nature	yes	Not explicit	no	no
South Africa	2011	Green Economy Accord	yes	no	no	no
Singapore	2006	Singapore Green Plan 2012	yes	no	Not explicit	no
Framework plans						
Country	**Year**	**Plan**	Is mitigation included?	Is mitigation in agriculture included?	Is adaptation included?	Is adaptation in agri-culture included?
Cambodia	2009	National Green Growth Roadmap	yes	yes	yes	Yes
China	2007	National Climate Change Program (2007-2010)	yes	yes	yes	Yes
China	2012	Twelfth Five Year Plan for Socio-economic Development	Yes	yes	yes	Yes
Colombia	2012	Colombian Low Carbon Development Strategy	yes	yes	no	no
Ethiopia	2011	Ethiopia's Climate-Resilient Green Economy Strategy	yes	yes	not yet	not yet
India	2008	National Climate Change Action Plan	yes	no	yes	yes
India	2007	Eleventh Five Year Plan	yes	no	Yes	Yes
Indonesia	2009	Indonesia Climate Change Sectoral Roadmap 2010-2029	yes	no	yes	Yes
Kenya	2010	National Climate Change Response Strategy	yes	yes	yes	Yes
Mexico	2007	National Strategy on Climate Change (ENACC)	yes	yes	yes	Yes
Peru	2010 2011	National Guidelines on Climate Change Mitigation	yes	yes	n/a	n/a
Philippines	2010	National Framework Strategy on Cli-mate Change (2011-2022)	yes	no	yes	Yes
Rwanda	2011	National Strategy for Climate Change and Low Carbon Development	yes	yes	yes	Yes
Singapore	2012	National Climate Change Strategy	yes	no	yes	no
South Africa	2010	National Climate Change Response Green Paper	yes	yes	yes	Yes
Republic of Korea	2009	National Strategy for Green Growth	yes	yes	yes	Yes
Action plans						
Country	**Year**	**Plan**	Is mitigation included?	Is mitigation in agriculture included?	Is adaptation included?	Is adaptation in agri-culture included?
Brazil	2008	National Plan on Climate Change	yes	yes	yes	not explicit
China	2012	Twelfth Five Year Plan on Energy Con-servation and Emission Reduction	yes	yes	n/a	n/a
Costa Rica	2009	National Strategy on Climate Change	yes	yes	yes	yes

Action plans						
Country	**Year**	**Plan**	Is mitigation included?	Is mitigation in agriculture included?	Is adaptation included?	Is adaptation in agri-culture included?
Dominica	2010	Dominica Low Carbon Climate Resilient Development Strategy	yes	yes	yes	Yes
Guyana	2001	Climate Change Action Plan	yes	yes	yes	yes
Indonesia	2010	Medium Term Development Plan 2010-2014	yes	yes	yes	Yes
Kenya	2012	National Climate Change Action Plan	yes	yes	yes	yes
Mexico	2009	Special Program on Climate Change (PECC)	yes	no	yes	yes
Peru	2010	National Plan of Action on Climate change Adaptation and Mitigation	yes	no	yes	yes
Philippines	2010	National Climate Change Action Plan (2011-2028)	yes	yes	yes	yes
South Africa	2011	National Climate Change Response White Paper	yes	yes	yes	yes
Republic of Korea	2009	Five Year Plan for Green Growth (2009-2013)	yes	yes	yes	yes
Tuvalu	2011	Tuvalu National Strategic Action Plan for Climate Change and Disaster Risk Management 2012–2016	yes	Yes	yes	yes

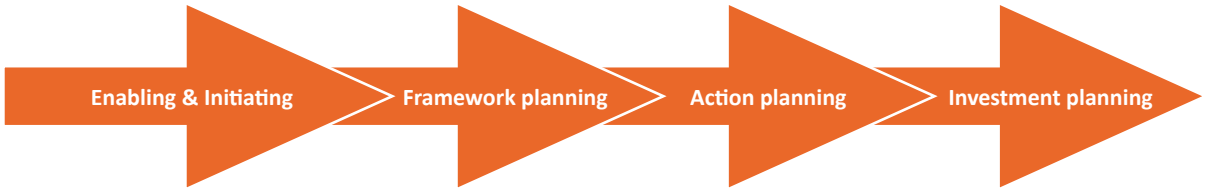
The following subsections analyse the plans from the following perspectives:

- planning processes and types of plan;
- what the plans contain;
- enabling conditions for planning;
- alignment of multiple policy goals;
- funding the plan; and
- lessons from experience.

2.2.1 Planning process

Table 1 includes 32 plans from 18 countries for which a published planning document could be accessed. An overview of the plans suggests that in general the low-emission planning process involves establishing enabling conditions and initiating the planning process, framework planning, followed by action planning and ultimately investment planning. Most countries have not yet reached the investment planning stage (Figure 3). The 32 plans in Table 1 are categorized into vision strategy documents, framework plans and action plans. However, the distinction between these types of plan is not always clear. The specific functions in the planning process (e.g. prioritization, scenario analysis) are in some cases performed before, and in some cases after the framework guidance has been issued. See also van Tilberg *et al.* (2011) for a list of functions or 'building blocks'.

Figure 3: Stylized low-emission development planning process



- Vision statement
- Establish legal basis
- Create coordination institutions
- Presidential decisions
- Donor interaction

- Situation assesment
- Defining priorities
- Establish legal/policy framework
  - Scenario analysis
  - Mitigation assesment
  - Scoping options
    - Identifying options
    - Feasibility/barrier/cost analysis

  Consultation

- Detailed feasibility analysis
- Program or project design
- Investment planning

Table 1 includes more than one plan from some countries. This is because many countries initially develop a framework plan that provides the general priorities and perspectives within which action planning takes place. For example, South Africa first produced a Green Paper (2010) on climate change that set out the principles on the basis of which national adaptation and mitigation responses would be considered, identified priority adaptation and mitigation sectors, and clarified roles in the planning process. It then developed a White Paper (2011) that outlined the overall framework to guide the elaboration of detailed sectoral plans. After the White Paper, analysis and consultations have contributed to the elaboration of those plans. The Philippines first developed a Framework Strategy on Climate Change, which formed the basis of a National Action Plan. The Framework Strategy clarifies 'key result areas' for adaptation and mitigation, while the Action Plan elaborates specific outcomes and activities contributing to the outcomes for each key result area. Kenya also first developed a Response Strategy and followed this with an Action Plan.

2.2.2 What the plans contain

The contents of plans vary. This is because plans differ in their function (setting framework conditions or planning for action) and because there are differences in national political processes and the availability of data and institutional capacities for analysis. Most plans contain the following (see also Project Catalyst, 2009):

- an analysis situating the strategy within the national context (e.g. in relation to national conditions, existing national policy frameworks, international negotiations);
- an analysis of baseline (historical or business-as-usual) GHG emissions by sector;
- an identification of priority sectors;
- policies and measures (in action plans, but generally not in framework plans);
- targets or estimates of mitigation potential of policies and measures (in action plans but generally not in framework plans)
- institutional arrangements for implementation;
- costs (in some action plans only); and
- arrangements for monitoring and review (in some cases only).

Very few of the national plans go so far as to specify low-emission investments in detail (Guyana's Low Carbon Development Strategy is an exception). The planning documents are rather to be seen as part of an ongoing planning process, with each stage or iteration of the process progressively clarifying the options and intended actions. In some cases, further work at the national level is envisaged. In many cases, further specification is to be done at the sector and/or regional level. Thus, even where low-emission development plans exist, planning processes continue.

2.2.3 Enabling conditions for planning

It is frequently noted that senior leadership within government is a key enabling condition for low-emission development planning (Clapp *et al.,* 2010; Knight, 2012; Project Catalyst, 2009). From available documentation it appears that several of the national low-emission development plans were initiated at the level of head of state. In addition, climate change coordination bodies are often located in the offices of the head of state and may be chaired by these offices in collaboration with environment or planning ministries.

In some countries, various conditions have been put in place to provide a legal mandate for planning and for the uptake of the resulting plan. For example, the Philippines instituted the Republic Act 9729 (2009), which established the Climate Change Commission and set out specific requirements for the national Framework and Action plans. It also required local governments to make action plans that are consistent with the national plans. The Republic of Korea developed a Framework Act on Low Carbon Green Growth, which also legally clarified that each level of government has the responsibility to develop national, sectoral and local strategies and plans for green growth. It also lays out the principles on which such plans should be based (e.g. reducing fossil fuel use, promoting new green industries and providing support for low-income groups). Brazil's National Plan on Climate Change, together with the National Policy on Climate Change (Law No. 12,187/2009*)* sets out the targets and policy priorities for meeting Brazil's voluntary GHG emission reduction commitments. The translation of the national plan into sectoral plans was enabled by Federal Decree No. 7,390/2010, which clarifies the formal status of the Sector Plans.

In some countries, low-emission development planning has taken place within the existing planning framework. For example, in Costa Rica the mandate to develop a climate change action plan was stated in the National Development Plan (2007-2010) and reaffirmed in a Governing Council Decision. In 2009, Indonesia developed a long-term Climate Change Roadmap, which informed the Medium-Term Development Plan (2010-2014) that was under preparation at that time. China and India have also used their existing five-year planning systems to integrate climate change mitigation and adaptation in national development planning.

Other key framework conditions that are often elaborated in low-emission development plans are the institutional frameworks for coordination across government sectors, between administrative levels of government, and with stakeholders outside the government. Many countries already have inter-ministerial climate change committees. These committees are most often chaired by a head of state and coordinated by the environment ministry, but they also involve a number of other ministries. In the 18 countries whose national plans were reviewed here, the ministry responsible for agriculture is represented in almost all cases. In several countries, the initial low-emission development plan was not elaborated within the existing state planning system. Several plans note the need for new coordination mechanisms to continue with the planning process and/or coordinate implementation of the plan. Indeed, one of the key functions of developing a low-emission development plan may be to promote coordination between agencies (Clapp *et al.,* 2010). Examples of such institutional innovations are shown in the final column of Table 2.

2.2.4 Alignment of policy goals

Although a number of plans were developed outside existing national plans or planning processes, almost all plans refer to, or in other ways indicate, alignment with the national development plan. In a few cases, this has been done explicitly. Mexico's Special Program on Climate Change (PECC, Spanish acronym) opens with a table indicating the contribution of PECC to the objectives of the national development plan. Ethiopia's Climate-Resilient Green Economy Strategy (2011) takes the Growth

and Transformation Plan (GTP), Ethiopia's five-year planning document, as the basis for defining the business-as-usual scenario, against which lower-emission options that also contribute to achieving GTP objectives were identified. Another approach adopted in a number of countries (e.g. Brazil, China, Costa Rica, India, Indonesia, Mexico) has been to mandate the emission reduction efforts in sectoral plans developed after the low-emission development plan. This ensures that GHG mitigation activities are mainstreamed into development planning.

Another approach to aligning policy goals has been in the prioritization of mitigation sectors and actions. Reflecting the diversity in national circumstances, the low-emission development plans reviewed take a variety of approaches to prioritization of sectors for GHG mitigation. For example, South Africa's Green Paper clearly outlines a planned trajectory for the country's GHG emission, and prioritizes "mitigation interventions that have potential positive job creation, poverty alleviation and/or general economic impacts…in particular, interventions that stimulate new industrial activities and those that improve the efficiency and competitive advantage of existing business and industry." Similarly, the Republic of Korea's green economy strategy focuses not just on GHG emission reductions, but also on fostering new green industries with high potential for growth. Elsewhere, GHG mitigation has other values. Dominica's Low-Carbon Climate-Resilient Development Strategy justifies investments in GHG mitigation "on the understanding that savings in energy costs will allow Dominica to invest more in much needed adaptation measures." At a practical level, sectors for investigating mitigation options have mostly been selected on the basis of the contribution of a sector to total emissions in the country's GHG inventory or the sector's contribution to future emissions under a business-as-usual scenario.

Using these various approaches to identify priority sectors for mitigation, 21 of the 32 national plans reviewed included agriculture in some manner in their consideration of GHG mitigation (see Table 1). In some cases, this went only so far as to note a potential or the relevance of the sector in mitigation. However in several cases, interventions in the agriculture sector were prioritized and mitigation potentials or targets were set. In a minority of cases the cost effectiveness of mitigation options was assessed. Chapter 3 goes into further details on the agriculture-specific actions proposed in these plans, as well as other proposed initiatives related to NAMAs. Here, we note that justifications for including agriculture in mitigation plans varied widely. Some countries' analysis places agriculture in the context of REDD+ policies. Ethiopia's plan noted not only agriculture's high contribution to total emissions, but also the threat agricultural growth in the business-as-usual scenario posed to wider environmental sustainability. Rwanda's consideration of agriculture is based on the importance of sustainable land management for food security and the fact that GHG mitigation may have synergies with these objectives. China's plans partly cover agriculture because of the link between current practices and non-point pollution of water resources, and in fact include a target for reduction of chemical oxygen demand, a proxy indicator for methane emissions under anaerobic fermentation.

Table 1 indicates that of the 32 low emissions development plans reviewed (all of which addressed GHG mitigation), 25 also addressed adaptation to climate change. The majority of plans analysed were national climate change strategies and plans that address both adaptation and mitigation. There are, however, some exceptions. Ethiopia's Climate-Resilient Green Economy Strategy, for example, aims to promote resilience to climate change, but the initial planning phase only elaborated priorities for low-emission development, with climate resilience expected to be addressed in future planning work. Even in least developed countries, National Adaptation Programmes of Action (NAPAs) do not always provide the framework for considering adaptation in such plans. One reason for this is that NAPAs were intended to focus on "immediate and urgent" adaptation needs, while most of the plans reviewed here focus on longer-term transformation of the economy. Of those countries that consider agriculture in relation to GHG mitigation, the majority also consider adaptation to climate change in the agriculture sector. However, mitigation and adaptation in the agriculture sector are mostly treated separately, with little explicit examination of possible synergies between the two. A number of countries considered agriculture in relation to adaptation, but did not deem it a priority sector for climate change mitigation. Chapter 3 also looks at the extent to which proposed mitigation actions in the agriculture sector relate to adaptation needs.

Table 2: Positioning of LED plans in relation to national economic development planning for a selection of countries

Country (LED plan)	LED plan alignment with national development plan	LED plan feeds into	Agency responsible for LED plan development (coordinating mechanism)	Institutional needs suggested in plan
China (Work Plan for Controlling GHG Emissions)	Aligned with 12th Five-Year Plan for National Economic and Social Development	12th Five-Year Plan for National Economic and Social Development	National Development and Reform Commission	State council has issued a number of policy documents to strengthen policy and guidance in addressing climate change
Dominica (Low Carbon Climate Resilient Development Strategy (LCCRDS)	Aligned with Growth and Social Protection Strategy (GSPS)	LCCRDS investments are anchored in the Sector Strategies for Growth in the GSPS	Pilot Programme for Climate Resilience project team working in environment ministry (5 technical working groups+ private sector working group)	Implementation to be coordinated by Council for Environment, Climate Change and Development (CECCD) to be established through new Bill under PM & environment ministry
Ethiopia (Climate-Resilient Green Economy Strategy)	aligned with Growth and Transformation Plan	Four sectoral proposals	Prime Minister's Office, environment agency and development research institute	Implementation proposed to be led by the Environmental Protection Agency with the ministry of finance
Guyana (Low Carbon Development Strategy (LCDS))	National Development Strategy and National Competitiveness Strategy; also strongly oriented towards international initiatives (e.g. REDD+)	Specific investment plans, some to be funded through Guyana REDD Fund	Office of Climate Change in the President's Office (Multi-stakeholder Steering Committee)	New Office of Climate Change; LCDS project office; REDD Investment Fund; REDD Secretariat in the Forestry Commission
Indonesia (Climate Change Sectoral Roadmap)	aligned with Long-term Development Plan (2005-2025)	Medium-term Development Plan	National development planning agency (multi-sector steering committee + sectoral working groups led by responsible ministry)	Strengthen capacities of existing ministries
Kenya (Climate Change Action Plan)	Vision 2030	Second Medium Term Plan	Ministry of Environment and Mineral Resources	Creating a vision and providing a practical framework for integrating climate change into planning process
Mexico (Special Program on Climate Change (PECC))	closely aligned with National Development Plan (2007-2012)	Actions to be integrated in sectoral plans of federal agencies and sub-national governments	Environment ministry (Inter-sectoral Commission on Climate Change)	To strengthen horizontal and vertical coordination, create a section within the planning division of the environment ministry
Mongolia (National Action Programme on Climate Change (NAPCC))	Aligned with all major national development plans e.g. National Millenium Development Goal based comprehensive sustainable development strategy	Sectoral development plans (e.g. National Livestock Programme)	Ministry of Environment and Green Development	Strengthening national adaptation and mitigation capacity

2.2.5 Funding plan implementation

General experience suggests that the involvement of finance ministries can help ensure that climate policy is tied to fiscal priorities. Indeed, finance ministries are often involved in discussions on low-emission development planning (Clapp *et al.,* 2010). Of the 18 countries whose plans were reviewed here, 10 mention using the Clean Development Mechanism (CDM) as a potential financing mechanism for specific mitigation actions;[12] 8 mention REDD+ financing; and 6 mention funding support for NAMAs. Some plans (e.g. Guyana, Rwanda) mention specific potential sources of finance in relation to proposed

[12] But see Larson *et al* 2011 on opportunities and constraints presented by the CDM as a financing mechanism in agriculture.

actions, but most plans do not specify financing details. In some cases, it can be assumed that the inclusion of mitigation actions into sectoral plans implies a reliance primarily on domestic finance. This domestic financing may include funds secured through domestic emissions trading markets or other forms of crediting mechanisms that are currently at different stages of development in Brazil, Mexico, Costa Rica, Chile, China, India, Indonesia and the Republic of Korea (Kossoy and Guigon, 2012).

2.2.6 Lessons from experience

There are a number of manuals and guides on low-emission development planning (e.g. Lütken *et al.,* 2011; Bray, 2009; UNDP, 2011), compilations of planning tools (Ecofys and IDS, 2011), inventories of recent and ongoing activities (e.g. Cox and Benioff, 2011) and reviews of experience (e.g. Project Catalyst, 2009; Clapp *et al.,* 2010; Kaur and Ayers, 2010; Knight, 2012; van Tilburg *et al.,* 2011). The following key lessons are commonly reported:

Technical issues:

- **Data:** The analysis for low-emission development planning depends on abundant and good quality data on both emissions and costs (Project Catalyst, 2009; Clapp *et al*., 2010). Many developing countries lack sufficient and reliable data. Many low-emission development plans therefore propose additional data collection, analysis and modeling activities. Some specify knowledge generation programmes as part of the plan's activities in an effort to gradually provide the basis for improved analysis. In practice, however, many low-emission development plans are not driven by data availability, since priorities are decided on the basis of other information sources. Existing data sources and assumptions provide enough guidance to determine overall directions of future action. While data-intensive marginal abatement cost curves (MACCs) have been promoted as a key policy analysis tool, others have pointed out their shortcomings. In practice, MACCs are not used to inform many planning processes. In addition to the availability of data itself, obstacles to data sharing and multi-disciplinary analysis are also key barriers to overcome. It is notable that several countries' plans were developed after the preparation of a national communication to the UNFCCC. This suggests the importance not only of data availability but also of cooperation among individuals and institutes (Clapp *et al*., 2010). If mitigation finance moves towards performance-based payments (Würtenberger, 2012), this may create more demand for data. Milestones and quantitative performance indicators may provide a stepping-stone towards future quantification in terms of mitigation impacts (see Box 10 below).

- **Analytical process:** Several reviews stress that there is no single series of steps that can be followed as a model to planning. Data availability, the political context and key areas for inquiry will differ greatly from country to country. What is required is a flexible process that can bring together the required expertise with policy stakeholders (Clapp *et al*., 2010). Low-emission development plans need to be improved and revised over time. Many, but by no means all, plans elaborate procedures for the revision of these plans on a periodic basis.

Institutional issues:

- Support from the highest level of government is important for giving political impetus to the planning process and for coordinating multiple stakeholders.

- Stakeholder engagement throughout the process serves several functions, including enabling data collection; garnering the support and buy-in of different government departments and sectoral stakeholders; promoting coordination within government; raising broader public awareness; and generating agreement on principles and priorities (Project Catalyst, 2009). An illuminating analysis of options for coordination between agencies, between administrative levels and with wider stakeholders in South Africa is given in Giordano *et al*. (2011).

- Inter-ministerial cooperation is highlighted as a key requirement for developing cross-government support (Project Catalyst, 2009; Clapp *et al*., 2010; Knight, 2011). In some countries, the lack of appropriate institutional arrangements for achieving this cooperation has hindered progress in developing low-emissions development plans (Koblowsky and Ifejika-Speranza, 2012) and in implementing them where they do exist (van Tilburg *et al*., 2011).

Finance issues:

Only a small proportion of the LEDS reviewed here provided estimates of implementation costs. Those that did include estimates indicate that the costs of adopting low-emission development pathways can be substantial. For example, Guyana's Low Carbon Development Strategy indicates financing needs of around USD 1 billion up to 2015. Ethiopia's Green Economy Strategy suggests expenditure needs of USD 150 billion over 20 years. Such scales of investment require access to finance from a variety of sources. Developed countries report that they allocated close to USD 30 billion of 'fast-start' climate finance by the end of 2012,[13] although increased levels of finance through to 2020 are currently less certain. Developing countries therefore have to prioritize the elements of low-emission development strategies that they want to fund through international support. It should also be realized that most international climate finance is not grant aid. UNEP's Bilateral Finance Institutions Climate Change Working Group[14] reports that concessional loans account for 73 percent of the climate finance provided by its members (Hodas, 2012). Only 7 percent of what is more broadly defined as publicly provided climate finance is given as grant aid (Buchner *et al.,* 2012). International climate finance sources also have their own priorities. In general, key priorities for the OECD (Organisation for Economic Co-operation and Development) public sources of international climate finance include supporting readiness (e.g. low emissions planning); demonstrations (e.g. proof-of-concept for technologies or policies); and key investments that are likely to have transformative impacts, even where these are not currently the least-cost emissions reduction options (Knight, 2012; Mabey, 2012). International climate finance can be used to leverage domestic and private finance to implement and replicate priority actions. In this regard, there are close synergies with the priority need identified in some developing country LEDS to develop readiness for accessing and managing climate finance. Several countries' LEDS propose the establishment of new financial vehicles for the management of climate finance, such as national climate funds. Some experiences specific to the design of national climate funds are reported in Fu-Bertaux and Fröde (2012).

2.3 National mitigation planning related to REDD+

Agriculture is a main driver of deforestation. For this reason, REDD+ implementation plans will require cross-sectoral planning and implementation of actions in the agriculture sector. Numerous studies have documented the importance of agriculture as a driver of deforestation (e.g. Geist and Lambin 2002; Gibbs *et al.,* 2010). Hosonuma *et al.* (2012) estimate that commercial agriculture is responsible for 40 percent of deforestation. Subsistence agriculture accounts for 33 percent of deforestation. Livestock grazing in forests leads to 7 percent of forest degradation (ibid.). Regional deforestation patterns are similar in Africa and Asia, where subsistence agriculture is the main driver. In South America, commercial agriculture is the main driver of deforestation. Modeling studies also confirm the importance of agricultural activity in long-term projections of emissions trajectories in developing countries. Climate Focus *et al.* (2011) used modeled scenarios to predict land-use-based emissions up to 2050. Under a business-as-usual scenario (i.e. technological improvement is slow and livestock production and fertilized cropland expand into natural ecosystems), agricultural emissions are projected to increase between 57 - 70 percent by 2050. The primary sources of agricultural emissions reductions are livestock, land management for cropland/grazing and avoiding land-use changes such as deforestation (ibid.). The study found that agricultural abatement measures could cut emissions up to 55 percent (3 600 megatonnes of carbon dioxide equivalent (CO_2eq) per year) from a baseline of 8 600 megatonnes of CO_2eq per year by 2050. However, agricultural emissions reduction could increase to 71 percent with the successful implementation of REDD+.

Since countries do not report on the drivers of deforestation and forest degradation, there is limited information available about specific agricultural drivers, their underlying causes, related opportunity costs and mitigation strategies. A number of governments have put in place market-related initiatives (e.g. sustainable commodity roundtables on soya and livestock) to tackle the agricultural drivers of deforestation. Kissinger *et al.* (2012) recently reviewed 31 national REDD+ Readiness Preparation Proposals and identified 11 intervention strategies related to agriculture, including agroforestry, agricultural intensification, land tenure, land use planning, and policy and government reform. However, the report also pointed out that agricultural development plans often conflict with REDD+ goals and that few national proposals specified cross-sectoral policies to resolve these conflicts.

[13] http://pdf.wri.org/climate_finance_pledges_2012-11-26.pdf

[14] This includes Agence Française de Développement (AFD), Japan International Cooperation Agency (JICA), KfW, Nordic Environment Finance Corporation (NEFCO) and UNEP.

3. National mitigation planning in the agriculture sector

As mentioned earlier, around 10-12 percent of global GHG emissions originate from agriculture (Smith *et al.,* 2007). Together with indirect emissions from land-use change attributed to the forestry sector, land-use-related emissions amount to 31 percent of the global total (IPCC, 2007). While land-use-related fires constitute over 35 percent of all emissions in tropical forested countries, in the rest of the world they account for less than one percent of total emissions (DeFries and Rosenzweig, 2010). Similarly, the shares in total emissions of methane (from livestock and rice cultivation) and nitrous oxide (from fires, fertilizer and manure) in developing countries are far above shares in the rest of the world (ibid.). Despite low per capita emissions to date, developing country emissions are expected to grow at a more rapid rate than elsewhere.

In contrast to industrialized countries and temperate zones, where mitigation potential lies mostly in the energy sector, agriculture's substantial contributions to total emissions profiles in many developing countries suggests that agricultural landscapes have a significant mitigation potential (IPCC, 2007). This is confirmed in some of the low-emission development plans reviewed above, where agriculture's contribution to national GHG emissions has been one justification presented for addressing agriculture in national mitigation strategies.

Agriculture is also the backbone of many developing countries' economies, and is expected to contribute to food security, employment, poverty alleviation and overall gross domestic product (GDP) growth. Climate change is expected to increase the challenges facing agricultural producers in delivering these outcomes. Conventional pathways of agricultural development may exacerbate the depletion of natural resources and increase exposure to climate risks. Sustainable agriculture with increased consideration of climate change is becoming known as 'climate-smart' agriculture (FAO, 2012c). In regard to climate change, adaptation is a higher priority for most countries (as indicated in Table 1). However, the potential for synergies between carbon sequestering or emission-reducing practices and adaptation to climate change is increasingly recognized,[15] as are the synergies between carbon sequestration and food security gains (e.g. Branca *et al.,* 2011). Consistent with the concept of mitigation measures in the context of sustainable development, mitigation planning is relevant to the agricultural sector, just as agricultural planning is relevant to low-carbon development. Besides conventional agricultural planning processes, preparation of NAMAs in the agriculture sector is emerging as a new planning context in some countries.

3.1 Overview of agricultural NAMAs

To date (December 2012), 55 countries, as well as the Group of African States, have submitted NAMAs to the UNFCCC. Many more NAMAs are in the process of development (UNFCCC, 2012a). At least 21 of the officially submitted NAMAs make specific reference to mitigation activities in the agriculture sector, and further NAMAs in the energy sector will also relate to energy crops. With the exception of submissions by Brazil, Chile, Indonesia, Jordan, the Former Yugoslav Republic of (FYR) Macedonia, Mongolia, Papua New Guinea and Uruguay, all of the NAMA submissions that mention agriculture come from African countries. Some of these submissions entirely focus on the agricultural sector (e.g. the Group of African States and Swaziland). The submitted NAMAs are summarized in Annex I and are analysed along the following key questions:

- How is the mitigation action communicated?
- Which aspects of the agriculture sector are covered and what type of mitigation benefits can be expected?
- At what stage of development are the NAMAs?

[15] See, for example, contributions to FCCC/SBSTA/2012/MISC.6. See also discussion in Chapter 4 below.

- How are they aligned with other policies, specifically LEDS?
- Are synergies between mitigation and other dimensions of sustainable development addressed?
- How are baseline emissions and mitigation potentials calculated?

Communication of agricultural NAMAs

Most of the policies, measures or actions in the agricultural sector that are described in NAMA statements submitted by Parties to the UNFCCC are not specifically mentioned in the country's national climate change or agricultural development strategies. Of the 62 NAMAs identified in this report, 27 are not mentioned in sectoral strategy documents. Exceptions include four of Brazil's NAMAs, and the NAMAs described by Ethiopia, Indonesia, FYR Macedonia and Mongolia. In addition to these officially submitted agricultural NAMAs, some countries (e.g. Colombia, Costa Rica, Guyana, Kenya, Mexico and Rwanda) mention agricultural NAMAs in their national climate change or low-carbon development plans, but have not communicated specific NAMAs to the UNFCCC (23 of the 62 identified NAMAs). In some cases, this is because the process of developing specific NAMAs has not yet begun or is just beginning. In other cases, it is because countries may be planning agricultural mitigation actions but do not yet intend to register them as NAMAs under the UNFCCC. Some of these cases are described in Section 3.2.

Agricultural subsectors and specific mitigation actions

The submitted NAMAs cover several agricultural subsectors and most focus on actions in the input and production stages:

- crop residue management;
- cropland-related mitigation practices in specific areas;
- restoration of grasslands and degraded agricultural lands;
- fodder crop production;
- introduction of combined irrigation and fertilization techniques to increase efficiency;
- methane capture for livestock;
- improved productivity of livestock; and
- reduced forest conversion and plantation of forests on agricultural land.

The proposed actions deliver mitigation benefits in different ways, including increasing carbon stocks, descreasing the loss of carbon stocks and reducing non-carbon dioxide (CO_2) emissions. Some actions have multiple benefits, but others are not specific enough to identify the type of mitigation benefits foreseen (Table 3).

Table 3: Type of mitigation benefits of agricultural NAMAs

Mitigation benefits	Number of NAMAs
Increasing carbon stock	
agroforestry, silvopatoral systems	4
planted forests	1
restoration of degraded grazing and croplands	4
Decreasing carbon loss	
improved agronomic practices	29
bioenergy production	2
Non-CO2 emission reduction	
improved livestock management, animal waste treatment	8
biogas collection and combustion	2
Efficiency per unit of agricultural product	
irrigation	3
post-harvest practices	1
Multiple mitigation benefits	
reduction of deforestation	3
Unknown	
enabling conditions, capacity building, not specified	5
Total	**62**

References to mitigation measures along the food supply chain are rare. However, Jordan, FYR Macedonia and Uruguay, mention the promotion of low-emission technologies, including biogas in livestock and chicken farming, and along agro-industry production chains. While many countries are engaged in strengthening policy frameworks, feasibility analyses, applied research and demonstration, most of the proposed agricultural NAMAs focus on the farm-level production practices that would bring direct GHG emission reductions.

Not all the proposed NAMAs summarized in Table 3 are described to the same level of detail, but some may be identified as potentially having 'transformational' impacts in their national context. For example, agricultural interventions that effectively reduce trends in deforestation or that change long-term livestock emission pathways can have major impacts on national GHG emissions profiles. Agricultural NAMAs that link to other sectors (e.g. bioenergy policies and measures) and readiness activities that lead to the identification of a number of mitigation options may also have transformative impacts.

Stage of development and prioritization

Current agricultural NAMAs include proposals at different stages of development, from statements of intention and priority, and initial concepts with actions described, to more elaborated plans that include feasibility analyses. A small number of agricultural NAMAs are already being implemented. Many countries have submitted statements of intent and broad concepts of what they propose to do, but very few have started to undertake in-depth analysis or detailed planning. It should be recalled, however, that Table 3 does not reflect the level of developing country activity in adopting mitigation actions in the agriculture sector, because it reviews only those mitigation actions that have been referred to as NAMAs in national policy documents or statements.

The majority of NAMA statements identify broad priority subsectors for agricultural development or a short list of specific actions. The Group of African Countries' submission (UNFCCC, 2012c) for example, provides a thorough list of priority investment areas, from changes in agricultural systems and practices, risk management and insurance measures, to agricultural market development and governance, without going into further details on budgeting and the timeframe.

Ethiopia, on the other hand, is relatively far advanced in the NAMA design process. In its initial communication, Ethiopia proposed sustainable cropland management practices, bioenergy and agroforestry as agricultural subsectors for NAMA development, and provided land area targets, but no further specifications. However, in its Climate-Resilient Green Economy Strategy (Federal Democratic Republic of Ethiopia, 2011), a systematic approach was taken to identify priority areas for mitigation action. To develop a green economy, 150 initiatives were scanned and 60 prioritized based on their local relevance, feasibility, contribution to reaching GDP targets, and significant potential for emission reduction at a reasonable cost. For each sector, 3 'best-bet' options were selected for further elaboration. Brazil's low-carbon agriculture programme, which implements Brazil's communicated NAMAs in the agriculture sector, has already gone into implementation (see Section 3.3.1). Uruguay has submitted a concept note for support in preparation of an agriculture-energy NAMA.

Alignment with climate change strategies

In general, there is a low level of convergence between officially submitted NAMAs and NAMAs mentioned in national climate change action plans or low-emission strategies. Only Brazil, Indonesia, FYR Macedonia and Mongolia seem to have included agricultural NAMAs in their national low-emission strategies and at the same time communicated them to the UNFCCC. These countries have several NAMAs in the pipeline, accounting for 12 out of the 62 NAMAs identified. In Brazil for example, the Low Carbon Agriculture Plan (Plano ABC) sets the framework for development of specific NAMAs and outlines the actions that are reported as NAMAs to the UNFCCC. FYR Macedonia has submitted the entire mitigation chapter of its national climate change action plan as a NAMA under the UNFCCC.

Some countries have submitted NAMA statements to the UNFCCC, but these actions are not reflected in national strategies or plans. This indicates limited integration of agricultural NAMAs with national climate change plans, or that national strategies have yet to be developed. Also, despite the relationship between LEDS and NAMAs posited in Figure 1 above, few of the agricultural NAMAs are explicitly described in relation to a LEDS. There are some exceptions. In Colombia, the Low Carbon Development Strategy is the cross-sectoral framework under which sectoral NAMAs are being developed. However these NAMAs have not been officially communicated to UNFCCC and may not be if the NAMAs are entirely domestically financed. In Kenya's National Climate Change Action Plan, the chapter on 'Low Carbon Climate Resilient Development' elaborates on the mitigation potentials of activities in various sectors, including agriculture. The chapter on mitigation further specifies actions identified as 'low carbon' and proposes NAMAs as an implementation mechanism (see Box 1 on agricultural NAMA development in Kenya). In theory, a NAMA can take a more programmatic approach and be a LEDS itself. In its recent submission to the UNFCCC, Uruguay identified the first stage in its NAMA as "strengthening the policy framework to promote sustainable production schemes and implement low-emission technologies in target sectors". Further steps are then planned in order to mitigate GHG emissions related to waste in primary and secondary crop and livestock farming processes (see also Section 3.3.1).

Synergies between mitigation and other development goals

In the description of NAMAs, synergies between mitigation and adaptation to climate change are frequently mentioned, especially by African countries. However, the precise nature of the synergy is usually not assessed systematically and is rarely presented as a justification for the prioritization or choice of the NAMA. Links between the identification of agricultural mitigation actions and National Adaptation Plans or climate vulnerability analysis are not evident in any of the countries reviewed here, except Ethiopia. In Ethiopia's low-emission planning process, mitigation actions were mainly considered in relation to sectors that had been previously identified as the most vulnerable to climate change (see Figure 9).

Synergies between agricultural mitigation actions and development goals other than adaptation are more evident. In Colombia's Low Carbon Development Strategy, adaptation is not even mentioned in any of the sectors, including agriculture. However the identification of NAMAs is expected to lead to better economic performance and higher efficiency due to the adoption of resource-efficient technologies. Brazil's objectives for low-carbon agriculture include adaptation, but are clearly focused on economic

outcomes. Good agricultural practices are seen as a way of improving revenue while reducing GHG emissions. The export-competitiveness of agricultural subsectors is also a motivating concern (OECD, 2011). FYR Macedonia is also explicit in its outline of goals. General economic benefits as well as better access to EU funds and higher quality agricultural markets are seen as the main reasons to invest in an enabling environment for mitigation actions (UNFCCC, 2010).

Descriptions of agricultural NAMAs rarely have explicit links to social policies. Issues such as social differentiation, equity or gender are not mentioned in most NAMA descriptions. Brazil's agricultural mitigation plan briefly mentions that vulnerable communities in particular should be targeted by adaptation efforts within the low-carbon agriculture strategy. In some other plans, the sustainable development benefits of agricultural NAMAs appear to be implicitly assumed in the selection of subsectors. The selection of these subsectors may be based on their importance for food security or incomes (e.g. potato in Colombia), or on the basis of expected economic benefits as indicated by marginal abatement cost or other economic analyses. Recent research on pilot projects and policy processes suggests that distributional effects of mitigation policies and measures may be a relevant concern (Atela, 2012; Chisinga *et al*., 2012; Sarpong *et al.,* 2012).

Estimation of emissions baselines and mitigation potentials

Baseline emissions scenarios at the national, sector, subsector or NAMA level have been calculated for less than half (28 out of 62) of the identified NAMAs. Some countries provide voluntary sector-wide agricultural mitigation targets. A few have submitted quantitative estimates of mitigation potential (or mitigation target) for specific agricultural actions. Table 4 gives an overview of the countries that have quantified the mitigation potential or emission reduction targets to some degree.

Brazil, Ethiopia, Kenya and FYR Macedonia have carried out analyses on the NAMA level (i.e. estimating mitigation potential per agricultural activity). Indonesia and Papua New Guinea have made estimations at the overall agriculture sector level. Morocco's estimation is for the country's cropland management subsector. The few countries that do estimate emission baselines (8 out of 30 countries with NAMA activities) have generally developed business-as-usual emission scenarios based on the estimation of a conventional development pathway.

Table 4: Quantified NAMA mitigation potentials / emission reduction targets

Country and mitigation action	Estimated emission reduction in megatonnes of CO_2eq
Brazil	by 2020
reduction of Amazon deforestation	564
reduction of Cerrado deforestation	104
restoration of grazing land	83-104
integrated crop-livestock system	18-22
no-till farming	16-20
biological nitrogen fixation	16-20
planted forests	8-10
animal waste treatment	6.9
Ethiopia	by 2030
ethanol / biodiesel production	1
change herd mix for more efficient feed conversion	18
better feed, breeds, management, lower age at off-take	17
reduce draught animals population	4
improved range management	3
improved agronomic management of soils	40
increase yields (better seeds, fertilizers, agronomic practices)	27
irrigation in arid lands	2-9

Country and mitigation action	Estimated emission reduction in megatonnes of CO_2eq
Indonesia	Overall
agriculture sector	8, more with int. finance
Kenya	by 2030
agroforestry	4.2
conservation tillage	1.1
fire reduction in crop- and grasslands	1.2
FYR Macedonia	per year
biogas collection and combustion on pig farms	0.0175
Morocco	per year
cropland management	2.025
Papua New Guinea	per year
agriculture sector	15-27

Source: Federal Democratic Republic of Ethiopia, 2011; UNFCCC, 2010: OECD, 2011

3.2 Mitigation activities not communicated as NAMAs

There are several types of mitigation action in the agriculture sector that are not (yet) NAMAs. These include agricultural NAMAs still under planning and design that have not been communicated to the UNFCCC; agriculture-related aspects of national REDD+ programmes; and national agricultural mitigation programmes that are not referred to as NAMAs.[16]

Some countries have ongoing agricultural NAMA planning and design processes, but have not submitted NAMA statements to the UNFCCC. In some cases, they may decide not to make submissions. The Government of Kenya, for example, formulated the National Climate Change Response Strategy in 2010 to systematically address climate change across sectors (see Box 1). Other countries where activities to develop agricultural NAMAs are ongoing but no NAMAs have been submitted include Colombia,[17] Malawi,[18] Peru[19] and Indonesia. Work may also be proceeding in Ghana in relation to the current development of its National Climate Change Policy. In Mongolia, the potential of NAMAs as a modality to support grassland-based livestock mitigation activities through the National Livestock Programme is being actively explored (see Box 2). In a number of countries, piloting activities have begun at the project level to identify feasible options for NAMA development in specific subsectors. These activities can supplement programmatic NAMA approaches. The activities presented below relating to Colombia (Box 3), Indonesia (Box 4) and Malawi (Box 5) point to preparatory analysis as a 'bottom-up' approach to identifying mitigation potential. A characteristic of the 'bottom-up' approach appears to be that it enables identification of adoption barriers and technology or knowledge gaps to consider in the NAMA development process. Many of the NAMAs defined through 'top-down' processes appear more reliant on assumptions to determine the description of activities.

[16] Some of these may be described in national communications to the UNFCCC or in reviews of national mitigation policies and measures.

[17] http://www.mapsprogramme.org/country-projects/colombia/

[18] http://cdkn.org/project/climate-compatible-agricultural-development-namas/

[19] http://namadatabase.org/index.php/Scaling_up_waste-to-energy_activities_in_the_agriculture_sector

Box 1: Agricultural NAMA development in Kenya

To operationalize the 2010 National Climate Change Response Strategy, a participatory process of designing the Kenya Climate Change Action Plan has been finalized (Government of Kenya, 2012). The action plan is coordinated under the leadership of the Ministry of Environment and Mineral Resources. It is guided by a multistakeholder, multidisciplinary taskforce that includes representatives from the Ministry of Agriculture, the private sector and civil society organizations from the agricultural sector. Agriculture contributes to at least three of the six subcomponents of the action plan:

- Subcomponent 1 - Long-term National Low-Carbon Development Strategy: Within the agricultural sector, prioritization was done based on actions that deliver sustainable development, mitigation and adaptation benefits simultaneously. Mitigation potentials were estimated for those practices for which data existed and there were no barriers to implementation. This resulted in the proposal of three possible agricultural low-carbon actions that could possibly be developed later into NAMAs: agroforestry, conservation tillage and reducing fire in crop- and grassland management.

- Subcomponent 3 - Adaptation Analysis and Prioritization: Besides the low-carbon priority interventions, further actions with mainly adaptation benefits were identified in agriculture: the promotion of drought tolerant crops; water harvesting; integrated soil fertility management; insurance schemes; price stabilization schemes for livestock; strategic food reserves; providing farmers and pastoralists with climate change-related information; and mainstreaming climate change into agricultural extension services.

- Subcomponent 4 - Mitigation and NAMAs: Based on the prioritization of the low-carbon development strategy, sector-specific NAMAs were further developed. Agroforestry is the only agricultural mitigation option mentioned in this NAMA section. It is also aligned with the government's goal of 10 percent tree cover on farms. Agroforestry also enhances food security and improves livelihoods for farmers. Currently, it is an initial concept with a described target and mitigation potential, but no specific actions are elaborated yet.

The implementing agency for agricultural NAMAs is the Ministry of Agriculture. The Agriculture Sector Development Strategy (2010-2020) provides an implementation mechanism for the climate change action plan in the sector.

Source: Government of of Kenya, 2012

Box 2: Mongolian Grassland and Agricultural NAMA

The Parliament of Mongolia approved the National Action Programme on Climate Change (NAPCC) in 2011. It is aligned with the Millennium Development Goals-based Comprehensive National Development Strategy of Mongolia published in 2008. The NAPCC includes climate change adaptation and mitigation measures. Its main objective is to ensure ecological balance; develop socio-economic sectors to reduce vulnerabilities and risks; mitigate GHGs; promote economic effectiveness and efficiency; and implement 'Green Growth' policies. The key objectives and agriculture-related activities are specified in two phases (first phase: 2011-2016, second phase: 2017-2021):

- **Set up legal, structural and management systems** that support measures against climate change, including new laws on improved pasture utilization and soil protection and a new institution to coordinate cross-sectoral climate change issues
- **Ensure ecological balance and reduce socio-economic vulnerabilities and risks** by using a step-by-step approach to by strengthen national adaptive capacity to climate change. This includes activities to reduce land degradation and desertification, and the implementation of projects and programmes to increase the capabilities of pastures and soils to act as GHG sinks.
- **Mitigate GHG emission and establish a low-carbon economy** through the step-by-step introduction of environmentally friendly technologies and increasing effectiveness and efficiency. This includes activities to improve land-use efficiency, the re-use of abandoned crop land and carbon absorption.
- **Enhance the national climate observation network for research and assessment.** This includes: strengthening hydrology, meteorology, pasture and biome observation networks; and enhancing the assessments and studies of climate change - its impacts on environment and socio economic sectors, risk research, adaptation and mitigation measures.
- **Conduct public awareness activities and support citizen and community participation** in actions against climate change. This includes climate change education on disaster risk management.

Within the NAPCC, a grassland agricultural NAMA is currently being developed jointly by the Ministry of Environment and Green Growth and the Ministry of Industry and Agriculture. The NAMA will be integrated into the National Livestock Programme, a nationwide programme with substantial domestic funding. The NAMA approach is suited to provide additional incentives for herders to shift from extensive, risk-prone, grazing systems to semi-intensive systems. This makes herders more resilient to climate risks and offers incentives for good land stewardship. Climate benefit and performance monitoring will be embedded and requires investments in monitoring and evaluation systems in the agriculture sector to provide improved activity data and research to gradually improve emission factors.

Source: Mongolian Ministry of Environment and Green Development, 2011; Tennigkeit *et al*. 2013

Box 3: Colombian potato NAMA

In Colombia, feasibility analysis and prioritization of low-carbon development options are under way in the framework of the Low-Carbon Development Strategy. The Mitigation Action Plans and Scenarios (MAPS) programme has analysed the potential for a potato sector NAMA.

Based on a literature review, the combination of potato crops with forestry and cattle ranching was identified as the best mitigation option. Economic field testing was carried out in one of the main potato production zones. Based on the findings, specific recommendations were made as to which agroforestry and silvopastoral systems to use. This included an analysis of their cost implications.

The expert team also identified the following technological and knowledge barriers to NAMA design:

- Activity data on business-as-usual practices is not available in enough detail (e.g. amounts of fertilizer, burning practices, use of manure, tillage system).
- Estimates of crop yield increases and reduction in fertilizer use due to improved practices have not yet been quantified.
- The time lag between the implementation of improved practices and soil carbon sequestration is not clear and the average carbon contents of agroforestry tree species are not known.

Geographic scoping for the feasibility of different production zones for a potato NAMA and the development of an MRV methodology are seen as the next technical steps in NAMA development.

Source: Cadena and Rosales, 2011

Box 4: Indonesian peatland NAMA

Indonesia has voluntarily committed to reducing its GHG emissions by 26 percent by 2020 through NAMAs (UNFCCC 2010). NAMA proposals are being developed under the overall coordination of the National Development Planning Agency. Proposals for the agriculture sector include sustainable peatland management, reducing degraded lands and developing agricultural carbon sequestration projects.

Peatland was identified as a priority area for mitigation actions since it is a major contributor to national GHG emissions and its share is projected to rise under a business-as-usual development scenario. Yet national plans point out that to ensure food security, it will be necessary to further develop agricultural land in lowland coastal areas, including peatlands. Water table management is thus seen as a necessary part of the expansion strategy to ensure crop yields and reach mitigation targets at the same time.

The sustainable peatland management NAMA has been backed up by a thorough feasibility analysis and is planned to be carried out on a project basis in an area of approximately 10 000 ha. Emissions will be reduced by raising the water table in the peat layer through water gates to inhibit aerobic decomposition of peat. Raising the water table also increases crop yields by enabling double cropping. The project, expected to run for ten years starting in 2015, will be financed and implemented by a Japanese-Indonesian consortium.

Source: Shimizu Corporation, 2011

Box 5: Supporting dairy sector development through a NAMA in Malawi

In an effort to identify feasible pilot mitigation activities, the Climate and Development Knowledge Network has supported a scoping analysis in Malawi's dairy sector as a follow up on the country's NAMA communication to the UNFCCC. While increasingly important to rural livelihoods and one of Malawi's national priorities for future development, dairy production is a source of GHGs. Reconciling the simultaneous potentials for poverty alleviation and emissions mitigation makes the sector a focus for NAMAs. A number of small-scale pilots show that increasing the productivity of the existing herd is one of the most effective ways to reduce the intensity of GHG emissions while increasing the availability of milk to consumers and income for producers. Once a number of adoption barriers are removed, improved practices have the potential to put the development of the dairy sector on a low-carbon pathway. These obstacles include:

- limited on-farm availability of feed and forage resources that are often below the nutritional requirements of dairy cows;
- low fertility and calving rates;
- inefficient artificial insemination systems;
- poor housing and manure treatment, potential for heat stress and pathogens; and
- often limited use of animal health services by farmers.

Malawi's National Dairy Development Programme aims to increase total milk production from around 30 000 tonnes per year to 61 000 tonnes per year by 2017 by introducing improved breeds. Initial analysis suggests that, if the above constraints are successfully addressed and the proportion of better managed dairy cows is increased, productivity could be further increased and emissions reduced compared to a business-as-usual scenario.

Source: Wilkes *et al*., 2012

Kissinger *et al.* (2012) reviewed 31 national REDD+ Readiness Preparation Proposals (RPPs) and identified 11 intervention strategies related to agriculture. Table 5 summarizes the proportion of reviewed RPPs that include agriculture-related strategies. Considering the contribution of agriculture as a driver of deforestation, REDD+ plans in general lack the necessary emphasis on agriculture, and options considered in the plans for addressing agricultural drivers are often not well elaborated (ibid.). Of course, some exceptions exist, as can be seen in some experiences in Brazil. For example, the positive impact of agricultural research on decoupling agricultural growth from agricultural area expansion was most impressively demonstrated by EMBRAPA, the Brazilian agricultural research agency. Production efficiency has increased tremendously in various agricultural subsectors of Brazil over the past decades. Improved production techniques, for example, have triggered a 240 percent increase in grain and oilseed (including soy) production. While yields more than doubled, cultivated areas only increased by 32 percent *(Pereira et al.,* 2012). The Amazon Fund is the best current example of a REDD+ financing mechanism in support of land-use planning and agricultural intensification. The World Bank managed Forest Investment Plan also provides performance-based support for agricultural activities that reduce deforestation and forest degradation. The Action Plan for Protection and Control of Deforestation in the Amazon highlights cross-sectoral policies that strongly contributed to the enforcement of land-use planning. Regional REDD+ plans, such as those in Acre state, sometimes include all land use types, linking support to agriculture to its REDD+ plan and sustainable development strategy.

Table 5: Agricultural activities in national REDD+ Readiness Preparation Proposals (n=31)

Agriculture-related intervention / strategy	Proportion of RPPs pursuing the intervention / strategy
Agroforestry	42%
Tenure and rights	42%
Zoning and land-use planning	35%
Cross-sectoral coordination	32%
Agricultural intensification	32%
Livestock / rangeland management	29%
Shifting expansion to / reforestation on degraded lands	26%
Payments for ecosystem services	23%
Financial incentives (agricultural sector)	16%

Source: Kissinger *et al.*, 2012

Independently of any NAMA process, many developing countries are already implementing policies and measures in the agriculture sector that have mitigation benefits.[20] In some cases, explicit mitigation policies have been developed for the sector. For example, China has announced a national policy on mitigation in the agriculture sector (see Box 6), and in its recent statement of policies and actions on climate change[21] refers to an even broader range of agriculture sector activities with mitigation impacts. However, these activities have not been linked in any policy documents to NAMAs.

[20] See for example case studies reviewed in Cooper *et al* 2012

[21] http://www.ccchina.gov.cn/WebSite/CCChina/UpFile/File1324.pdf

Box 6: Agricultural mitigation policy in China

In 2011, China's Ministry of Agriculture issued a policy statement, 'Suggestions on Agricultural and Rural Energy Conservation and Emission Reduction'. The policy outlines the following targets and actions:

Targets: By 2015, compared with 2010, total agricultural chemical oxygen demand emissions reduced by 8 percent, ammonia nitrogen emission reduced by 10 percent; coverage of national soil nutrient testing programme reaches 60 percent and fertilizer use efficiency increased by 3 percent; unified pest and disease prevention and control covers 30 percent of major crops by 2015; promote green pest and disease prevention and control and abolish high-pollution, high-residue pesticides; promote energy conserving cultivation methods and reduce high-energy consumption procedures; over 50 percent of intensive livestock farms or livestock-raising communities are equipped with waste treatment facilities; households with biogas reach 55 million, and annual biogas consumption reaches 21.6 billion cubic metres; phase out high-energy consumption and high-pollution machines and fishing boats; and update township enterprises for energy conservation and increase rural production energy efficiency.

ACTIONS

Energy Saving in Agricultural Production

- Enhance energy saving in agricultural machinery and fishing boats
- Promote energy saving in crop planting systems
- Promote energy saving in township enterprises
- Promote energy saving in rural domestic life

Actively Prevent and Control Agricultural Non-point Pollution

- Disseminate technologies for fertilizer, pesticide and water conservation
- Disseminate technologies for ecological livestock raising
- Disseminate technologies for healthy aquaculture

Establish Initiatives to Promote Reuse of Rural Waste

- Develop rural biogas
- Implement rural clean-up programme
- Use crop residues comprehensively
- Collect and reuse mulching plastic film

Provide Effective Enabling Measures for Rural and Agricultural Energy Conservation

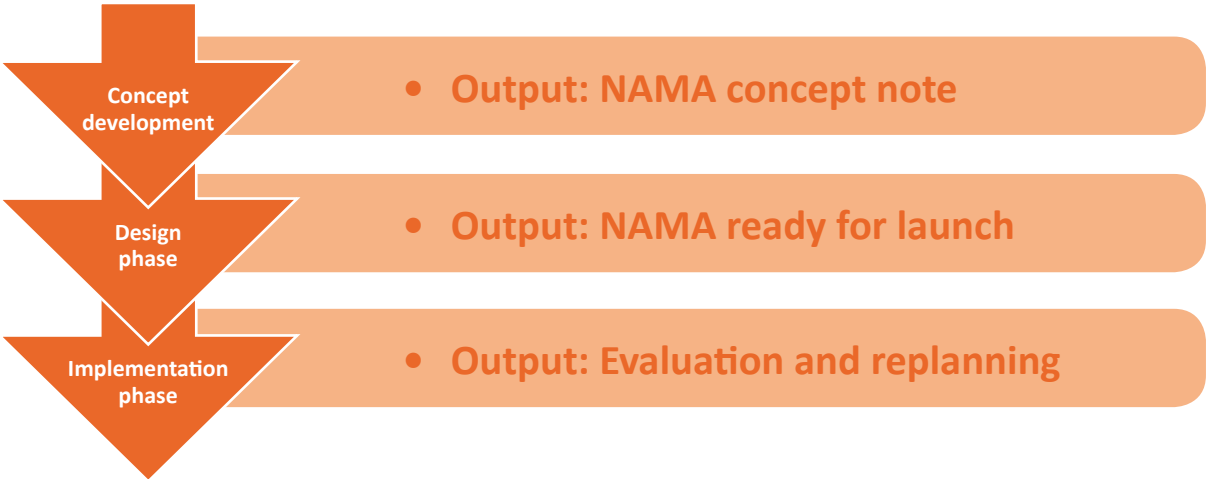
- Strengthen the leadership and consensus
- Design and improve relevant policies and regulations
- Increase financial inputs (including project funds, investments, agri-environment funds)
- Strengthen technical support
- Initiate extensive training and dissemination

Source: Ministry of Agriculture of the People's Republic China, 2012

3.3 NAMA processes and building blocks

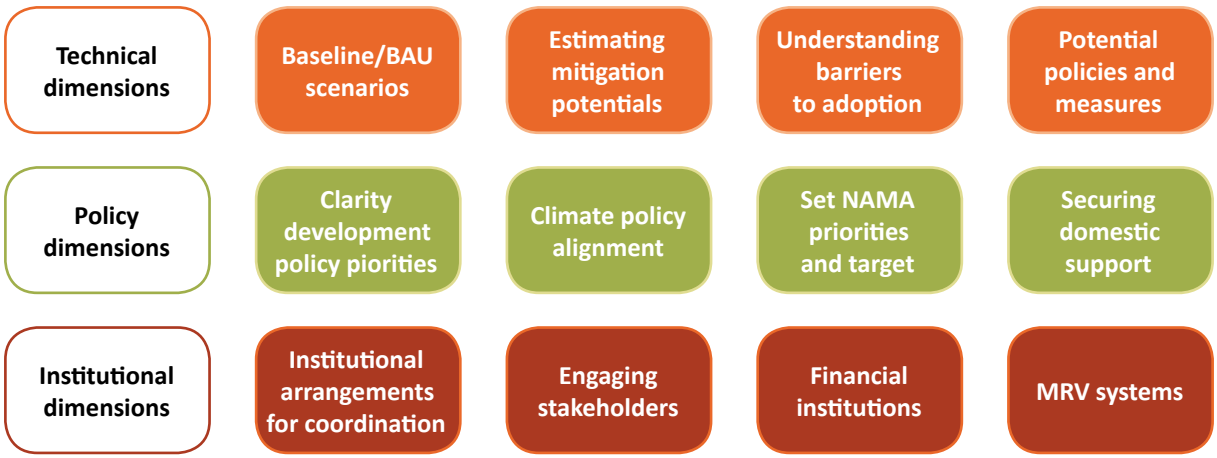
As with LEDS, countries are taking different approaches to developing NAMAs. With most agricultural NAMAs still in the very early concept stage, there is little documented experience to analyse. In general, NAMA development consists of three phases: concept development, design and implementation (Figure 4). Along with the development of specific NAMAs, enabling elements, such as a policy framework for development and climate, institutional arrangements, national NAMA procedures and registries, finance vehicles, and MRV systems, need to be put in place. These elements are not likely to be specific to the agriculture sector. They will require the alignment of the development process and design of the agricultural NAMAs with arrangements emerging at national level or from initiatives in other sectors. Below, we highlight some experiences from the process of agricultural NAMA development and implementation. As with national low-emission development plans, the specific functions completed in each phase may differ between countries. Figure 5 summarizes some of the key elements.

Figure 4: NAMA process



Source: adapted from IRENA, 2012

Figure 5: Key elements ('building blocks') in the NAMA process



Source: the authors

3.3.1 NAMA concept development

Some key elements of NAMA concept development include:

Policy dimensions:

- Establishing mandates and institutional arrangements for NAMA development
- Clarifying NAMA alignment with national and sectoral development policies
- Identifying priority sectors / subsectors or targets

Technical dimensions:

- Establish the scope and measures of the NAMA
- Identify mitigation potentials
- Understand barriers
- Identify appropriate measures to support adoption

Institutional dimensions:

- Identify or establish leading or focal agencies for NAMA development
- Engage expertise and other stakeholders

National climate change coordination committees and other similar interministerial bodies play a key role in facilitating the interface between NAMA development and national policy. Where NAMA development is preceded by a broader assessment of options, such as the elaboration of a national climate action plan, it is common for ministries responsible for the sector or subsector to be mandated to develop NAMAs. This may not be the agriculture ministry. For example, in Uruguay the Ministry of Industry, Energy and Mining is responsible for development of the country's bioenergy NAMA. Some countries have established interministerial committees to oversee the NAMA development process. Egypt, for example, outlines in its UNFCCC communication (UNFCCC, 2012c) that a national team of experts has been established and is responsible for assessing and surveying mitigation potentials in relevant sectors and taking the NAMA formulation process further. The expert team is composed of representatives of relevant ministries and departments including: Environment, Energy, Industry, Petroleum, Transport, Agriculture, Foreign Affairs, International cooperation, Housing and Planning. In Ethiopia, the Ministry of Transport is responsible for the NAMA ethanol/biodiesel production, while the Ministry of Agriculture is responsible for mitigation actions concerned with livestock management, soil improvement and irrigation. These sectoral responsibilities are embedded in a wider framework. The Climate Resilient Green Economy Strategy is led by the Prime Minister's Office, the Environmental Protection Authority, the Ethiopian Development Research Institute, six ministries, and several other government agencies. The Ministerial Steering Committee, comprised of State Ministers and senior officials from the participating institutions, is the most senior body in the strategy development effort and decides on the overall direction and sector-specific initiatives (Federal Democratic Republic of Ethiopia 2011).

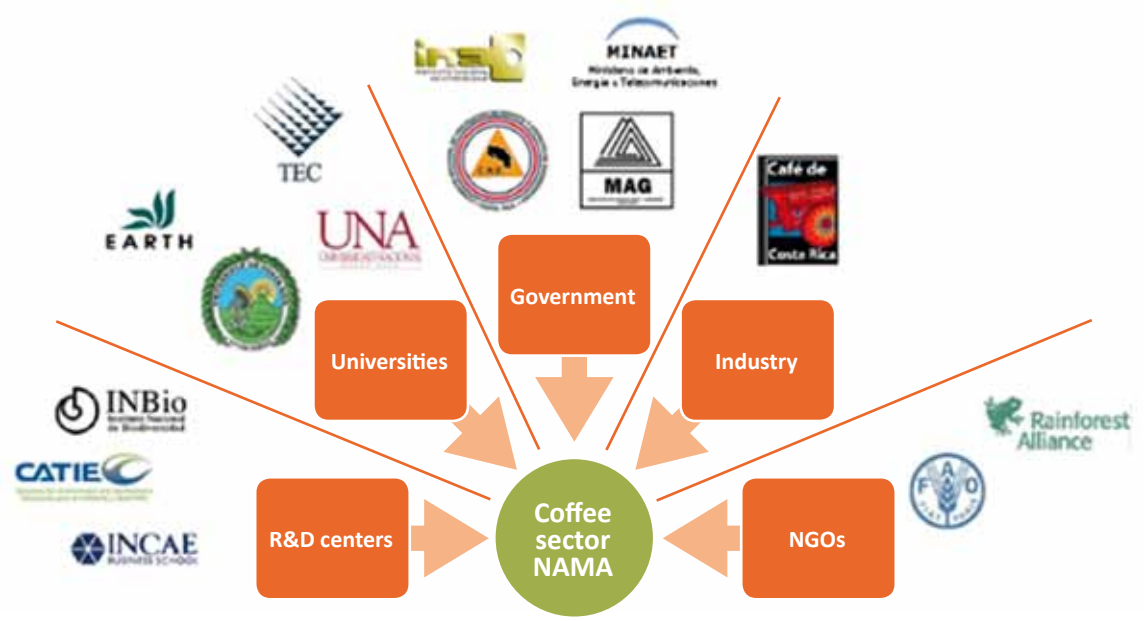
In some countries (e.g. Mongolia), NAMA development in the agriculture sector is being driven by initiatives under the guidance of the environment ministry (which is responsible for climate change). This is partly because the understanding of NAMAs and potential for climate finance are stronger in the environment sector than in agriculture. In Costa Rica, development of a coffee sector NAMA has drawn together a broad coalition of actors with common interests. (see Box 7)

In some cases, the creation of enabling conditions for NAMA development and implementation is explicitly stated as part of the NAMA process. For example, FYR Macedonia, the Group of African States and Swaziland specifically describe the creation of enabling conditions for GHG emission reductions as important parts of the NAMA process. They specify a variety of NAMA actions including capacity building for mitigation technologies and carbon finance, the training of farmers, and awareness raising.

Box 7: Actors in Costa Rica's coffee sector NAMA

The Ministry for Environment, Energy and Telecommunications through its climate change office is the national focal point for climate change issues in Costa Rica. It has elaborated a National Climate Change Strategy that recommends the mainstreaming of mitigation and adaptation into sectoral programmes, including agriculture. Making the country carbon neutral by 2021 is the main goal of the mitigation pillar.

Actors in the coffee subsector, supported by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), have started to promote a Costa Rican coffee NAMA. The main driving forces are the Costa Rican Coffee Institute, with technical support from Coopedota R.L., a coffee producer, processor and marketing cooperative with 769 members; and CO2 Costa Rica, a think tank working to operationalize the country's carbon neutral goal. The Ministry of Agriculture and Livestock is also beginning to take ownership of the NAMA proposal. All stakeholders involved in this NAMA process are shown in the following figure.



An as yet unofficial NAMA proposal has been produced by this group based on the fact that 20 percent of Costa Rica's GHG emissions come from nitrogen-based fertilizers, with the coffee subsector as the biggest consumer. A coffee life cycle analysis was carried out to identify the most GHG intensive stages of production. The analysis revealed that the main emitting sources are coffee mills and fertilizer use on farms. The group is now seeking initial finance of USD 500 000 to engage more coffee producers in an initiative based on payments for environmental services.

Source: CO2 Costa Rica, 2012

Some, but not all, proposed NAMAs have a clear alignment with national development strategies, climate policies, and sectoral policies in agriculture and other related sectors. Some countries state in their NAMA submission that the recommended action is in line with sectoral policies. Uruguay, for example, aligns its agricultural NAMA on low-emission technologies (biogas) in agricultural production and value chains with its Energy Policy 2005-2030 (UNFCCC, 2012b). Brazil's agricultural NAMAs show strong policy alignment with broader climate strategies, agricultural strategies to promote productivity growth, REDD+ and overarching sustainable development strategies. In its communication to the UNFCCC (2010), Brazil provided a list of agriculture-related NAMAs that largely corresponded with mitigation actions outlined in Plano ABC of the same year (see Table 6). Plano ABC is one of the twelve sector plans that followed from the country's National Climate Action Plan and the National Climate Change Policy (Law 12.187/2009) launched after the COP-15 in Copenhagen. Ethiopia has identified key mitigation actions in the agriculture sector through a process that included screening potential options to ensure that considered options align with their medium-term development plan.

Table 6: Mitigation actions in Brazil's NAMA submission and Low-Carbon Agriculture Plan

Mitigation action	Mentioned in NAMA submission	Mentioned in ABC Plan
Reduction of Amazon deforestation	X	
Reduction of Cerrado conversion	X	
Restoration of grazing land	X	x
Integrated crop-livestock system	X	x
No-till farming	X	x
Biological nitrogen fixation	X	x
Planted forests		x
Animal waste treatment		x

Source: UNFCCC, 2010; Zanella and Cardoso, 2011

In some cases, priority sectors and subsectors are identified based on the existing policy framework. In other cases, they are identified through consultation processes. For example, as part of the development of priority options for its Climate Resilient Green Economy Strategy, Ethiopia conducted a series of regional workshops, part of which focused on identifying adaptation needs in each region. Analysis of the results (see Figure 9) contributed to identifying "improving crop and livestock production practices to increase food yields, food security and farmer income, while reducing emissions" as one of the pillars of the green economy strategy. This helped set the framework for analysing specific options for NAMA development.

In a number of other cases, identifying priorities has been part of the technical assessment in the NAMA development process. Brazil and Costa Rica used national GHG inventories as their initial basis for identifying and planning agricultural NAMAs. In Brazil, further specification of the NAMAs has been a gradual process. Plano ABC, the main agricultural mitigation programme, has been developed and approved and is now going into implementation. At the same time, research to quantify the mitigation benefits is going on in parallel. Barioni (2012) has reported on the preliminary results of the analysis to estimate the mitigation potential of the grassland restoration action line in Plano ABC. The analysis included: detailed identification of the area of degraded grasslands with restoration potential; an estimation of future demand for beef and thus for higher productivity pastures; and an estimate of mitigation potential compared to the pre-NAMA historical baseline carbon stocks. FAO is also working with Brazilian experts to assess whether elements of a carbon accounting methodology developed for the voluntary market would support an estimation of mitigation potential and subsequent monitoring and quantification of the climate benefits.

Other countries have developed business-as-usual scenarios as a basis for identifying mitigation priorities in agriculture. For example, in the development process for Ethiopia's Climate-Resilient Green Economy Strategy, trends in business-as-usual emissions were constructed on the basis of existing plans and on an analysis of trends in Ethiopia and in similar countries. The results were

analysed to identify emissions hotspots and the key drivers of increasing emissions. This enabled the identification of potential 'levers' to reduce emissions, which were then elaborated into proposed mitigation actions with estimations of mitigation potentials. MACCs are widely used in mitigation studies. Ethiopia's Strategy also applied this approach to estimating the costs per tonne of CO_2 of agricultural mitigation options. Tapasco *et al.* (2012) report preliminary results of applying the approach to assess the costs of several mitigation options in Colombia (e.g. fertilizer management in rice production, pasture improvement and silvopastoral systems). However, their experiences suggest caution as the results are highly sensitive to the cost assumptions, including the kinds of costs considered. Many MACC studies do not consider social benefits and costs, and alternative methods for cost accounting (e.g. cost per kg meat as opposed to cost per tonne of CO_2) may lead to different rankings of options.

Figure 9: Sectors in Ethiopia identified as most vulnerable to climate change

Source: Federal Democratic Republic of Ethiopia, 2011

MACCs and other techniques often used in prescriptive planning tend to underestimate or ignore other non-cost obstacles to adoption of mitigation practices. Understanding the barriers to adoption should be an essential part of mitigation planning (FAO, 2012c), but there is little evidence that existing NAMA proposals have made in-depth assessments of these barriers in the process of identifying promising options or suggesting interventions. There is a risk that prescriptive lists of mitigation options may be able to garner policy and financial support, but prove to be problematic in subsequent implementation (see Section 3.3.3).

A step-by-step approach proposed in relation to Uruguay's NAMA (UNFCCC, 2012b) may be a useful model for other countries. Uruguay has proposed that the main contents of its NAMA include:

a) strengthening the policy framework to promote sustainable production schemes;

b) feasibility analysis of energy production and other forms of waste utilization;

c) research for technology development, adoption, assessment and transfer; and

d) demonstration of feasibility.

The output of the NAMA concept development phase is a NAMA proposal. The UNFCCC's prototype NAMA Registry provides templates for submission of NAMA concepts and outlines the key elements that must be described (see Box 8).

Box 8: Contents of NAMA proposals for registry with UNFCCC

Name of party:
Title:
Brief description of the action:
Sector:
Technology:
Type of Action (national or sectoral goal, a strategy, a national or sectoral program, a project, or 'other' form of action)
GHGs covered:
Implementing enetity contact details:
Timeframe:
Costs and support required:
Estimate of emission reductions
Links to relevant national policies:

Source: http://unfccc.int/files/cooperation_support/nama/application/pdf/01-nama-seeking-support-for-preparation-v1.0.pdf

3.3.2 NAMA design

Where NAMA statements list agricultural practices as mitigation actions, the elements of feasibility analysis and design mentioned above are likely to occur not in the conception stage, but in the design stage. This would be the case, for example, where a submission to the UNFCCC is made for support in NAMA preparation. Designing an operationalizable NAMA depends not only on the completion of technical elements, but also on putting the elements of an enabling framework into place.

Two key elements of the NAMA design phase not discussed in 3.3.1 include:

- costs and financing, and
- MRV approaches.

NAMA costs and finance

Many countries assume the NAMA implementation process will receive international support in the form of capacity building, technologies and finance. Few have yet estimated the exact budget requirements and financing sources. Table 7 gives an overview of cost estimates provided by some countries.

Table 7: Agricultural NAMA cost estimates

Country and mitigation action	Cost specifications
Brazil	
Integrated crop-livestock system	USD 130 billion, applied by the ABC plan until 2020
Ethiopia	
Ethanol / biodiesel production	USD 5 million initial cost and 0.5 million per year thereafter
Change herd mix for more efficient feed conversion	USD 10 million establishment costs, 7 million per year extension costs, 1 million monitoring costs
Better feed, breeds, management, lower age at off-take	USD 10 million establishment costs, plus costs for abattoirs and monitoring costs
Reduce draught animals population	USD 1 million set up costs plus operating costs
Improved agronomic management of soils	USD 10 million to set up programme plus annual operation costs
Increase yields (better seeds, fertilizers, agronomic practices)	USD 212 million plus operating costs
Irrigation in arid lands	USD 5-10 million
Guyana	
Irrigation and other infrastructure	USD 10 million (USD 5 million in first phase) Most actions to be funded through Guyana REDD fund, which is now being supported by a UNDP project to get it up and running.
Kenya	
Agroforestry	USD 0.82 – 1.37 billion until 2030 Net present value of investment at a 10% real discount rate: USD 0.31 – 0.51 billion; Estimated split between public, private sector and household investments: 100% public
Swaziland	
Agriculture sector and enabling environment	Total budget of the whole programme is USD 4.4 million (USD 2.9 million own, 1.5 million USD international support), Including capital expenditure, recurrent costs and any other costs.
Uruguay	
Low-emission technologies in production and value chains	USD 625 000 required as a grant (=100% of cost)

Source: UNFCCC 2010

Table 8: Criteria for financing NAMAs by development banks

Level of ambition	National interest & ownership
• Significant GHG reduction potential and cost effectiveness of emission reductions • Potential for transformation (e.g. replicability, potential for sectoral change, use of national systems)	• Initiative for financing from national actors and broad ownership among different ministries • NAMA embedded in an existing climate and development strategy • Co-benefits
Maturity and bankability	**MRV-system**
• Financial viability and sustainability • Financial capacity of implementation partners • Comprehensiveness and conclusiveness	• Conclusive and cost effective MRV approach, including indicators for actions, baselines, milestones • Availability of data for MRV system • Costs of proposed MRV approach

Source: KfW, 2012

A number of multilateral and bilateral development banks are engaged in the recently developed NAMA Partnership.[22] They have listed 8 national NAMAs in a range of sectors that are currently being considered for funding: 6 by the Inter-American Development Bank (IDB) and 2 by NEFCO. The World Bank has mentioned that a number of NAMAs may evolve out of regional and sectoral investment programmes related to renewable energy. The International Development Finance Club, a consortium of bilateral development finance institutions representing combined assets four times larger than the World Bank Group, has committed USD 15 billionin 2011 for green finance, which will be partly used for NAMA activities. Bilateral development finance institutions, like Kreditanstalt für Wiederaufbau (KfW) in Germany, have started to finance NAMAs. For example, KfW is supporting a low-emission housing programme in Mexico, the Ecocasa Programme,which received 159€ million in loans, 2.3€ million in technical assistance (mainly grants) and 6.5€ million in investment grants. The financing volume and the ratio between loans and grants may indicate evolving NAMA financing standards for emerging economies. The German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety and the United Kingdom's Department of Energy and Climate Change have recently announced the establishment of a 'NAMA Facility' to support early action to develop and implement transformational NAMAs.[23] In operational terms, the facility will rely on existing financial institutions, such as KfW. Table 8 summarizes the NAMA financing criteria of the KfW Bank.

What is the prospect of attracting climate finance for agricultural NAMA development or implementation? Overall, the emerging practice of NAMA financing indicates that there may be substantial financing for NAMAs, with as yet uncertain prospects for agricultural NAMAs. One NAMA database currently lists two agricultural NAMAs that are in the concept stage.[24] This represents 3 percent of the total number of NAMAs listed. Another review of recent climate finance investments by a small number of OECD institutions also reports only 1 percent of total investments targeted to the agriculture sector (Hodas, 2012). This is surprising considering that about 40 percent of the UNFCCC NAMA submissions include agricultural activities.

In addition to the NAMA requirements listed above, a number of other barriers specific to agricultural NAMA financing can be identified:

- lack of agricultural finance background on the part of the green finance experts in most development financing institutions and donor agencies;
- lack of agricultural finance know-how in general, and the fact that existing agricultural finance mechanisms focus on value chain investments and crop finance, while the majority of proposed agricultural NAMAs relate to carbon sequestration and avoided carbon losses (Table 3);
- limited practical experience with robust MRV systems for some agricultural mitigation options (e.g. improved agronomic practices, which represent about half of the proposed actions reported in Table 3);
- poor rural financial services in many parts of the world, which limit the options to link climate finance to the provision of other financial products, such as loans or insurance; and
- significant up-front investment costs for some proposed NAMA activities.

However, independent of NAMA processes, there are an increasing number of financial vehicles to service farmers and supply chain links that might support NAMA financing mechanisms. Mobile phone money transfer and saving schemes, as well as biometric cards to transfer public payments are innovative technologies, which will dramatically reduce transaction costs related to serving farmers. The Climate Innovation Centres (CIC)[25], which were recently established by the World Bank and the United Kingdom's Department for International Development (DFID) in six countries (Ethiopia, Kenya, South Africa, Viet Nam and India), especially target innovative financing for climate protection measures. The CIC is expected to finance a number of agriculture-related proof-of-concept activities that may result in investable NAMAs.

[22] http://www.namapartnership.org
[23] http://www.decc.gov.uk/en/content/cms/news/pn12_159/pn12_159.aspx
[24] http://namadatabase.org/index.php/Agriculture
[25] http://www.infodev.org/en/Project.127.html

Figure 10: Matching finance tools to adoption barriers

Barriers to mitigation actions	Type of financing	Public Finance Mechanism
Low (or no) return on investment	Contribution to investments and operational costs	Up-front grant (e.g. direct subsidies, investment tax breaks, grant component of concessional loans) Funding during operation (e.g. feed-in remuneration, carbon market)
High up-front costs and lacking access to capital	Facilitating access to finance	Provision of debt, e.g. through loans of credit lines Provision of equity Incentivizing existing financing system*
High risk	Provision of risk coverage	Risk guarantees / insurance schemes
High transaction costs		Standardization and aggregation*
Non-financial barriers (e.g. regulatory barriers, lack of information and capacity)	(Financing) technical assistance	Mostly in the forms of grants

** Note that these mechanisms are not Public Finance Mechanisms but induded for the sake of completeness*

Source: Würtenberger, 2012

In addition to the potential to attract climate finance, the nature of the costs involved in agricultural NAMAs also needs to be considered. At the farm or household level, adoption of some agricultural mitigation practices by farmers has negative net costs (i.e. net economic benefits). In this case, finance may still be required for developing and operating the programmes for technical extension. However, adoption of many agricultural mitigation practices will incur positive costs. For example, an analysis to support the identification of mitigation options in Ethiopia concluded that none of the options in the livestock sector have positive net present values over a 20-year period. This implies that promoting adoption could not be done with normal loans, but would require subsidized loans, grants or performance-based payments for environmental services.

However, improving soil fertility included a number of options that deliver positive returns in the first 5 years. These options could potentially be supported with commercial or subsidized credit, while other options would also require grants. Figure 7 shows one way to conceive of the relationship between adoption barriers and financial instruments that might be part of the NAMA action. The distinction between grant and other forms of finance also applies to the conditions on which climate finance can be accessed by governments, since a significant proportion of climate finance is provided on a commercial or, at best, concessional basis.

The enabling conditions for NAMA implementation therefore also include the financial mechanisms required to allow for and incentivize the adoption of mitigation actions. Domestically, there may be a need for new regulations to permit the use of public finance in specific ways. With regard to attracting climate finance, it is necessary to assess existing domestic finance arrangements in order to identify specific options and needs that may arise in relation to support for NAMAs. Box 9 gives the example of the main financial institutions supporting rural development in Mexico and indicates that a number of financial institutions already exist that are supporting low-emission rural development.

Box 9: Financial institutions in rural development in Mexico

Nacional Financiera is the principal financial agent of the Mexican federal government for negotiating and obtaining lines of credit from multilateral and bilateral agencies. It also coordinates support for a number of individual programmes, including: the Mexican Forest Fund, which provides payment for environmental services; the Mexican Carbon Fund, which promotes the development and use of low-carbon-emission technologies; and Support Services for Agricultural Marketing, which works to liberalize markets and channel financial resources directly to producers.

Financiera Rural is an agency within the Mexican Ministry of Finance dedicated to supporting rural development. It offers two primary forms of assistance: loans and technical training. Funded through Congressional appropriation, the agency acts as both a first- and second-tier lending institution. Financiera Rural has forged partnerships with the IDB to finance low-carbon emissions strategies for rural development. Their Forest Investment Plan has been integrated into the national REDD + strategy.

Fideicomisos Instituidos en Relación con la Agricultura (Trust Funds for Rural Development) is a collection of four trusts. They operate as second-tier development banks passing resources through intermediaries (including commercial banks, credit unions, and other financial institutions) to eligible borrowers in rural areas. Priority is given to projects that encourage producer sustainability, including climate change risk-management plans, increased access to carbon markets, production of biofuels, installation of anaerobic digesters, conservation of soil and irrigation water, and reforestation.

Source: The Nature Conservancy, 2012

There is increasing discussion of making climate finance available in a performance-based manner (Würtenberger, 2012). The case of Guyana's REDD+ fund, which also plans to invest in agriculture, is illustrative of how a phased process linked to performance-based payments can support implementation while also ensuring that climate finance investments are effective (Box 10).

Measurement, reporting and verification of NAMAs

One reason for interest in NAMAs in the agriculture sector that is frequently mentioned by actors in the carbon and climate finance fields is that the requirements for MRV have the potential to be less restrictive than related requirements in carbon markets. Stringent measurement requirements have been cited as a main reason for limited development of agricultural carbon finance projects in developing countries (Larson *et al.,* 2011).

For some agricultural activities (e.g. biogas), experiences in the CDM have demonstrated practical MRV approaches. A number of GHG accounting and monitoring methodologies have been developed in voluntary markets, primarily for application in developed countries (Driver *et al.,* 2010; Denef *et al.,* 2012). However, project-level experience from developing countries (e.g. Seebauer *et al.,* 2012) suggests that if similar monitoring approaches are to be adopted in developing countries, adaptations to the monitoring approach must be made to reduce the transaction costs of monitoring in areas where there are large numbers of smallholders and where agricultural production practices are highly heterogeneous or variable. On the other hand, if project-type monitoring approaches become the benchmark for the MRV of NAMAs, the potential to up-scale adoption of low-emission agricultural practices in many developing countries may be constrained.

Box 10: Performance-based payments in Guyana's REDD+ Strategy

Guyana's national Low Carbon Development Strategy is to a great degree oriented around its REDD+ policy. Guyana's agreement with Norway (2010) states that Norway's contribution will be made available as performance-based payments for five years (through 2015) according to a pre-agreed schedule. For Guyana to be eligible for performance-based payments, REDD+ gains in terms of forest area and forest stocks must be measured and independently verified through an MRV system. Since establishing such a system and building capacities takes time, an agreement between the two parties states that until the national MRV system is operational, seven interim indicators, referred to as 'enabling indicators' will be used to determine performance and eligibility for funding. These indicators are:

- a strategic framework,
- continuous multistakeholder consultation process,
- governance,
- financial mechanism,
- measuring, reporting, verification,
- the rights of indigenous peoples and other local forest communities as regards REDD+, and annual assessment and verification of progress in relation to the enabling indicators.

These indicators are assessed independently each year. The process contributes to building Guyana's capacities and also builds credibility with investors. At the same time, Guyana is developing financial vehicles through which future performance-based payments can be used to finance domestic development needs outlined in its Low Carbon Development Strategy.

Source: Grüning and Shuford (2012)

Internationally, guidance on MRV for NAMAs is limited. Discussions in the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA) concluded that future guidance for MRV of unilateral NAMAs "should be general, voluntary, pragmatic, nonprescriptive, non-intrusive and country driven, take into account national circumstances and national priorities, respect the diversity of nationally appropriate mitigation actions, build on existing domestic systems and capacities, recognize existing domestic measurement, reporting and verification systems and promote a cost-effective approach".[26] Wilkes *et al.* (2011) give one example of how an existing domestic monitoring, evaluation and inspection system in the agriculture sector might provide the basis for MRV of an agricultural NAMA. Specific arrangements for MRV of agricultural NAMAs will have to be linked to national MRV systems, which vary from country to country. Teams of experts supporting NAMA development in Colombia have proposed the outline of a national MRV system. Cadena *et al*. (2012) and Duffó (2011) describe a proposed system based on the existing verification system the Colombian Government uses to verify the achievement of the goals set out in its National Development Plan. An information system managed by the National Planning Department consists of verifiable numerical targets and indicators. The evaluation of the National Development Plan is reported periodically to ministries, administrative departments, sector agencies, council of ministries, the National Planning Council and the National Congress. Experts identified a small number of additional indicators required for NAMA MRV that are not in the system. These indicators could in principle be incorporated into the existing information system.

While most published discussions of NAMA MRV focus on quantification of mitigation impacts, a basic function of MRV systems is to assist developing countries in managing for results. Particularly

[26] FCCC/SBSTA/2012/L.24

given the numerous barriers to adoption of many agricultural practices, MRV systems should support evaluation of actions and inform continual improvement of NAMA implementation (UNEP, 2012). MRV systems linked with national food security monitoring systems could also monitor the impacts of NAMA implementation on food security. In this respect, it is notable that existing agricultural monitoring and evaluation systems in many developing countries are in general weak. There is often scope for improvement so that monitoring and evaluation systems can better meet stakeholders' diverse information needs (Haddad *et al.,* 2010). Developing MRV systems for NAMAs could provide an opportunity to review and improve existing agricultural monitoring and evaluation systems.

3.3.3 Agricultural NAMAs in implementation

To date, most agricultural NAMAs are statements of policy intent. Some feasibility analysis and planning has been conducted in some countries. Few agricultural NAMAs are in implementation. One exception is Brazil's Plano ABC. The targets of this plan are presented in Table 6 above. A significant proportion of Plano ABC aims at reducing agricultural pressures on forest resources while also meeting agricultural development needs by increasing productivity through low-emission techniques (e.g. no-till agriculture, crop-livestock integration, livestock intensification). Providing subsidized credit to producers to enable them to adopt these techniques is one of the main measures adopted (Zanella and Cardoso, 2011). Although the programme has only recently begun implementation, at least one study suggests that initial adoption rates have been low (Stabile *et al.,* 2012). Recipients of the subsidized credit are supposed to demonstrate compliance with environmental legislation. The study, based on a small sample size, suggests that a range of general barriers as well as barriers specific to the programme are affecting adoption rates. Barriers that affect agricultural producers' decisions included: uncertainty surrounding the legal status of the Forest Code, which took a long time to revise because of the long time required to develop REDD+ systems at the state level; lack of technical knowledge of sustainable practices and limited extension support; and difficulty in accessing credit because of poor credit histories. The banks disbursing the credit reportedly had limited technical expertise to evaluate the agricultural proposals, with some banks preferring to steer funds towards lower-risk investments.

These and other implementation problems are not limited to the Brazilian Low Carbon Agriculture Program. In many countries, household adoption of biogas has also been identified as a mitigation action with potential. Several studies in China (e.g. Hallding *et al.,* 2012), where biogas extension programmes have a long history, report low rates of utilization due to a number of factors, such as lack of labour for maintenance, requirements to achieve certain minimum scales of adoption at the local level, and unattractive debt-financing arrangements. McCarthy *et al.* (2011) provide a review of barriers to adoption of climate-smart agriculture practices. While some agricultural NAMA planning processes appear or may intend to be prescriptive (aiming to support and incentivize households to adopt particular farming practices) successful planning will have to be based on a grounded understanding of farming systems and the multiple constraints that farmers face (FAO, 2012c). Adoption barriers may present a particular risk for NAMAs that propose transformational rather than incremental changes in agricultural practices. This is because a greater number of enabling conditions throughout the agricultural value chains must be put in place to make adoption of the proposed transformational measures feasible. NAMAs developed through 'bottom-up' processes appear more likely to identify adoption barriers during NAMA concept development than NAMAs developed through a largely top-down approach.

4. Discussion

4.1 Status and trends in national mitigation planning in the agriculture sector

Agriculture plays important roles in sustainable development and is a significant driver of GHG emissions in many developing countries. Among the 32 low-emission development plans reviewed in developing countries (Chapter 2), 21 consider mitigation of GHG emissions in the agriculture sector. Of the 55 countries that have submitted NAMA statements to the UNFCCC, 21 propose NAMAs in the agriculture sector (Chapter 3). Submissions on agriculture to the UNFCCC by a number of developing countries also indicate interest in the mitigation of agricultural GHGs.[27] In addition, there are a number of agricultural mitigation policies and measures under development or in implementation in developing countries that are not embedded in low-emission development plans and that have not been communicated in any policy document, such as a NAMA (Section 3.2).

The justifications for paying attention to GHG mitigation in the agriculture sector depend on country contexts. A high proportion of agricultural GHGs in the national inventory or projected increases in emissions under a business-as-usual scenario are often the reasons countries decide to address climate change mitigation in agriculture. Other reasons include: synergies of agricultural mitigation with sectoral objectives for increased efficiency and trade competitiveness; agriculture as a driver of deforestation; the promotion of rural energy access; the importance of sustainable practices to food security; agriculture's contribution to non-point pollution of water sources; and the importance of agriculture for adaptation to climate change. Specific mitigation actions are identified in a number of ways; not only through an analysis of GHG mitigation potential and the costs of mitigation but also through their alignment with national development priorities, their potential to deliver development or adaptation benefits, their feasibility, and their potential to deliver benefits in a short timeframe. Thus, there are many aspects of agriculture that define 'nationally appropriate' values of GHG mitigation in the agriculture sector.

National mitigation planning is in its early stages in many countries. Most developing countries have not developed LEDS. Where they do exist, LEDS align with broader national development strategies. This is often also the case for the agricultural components of these strategies. Similarly, where national climate change plans exist, they often provide the policy framework for agricultural NAMAs. However, explicit links between agricultural NAMAs and agriculture sector development plans are less commonly stated. Lessons from experience with low-emission development planning confirm the importance of policy and stakeholder coordination for effective planning (Section 2.2.6).

Agricultural NAMAs began to be communicated in 2009. In this report 62 agricultural NAMA statements have been identified (see Annex 1). Of these, 38 are statements of intent or lists of mitigation actions with no further elaboration. A further 20 have been elaborated to include mitigation targets or estimates of mitigation potential. From available documentation it appears that very few of the officially communicated agricultural NAMAs are in the process of feasibility analysis or detailed design. Actions outlined under Brazil's Plano ABC are already being implemented. The limited progress in developing and implementing agricultural NAMAs is also attested by surveys of sectoral allocations of climate finance to developing countries, which indicate very limited funding for readiness or action in the agriculture sector (Section 3.3.2). Outside official communications, however, analysis to support the development of agriculture sector NAMAs is ongoing in a number of countries (e.g. in Colombia, Costa Rica, Indonesia, Kenya, Malawi, Mongolia) (Section 3.2).

Internationally, definitions of NAMAs and agreement on related processes and requirements are limited, especially in relation to internationally supported NAMAs. While considerable sums of climate finance have been made available, there is uncertainty about future upscaling of available finance. Most existing climate finance is provided by the private sector, and most public climate finance is available as loans. Largely based on practice in other sectors, the main providers of climate finance are developing their own requirements for 'investable' options (Section 3.3.2). Thus, with ongoing analysis

[27] FCCC/SBSTA/2012/MISC.6

in a number of countries, agricultural mitigation plans will emerge, but it remains to be seen whether countries opt to officially submit these plans as NAMAs, and whether these plans will contain attractive investment options for climate finance institutions.

4.2 Barriers and risks in agricultural mitigation planning

The relatively small number of agricultural NAMAs that have progressed beyond statements of intent towards implementation invites reflection on the challenges in developing agricultural NAMAs and the potential limitations of NAMAs or other forms of mitigation plans as a tool for achieving agricultural sector objectives. Based on this assessment and the authors' experiences, the following issues and factors are involved.

National policy contexts: Low-emission development planning is a relatively recent practice. Many developing countries have limited capacities to estimate GHGs at a national level,[28] and only a small proportion of developing countries have elaborated low-emissions development plans at all (Table 1). The majority of plans are being developed in upper-middle or high-income countries.

National communications from many developing countries note the greater policy priority given to economic growth, poverty alleviation and adaptation compared to mitigation. In this context, even though many countries may note their need for support in agricultural mitigation,[29] agricultural mitigation is often not a policy priority either at the national level or within the agriculture sector. Synergies may exist between mitigation and other development objectives and benefits (Section 4.1), but it does not automatically follow that mitigation benefits will be pursued to achieve these other objectives.

On the one hand, networks among policy makers, donors, scientists and other stakeholders must be in place for the potential benefits of addressing mitigation to be raised to the policy level (Chinsinga *et al.,* 2012; Sarpong *et al.,* 2012). On the other hand, other, often more familiar, policy instruments and sources of finance also exist that may be used to pursue the same objectives.

It is notable that many developing country LEDS have been formulated with international donor support and in some cases with significant technical support from international experts. This indicates the key role international linkages may play in supporting mitigation planning.

Domestic readiness in the agriculture sector: In most countries, agriculture has, until relatively recently, focused mostly on production issues, with less attention paid to environmental impacts. Climate change mitigation agendas are often more advanced in other sectors (e.g. energy). In addition, politicians and officials are often unaware of the relevance of mitigation in general and mechanisms such as NAMAs in particular to the agriculture sector. This situation may provide little 'bottom-up' push to develop NAMA concepts in the agriculture sector. It also implies that the agriculture sector often faces strong requirements to demonstrate its potential in domestic NAMA circles, and domestic NAMA developments tend to be dominated by progress in other sectors. Similarly, it is notable that although agriculture is a major driver of deforestation, agricultural abatement plans are often relatively weak (Kissinger *et al*., 2012).

At the same time, identifying mitigation options in the agriculture sector is particularly challenging. In many developing countries, there is insufficient data on the GHG impacts of a range of agricultural practices to allow for the identification of 'sure-bet' mitigation practices. In the absence of national data, other default values for data can be used (Section 2.2.6). However, data on the production responses of many practices are also often limited, and this hampers the estimation of costs and benefits. Assumptions may be simplified, but this will introduce uncertainty into the results. Smallholder farmers, who dominate agriculture in most countries, face a number of barriers in adopting mitigation practices. More research is often needed to identify these barriers and to demonstrate effective solutions. Where proposed NAMAs in the agriculture sector are 'transformational' and move beyond existing practices, there will be a greater need to demonstrate feasibility and proof-of-concept. Where monitoring and verification is required, as is the case for NAMAs, suitable mechanisms will have to be developed that do not impose excessive transaction costs.

[28] See, e.g. http://unfccc.int/resource/docs/2011/sbi/eng/05a02.pdf

[29] E.g. as summarized in FCCC/SBSTA/2009/INF.1

International dimensions: International support has often been instrumental for mitigation planning. However, to date, investments in the agriculture sector have been limited. It is probable that this has been partly exacerbated by the lack of agricultural expertise in climate finance institutions. More broadly, the slow pace of the development of international agreement on requirements and procedures for NAMAs sends a mixed signal to national policy makers. 'Early-movers' will see this as an opportunity to shape international consensus on NAMAs. For others, the lack of precedence and guidance raises the risks of investment in developing agricultural NAMAs. While many of the actions outlined in developing country low-emission development plans and NAMA statements are oriented towards attracting international finance, most such finance is available as loans, and may not be suitable to supporting all types of agricultural mitigation actions (Figure 10). In any case, international public support will need to be coordinated with domestic and private finance. This is a more realistic approach in countries where strong rural finance institutions and previous experience with agribusiness finance exist. International public climate finance is increasingly focusing on investing in 'transformational' change in (sub)sectors, which may often involve addressing multiple barriers at the same time. As with other sectors (Würtenberger, 2012), there is limited experience of how international finance can be structured to bring about such transformational change.

4.3 Opportunities and potentials for agricultural NAMAs

A large number of developing countries, mostly in Africa, but also in Latin America and Asia, have expressed interest in implementing NAMAs in the agriculture sector. In developing countries as a whole, the sector has significant mitigation potential (Smith *et al.,* 2007). Existing estimates of the mitigation potential of particular policies and measures confirm the relevance of the sector to national mitigation planning (Table 4). Besides mitigation benefits, a variety of co-benefits have been identified for agriculture and other dimensions of development. Some studies have also identified mitigation options with low-costs or net economic benefits. These options warrant consideration in support for further elaboration of these NAMA concepts.

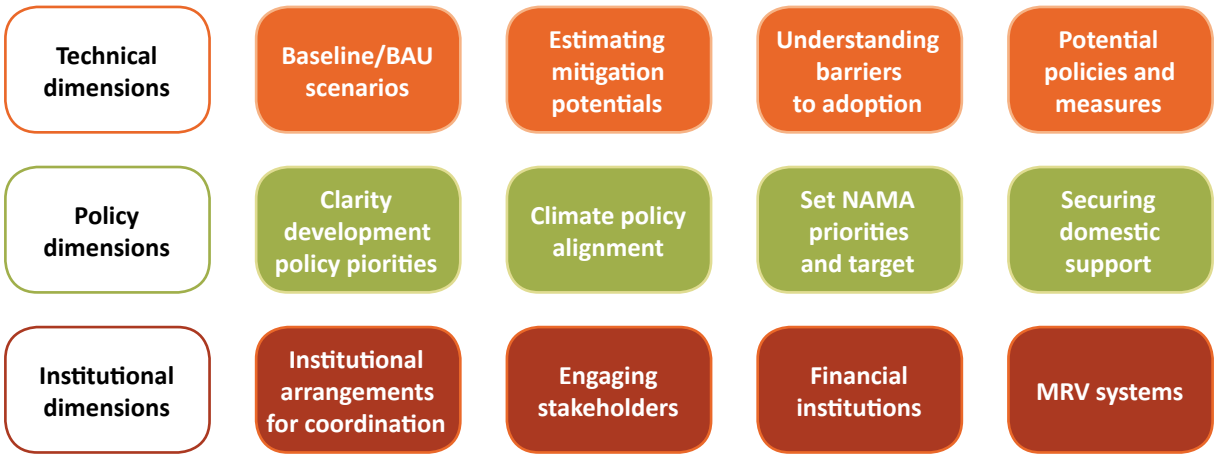
Progress in moving towards the implementation of agricultural mitigation actions has been most rapid in some emerging economies. It is also notable in some less developed countries where concerted mitigation planning and assessment initiatives have been undertaken. Besides domestic political processes, the availability of finance has been a facilitating factor. Domestic finance to support mitigation planning and promote action is available in countries such as Brazil and China. International support has played key roles in identifying agricultural mitigation options in countries such as Ethiopia and Rwanda, and further progress towards implementation may follow from continued progress in domestic readiness and negotiations with international finance institutions. A number of potential NAMAs are also being developed through 'bottom-up' and even non-government processes (Section 3.2), which may also be able to either garner government support for submission as NAMAs or secure support for implementation without formal NAMA status.

Several examples presented in this review suggest that technical constraints on data availability need not impede the development of mitigation plans and actions. Brazil's Plano ABC has begun implementation before methods for GHG accounting have been developed. Uruguay's agricultural NAMA explicitly proposes a step-by-step readiness process addressing policy frameworks, feasibility analysis, applied research and demonstration activities. Guyana's agreement with Norway allows for a process of readiness in which support will be provided as predefined milestones are met (Box 10). LEDS in Ethiopia and Rwanda also explicitly identify priority actions for follow-up to the planning process, focusing on key readiness activities. There is no single process that must be followed to make progress in planning mitigation policies and measures.

4.4 Towards building blocks for agricultural NAMAs

As with NAMAs in other sectors and with LEDS in general, it is appropriate to think of the process of NAMA development in agriculture as consisting of a range of key elements, or 'building blocks'. These elements refer to enabling conditions and the technical procedures that may be required to support the development of credible and effective NAMAs. Specific processes in each country differ depending on a variety of circumstances. These key elements may be put in place at different phases of the NAMA process. Some elements may not be needed in a particular country. Not all elements need to be in place before starting NAMA development or implementation.

Figure 5: Key elements ('building blocks') in the NAMA process



Source: the authors

Examples from Guyana (where donors signed agreements specifying key indicators and milestones to support the development and implementation of key elements), Uruguay (where the NAMA process is conceived at an early stage as a step-by-step approach from creating enabling conditions through feasibility studies to demonstration) and Brazil (where efforts to quantify mitigation benefits are ongoing even as the agricultural mitigation programme goes into implementation), suggest that a phased approach to agricultural NAMA development is the most appropriate.

A number of potential key elements or 'building blocks' have been described in this paper (see Figure 5, reproduced above). Among the most critical in the agriculture sector is the need for an understanding of the barriers to adoption. This understanding provides the basis for the identification of credible mitigation actions, a more realistic estimate of mitigation potentials and costs, and the particular needs that must be met to promote adoption. This in turn establishes the basis for the identification of effective implementation measures. To date, many processes identifying agricultural mitigation options have proceded in a 'top-down' manner, utilizing various assumptions to estimate costs and benefits. Further feasibility analysis is likely to significantly alter these initial assumptions before 'investable' proposals can be identified. By contrast, 'bottom-up' planning approaches, grounded in analysis of productivity constraints and barriers to adoption in a given sub-sector, represent an alternative approach to identifying feasible policies and measures. However, these 'bottom-up' processes may face more challenges when it comes to linking up with national mitigation planning processes.

4.5 Recommendations

For national policy makers:

- **Align agricultural mitigation plans with priorities in national and sectoral development plans:** In addition to their climate impacts, mitigation actions in the agriculture sector can contribute to delivering a range of sustainable development benefits. The precise benefits are defined in the national context and will vary between mitigation activities and between countries. In many countries, it is these benefits that have justified policy attention being paid to agricultural mitigation. Given the importance of these benefits to developing countries, efforts should be continued and strengthened to promote mitigation planning in ways that are consistent with national development priorities in the agriculture sector.

- **Use a step-by-step approach to NAMA development:** In many countries, current knowledge of agricultural mitigation options is insufficient to produce well-grounded, 'bankable' NAMA concepts. In such situations, the process of developing NAMAs in the agriculture sector should be conceived as a step-by-step or phased approach, in which the basic elements required for NAMA concept development are gradually put in place to address the particular gaps or weaknesses in

knowledge, analysis and readiness in the national agriculture sector. Addressing these gaps can also bring benefits for agricultural development (e.g. by improving monitoring and evaluation systems).

- **Combine climate finance with other sources of finance:** The implementation of mitigation policies and measures can incur significant costs. Various sources of finance will be needed to finance all these costs. International public climate finance is generally focused on supporting readiness, demonstrations, and key investments that are likely to have transformative impacts. Policy makers will need to consider how best to utilize potential sources of climate finance with other sources of finance to support the development and subsequent implementation of agricultural mitigation plans.

For development partners:

- **Climate finance should support country-led strategies and plans:** NAMAs are well aligned with programmatic approaches that aim to move away from a proliferation of projects and pilot activities. However, these approaches require strong leadership from the host country, coordination among host country agencies and potentially coordination among donors. In line with the principles of aid and development effectiveness, climate finance should support country-led strategies and plans, and be delivered through countries' own financial systems.30

- **Support phased readiness processes in the agricultural sector:** International support may be targeted at discreet activities. However, in most cases it is more suitable to structure support for a phased approach (as in Guyana or as proposed by Uruguay) with a long-term financing commitment based on agreed milestones. Agricultural NAMAs require close cooperation among a range of stakeholders, with a readiness phase at the national level as a starting point to build capacity and establish other enabling conditions.

- **Climate finance should support both technical analysis and creation of enabling conditions:** Given the relatively limited progress in developing agricultural mitigation plans, climate finance should support the development of both technical building blocks and enabling conditions (i.e. institutional and policy dimensions). Ideally, such support in the agriculture sector would be integrated into ongoing agricultural sector support programmes or regional rural development schemes, but this will also depend on country-led processes.

For researchers and NAMA developers:

- **Clarifying socio-economic and policy dimensions of NAMAs can help target biophysical research:** While there are many demands for basic research on mitigation potential of agricultural practices, the precise biophysical research needed to support NAMA development will be defined by the outcomes of research and stakeholder consultation on institutional, economic and policy issues. Clarifying the institutional, economic and policy dimensions of a NAMA can help define better targeted research for basic biophysical research.

- **Research on barriers to adoption is critical:** Research on barriers to adoption and solutions to those barriers will make critical contributions to designing feasible NAMAs. Perspectives from agricultural economics, finance policy and rural sociology will be needed to understand specific barriers to adoption and options for addressing them.

- **Research contributing to design of MRV systems should build on existing systems in the agriculture sector:** Much agricultural research is conducted relatively independently of key actors in agricultural extension and monitoring and evaluation systems. However, it is these systems that will be responsible for large parts of NAMA implementation. Research support to NAMA development should consider the capacities and potentials of these key actors and aim for feasible management systems within their institutional contexts. This is most likely to involve building on existing management systems rather than creating new parallel systems, as has often occurred in

[30] See also Busan Forum Building Block on Climate Finance, http://www.oecd.org/development/aideffectiveness/49512994.pdf

the carbon market. These systems should fulfil mitigation-related MRV requirements while also meeting the information needs of other stakeholders in the agriculture sector.

- **Build national research capacities:** Capacity building for national partners in a range of research skills may also need to be conducted along with activities to support increased understanding of NAMA-related policy processes. This may require that more time be allocated for certain phases of the research than is normally planned for.

For international agricultural research and intergovernmental organizations:

- There is also demand in some countries for technical support in the further development of NAMAs in the agriculture sector. Technical assistance related to mitigation planning should respond to country requests. In addition, there are a number of key areas where research and knowledge management can contribute to a better understanding of and further development of NAMAs in the agriculture sector.

Key areas for research:

Mitigation planning methods and processes: Relatively little has been documented in relation to agricultural mitigation planning beyond policy statements and the plans resulting from planning processes. A few LEDS documents (e.g. Ethiopia, Rwanda) contain annexes with descriptions of methodologies. A small number of publications or workshop presentations are available on related methodological processes or tools (e.g. Cadena and. Rosales, 2011, presentations at FAO workshop on agricultural NAMAs).[31] The available materials focus mainly on results of analysis. To date, there has been no reflective exposition on methods in relation to the practical processes in which they are embedded, or on the non-technical aspects of agricultural mitigation planning processes. Some studies of policy processes have been undertaken (e.g. Chisinga *et al*., 2012; Sarpong *et al*., 2012) from a particular perspective. Expanding available materials would provide potential guidance to others involved in mitigation planning and NAMA development. In particular, reflective contributions from those involved in mitigation planning processes would provide insight on the practical technical and political issues faced.

- **Mitigation options and their impacts:** Research to improve understanding of the feasibility and GHG impacts of different technical options continues to be needed. The impact of research funding can be increased by ensuring that research partners work with partners involved in mitigation planning processes, or at a minimum that research questions are developed around the specific needs of those involved in planning processes. Similarly, research on other (non-GHG) impacts of mitigation practices can improve understanding of the synergies and trade-offs between mitigation effects and other priority policy objectives. The relevance of the knowledge generated can be increased if research questions are developed around the priority concerns of policy makers and other stakeholders.[32] Knowledge of crop or livestock responses to changes in management practice is limited in many contexts, but this is key to modeling the effects of adoption in yields and incomes. The social dimensions of mitigation practices have received little attention. As few of the mitigation technologies listed in NAMAs are entirely novel, one way to increase knowledge of the social and general welfare impacts of mitigation activities and individuals' and households' responses to those impacts that appears to be underexploited is to research the impacts of existing agricultural development programmes that promote similar technologies.

- **Barriers to adoption:** A range of factors affect smallholder adoption decisions, but few LEDS or NAMAs contain any related analysis or targeted action. Research developed around policy-relevant questions can directly contribute to the identification of key design elements for mitigation programmes. Other actors in potential mitigation programmes (e.g. rural finance institutions, extension agencies, administrative agencies) may also face a range of constraints. Barriers and constraints among a range of actors can provide guidance on the feasibility and design of mitigation programmes. Lessons

[31] http://www.fao.org/climatechange/micca/72532/en/

[32] It is worth noting, as described in Section 4.1, that developing countries may be interested in synergies between mitigation impacts and a range of other impacts, and these may or may not include synergies with adaptation to climate change.

from experience of other agricultural development programmes are likely to remain relevant to mitigation programmes in the sector. More generally, there is a wealth of experience of 'what works' and 'what doesn't work' in past agricultural interventions by governments, donors and NGOs, but this experience appears to rarely be considered by those involved in mitigation planning.

Knowledge management:

- **Key areas for knowledge management:** In a number of countries, there is broad interest within agriculture, environment and other ministries in NAMAs in the agriculture sector. There is also a growing body of practitioners interested sharing and learning. International organizations have potential roles to play in knowledge management related to the practice and understanding of agricultural mitigation planning. It would be useful to increase the availability of knowledge in the following areas:

  – tracking NAMA-related activities in the agricultural sector;

  – documenting experiences, innovative methods, tools and analytical or processes;

  – supporting reflection among practitioners and other stakeholders to distill lessons; and

  – sharing lessons and accomplishments among stakeholders.

  This review has provided a general framework around which further generation and sharing of some of these aspects could be structured. This framework is based around the ideas of NAMA building blocks and a phased approach (Figures 4 and 5). It can be used to structure efforts to elicit, share and present knowledge and practices related to each key element.[33]

- **Bridging across policy communities:** International organizations can play particular roles in helping link distinct policy communities at international or national levels. For example, in general, donors involved in NAMA development have little awareness of agricultural NAMAs, while practitioners involved in NAMA development are not always aware of donors' requirements for 'investable' NAMAs. Similarly, in some countries, agriculture is just one of the sectors for which there are ongoing NAMA development activities. Support can be provided to encourage sharing, collaboration and alignment of these multisectoral activities.

[33] In addition, consultation and experience sharing can contribute to further elaboration of the key elements identified.

References

Atela, J. 2012. *The politics of agricultural carbon finance: the case of the Kenya Agricultural Carbon Project*. STEPS Working Paper 49. Brighton, UK, STEPS Centre.

Barioni, L.G. 2012. *Mitigation options and actions in Brazilian Agriculture, Development of the Brazilian Agricultural NAMAs*. Presentation given at the workshop on NAMAs: national mitigation planning and implementation in agriculture, organized by CCAFS and FAO, Rome, Italy, 16 -17 July 2012.

Beddington, J., Asaduzzaman, M., Clark, M., Fernandez, A., Guillou, M., Jahn, M., Erda, L., Mamo, T., Van Bo, N., Nobre, C.A., Scholes, R., Sharma, R., & Wakhungu, J. 2012. *Achieving food security in the face of climate change: Final report from the Commission on Sustainable Agriculture and Climate Change*. Copenhagen, CCAFS

Boucher, D., Elias, P., Lininger, K., May-Tobin, C., Roquemore, S. & Saxon, E., 2011. *The Root of the Problem: What's Driving Tropical Deforestation Today?* Cambridge, Massachusetts, USA, Union of Concerned Scientists.

Bradley, R., Pershing, J., Schipper, L., Baumert, K., Dubash, N. & Moreira, J. 2005. *Growing in the Greenhouse: Protecting the climate by putting development first*. Washington, DC, WRI.

Branca, G., McCarthy, N., Lipper, L. & Jolejole, M. 2011. *Food Security and Mitigation Benefits from Improved Cropland Management*. Mitigation of Climate Change in Agriculture Series No. 3. Rome, FAO.

Bray, T. (ed). 2009. *Charting a New Low-Carbon Route to Development: a primer on integrated climate change planning for regional governments*. New York, USA, UNDP (United Nations Development Programme).

Buchner, B., Falconer, A., Hervé-Mignucci. M. & Trabacchi, C. 2012. *The Landscape of Climate Finance 2012*. San Francisco, USA, Climate Policy Initiative.

Burney, J., Davis, S. & Lobell, D. 2010. Greenhouse gas mitigation by agricultural intensification. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* 107(26): 12052-12057.

Cadena, A. & Rosales, R. (senior researchers) 2011. *Mitigation Action in Developing Countries. Country Study for Colombia*. MAPS (Mitigation Action Plans and Scenarios)

Chisinga, B., Chasukwa, M. & Naess, O. 2012. *FAC Working Paper 46. Climate change and agricultural policy processes in Malawi*. Brighton, UK, Future Agricultures Consortium. (available at http://www.future-agricultures.org/publications/research-and-analysis/working-papers/)

Clapp, C., Briner, G. & Karousakis, K. 2010. *Low-emission Development Strategies (LEDS): Technical, institutional and policy lessons*. Paris, OECD.

Climate Focus, IIASA (International Institute for Applied Systems Analysis) and UNIQUE forestry and land use. 2011. *Carbon Market and Climate Finance for Climate-smart Agriculture in Developing Countries. DFID Climate Change, Agriculture and Food Security Policy Research Program*. Washington, DC, Climate Focus Inc.

Cooper, P., Cappielo, S., Vermeulen, S, & Campbell, B. 2012. The large-scale implementation of adaptation and mitigation actions in the agriculture and food sector. CCAFS discussion paper. (available at http://hdl.handle.net/10568/24863)

Cox, S. & Benioff, R. 2011. *International Assistance for Low-Emissions Development Planning Coordinated: Low Emissions Assistance Network (CLEAN) Inventory of Activities and Tools—Preliminary Trends*., Springfield, USA, NREL (National Renewable Energy Laboratory).

CO2 Costa Rica, 2012. NAMA proposal for the Costa Rican coffee sector. Slide show. (available at http://de.scribd.com/doc/73606397/NAMA-Proposal-for-the-Costa-Rican-Coffe-Sector-Presentation)

DeFries, R. & Rosenzweig, C. 2010. Toward a Whole-landscape Approach for Sustainable Land Use in the Tropics. *PNAS* 107 (46): 19627–19632.

Denef, K., Paustian, K., Archibeque, S., Biggar, S. &Pape, D. 2012. *Report of Greenhouse Gas Accounting Tools for Agriculture and Forestry Sectors. A report submitted by ICF International and Colorado State University for the project: Technical Guidelines and Scientific Methods for Entity-Scale Greenhouse Gas Estimation.* Interim report to USDA under Contract No. GS23F8182H (available at http://www.usda.gov/oce/climate_change/techguide/Denef_et_al_2012_GHG_Accounting_Tools_v1.pdf)

Driver, K., Haugen-Kozyra, K. & Janzen, R. 2010. *Agriculture Sector Greenhouse Gas Quantification Protocol Benchmarking From Agricultural Projects Market Mechanisms for Agricultural Greenhouse Gases (M-AGG) Phase 2 Report*.

Duffó, A., Pardo, L., Arias, J. & Moreno, A. 2011. Measurement and Performance Tracking: Scoping and Survey Results. Consultant report to the WRI Measurement and Performance Tracking (MAPT) project.

Ecofys and IDS (Institute of Development Studies). 2011. *Guiding Climate Compatible Development: user-oriented analysis of planning tools and methodologies*. Cologne, Brighton, Utrecht, London (available at http://www.climateplanning.org/sites/climateplanning.org/files/attachments/Ecofys%20%20IDS%202011_TM%20for%20CCD_main%20report%20format.pdf

Ellis, J., Baron, R. & Buchner, B. 2007. *SD-PAMS: what, where, when and how?* Paris, OECD/IEA

FAO. 2009. *How to Feed the World in 2050*. Rome.

FAO. 2010. *Agriculture, Food Security and Climate Change in Post-Copenhagen Processes: an FAO Information Note*. Rome. (available at

http://foris.fao.org/static/data/nrc/InfoNote_PostCOP15_FAO.pdf)

FAO. 2012a. *The State of Food Insecurity in the World 2012*. Rome.

FAO. 2012b. *Greening the Economy with Climate-Smart Agriculture*. Rome.

FAO. 2012c. *Developing a climate-smart agriculture strategy at the country level: lessons from recent experience*. Rome.

Federal Democratic Republic of Ethiopia. 2011. *Ethiopia's Climate-resilient Green Economy: Green Economy Strategy.* Addis Ababa.

Forner, C. 2012. Verbal presentation at the workshop on NAMAs: national mitigation planning and implementation in agriculture, organized by CCAFS and FAO, Rome, Italy, 16 -17 July 2012.

Fu-Bertaux, X. & Fröde, A. 2012. *GIZ Discussion Paper. It's not just the money: institutional strengthening of national climate funds*. Eschborn, Germany, GIZ.

Geist, H. & Lambin, E., 2002. Proximate causes and underlying driving forces of tropical deforestation. *BioScience* 52: 143–150.

Giordano, T,. Hall, L., Gilder, A. & Parrammon, M. 2011. *Governance of Climate Change in South Africa*. Johannesburg, Department of Environmental Affairs.

Grüning, C. & Shuford L. 2009. Case Study: Guyana REDD-Plus Investment Fund (GRIF). Frankfurt, Frankfurt School - UNEP Collaborating Centre for Climate & Sustainable Energy Finance.

Haddad, L., Lindstrom, J. & Pinto, Y. 2010. The sorry state of M&E in agriculture: Can people-centered approaches help? *IDS Bulletin* 41(6): 6-25.

HLPE, 2012. Climate change and food security. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security. Rome.

Hodas, R. 2012. *Bilateral Finance Institutions and Climate Change: a mapping of 2012 climate financial flows to developing countries*. Nairobi, UNEP (United Nations Environment Programme).

Hosonuma, N., Herold, M., De Sy, V., De Fries, R.S., Brockhaus, M., Verchot, L., Angelsen, A. & Romijn E. 2012. An assessment of deforestation and forest degradation drivers in developing countries. *Environmental Research Letters,* 7(4).

IEA (International Energy Agency) 2011. *CO_2 Emissions from Fuel Combustion 2012*. (available at http://www.iea.org/publications/freepublications/publication/name,4010,en.html)

IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K. and Reisinger, A. (eds.)]. Geneva, Switzerland.

IRENA (International Renewable Energy Agency). 2012. *IRENA Handbook on renewable energy Nationally Appropriate Mitigation Actions (NAMAs) for Policy Makers and Project Developers*.

Kaur, N. & Ayers, J. 2010. *Policy Brief. Planning Climate Compatible Development: lessons from experience*. London, CDKN (Climate and Development Knowledge Network).

Kissinger, G., Herold, M. & De Sy, V. 2012. *Drivers of Deforestation and Forest Degradation: A Synthesis Report for REDD+ Policymakers*. Vancouver, Canada, Lexeme Consulting.

Knight, O. (ed). 2012. *Planning for a Low Carbon Future: Lessons learned from seven country studies*. Washington DC, IBRD (International Bank for Reconstruction and Development).

Koblowsky, P. & Ifejika-Speranza, C. 2012. *African Developments: Competing Institutional Arrangements for Climate Policy: The Case of Nigeria*. Briefing Paper 7. German Development Institute.

Kossoy, A. & Guigon, P. 2012. *State and Trends of the Carbon Market 2012*., Washington, DC, World Bank

Larson, D., Dinar, A. & Frisbie, J. 2011. *Agriculture and the Clean Development Mechanism*. Policy Research Working Paper 5621. Washington, DC, World Bank.

Low, L. 2011. *CDKN Guide. Green Growth: implications for development planning*. London, CDKN.

Lütken, S., Fenhann, J., Hinostroza, M., Sharma, S. &Olsen, K. 2011. *Low Carbon Development Strategies: A Primer on Framing Nationally Appropriate Mitigation Actions (NAMAs) in Developing Countries*. Roskilde, Denmark, UNEP Risø Centre.

Mabey, N. 2012. *Driving Transformational Change: a practical framework for accelerating progress towards low carbon and climate resilient economies*. Presentation at the workshop on Low Carbon Sector Transformation in Developing Countries organized by KfW and the Wuppertal Insititute on 30 October 2012 in Frankfurt Germany (available at: http://www.kfw-entwicklungsbank.de/ebank/EN_Home/Climate_Change/Informations_and_Events/Low-Carbon_Sector_Transformation_in_Developing_Countries.jsp

Mersmann, F. 2012. Addressing climate change: transformational change in theory and practice. Wuppertal Institute. (available at http://www.kfw-entwicklungsbank.de/ebank/DE_Home/Klima_und_Umwelt/Dokumente_und_Veranstaltungen38167/Low-Carbon_Sector_Transformation_2012/Transformational_Change.pdf)

Ministry of Agriculture of the People's Republic of China. 2012. Suggestions on Agricultural and Rural Energy Conservation and Emission Reduction. Beijing.

Mitchell, T. & Maxwell, S. 2010. *Policy Brief. Defining Climate Compatible Development*. London, CDKN. (available at http://cdkn.org/wp-content/uploads/2012/10/CDKN-CCD-Planning_english.pdf)

Pereira, P., Martha, G.B., Santana, C.A.M. & Alves, E. 2012. The Development of Brazilian Agriculture: Future Technological Challenges and Opportunities. *Agriculture & Food Security* 1 (4).

OECD. 2011a. *Towards Green Growth*. Paris.

OECD. 2011b. Policy Framework for Low-Carbon, Climate-resilient Investment: the case of infrastructure development. (available at http://www.fil.pt/irj/go/km/docs/aip/documentos/estudos%20publicacoes/centro%20documentacao/Ambiente/OCDE%20-%20Policy%20Framework%20for%20Low-Carbon%20-%2009.11.2011.pdf) Paris.

Project Catalyst. 2009. *Low Carbon Growth Plans: advancing good practice*. Climate Works Foundation and European Climate Foundation.

Government of of Kenya. 2012. National Climate Change Action Plan 2012. Unpublished draft report. Ministry of Environment and Mineral Resources.

Román, M. 2012. Introduction: SD-PAM and the potential of promoting climate action through development policies. *Climate and Development* 4(3): 167-174

Sarpong, D. & Anyidoho, N. 2012. Climate change and agricultural policy processes in Ghana. Working Paper 45. Future Agricultures Consortium. (available at http://www.future-agricultures.org/publications/research-and-analysis/working-papers/)

Seebauer, M., Tennigkeit, T., Bird, N. & Zanchi, G. 2012. Carbon accounting for smallholder agricultural carbon credits: a Verified Carbon Standard for agricultural land management projects. In E. Wollenberg, A. Nihart, M-L Tapio-Biström, M. Grieg-Gran. (eds.) *Climate Change Mitigation and Agriculture*, pp.274-284. Routledge.

Seeberg-Everfeldt, C. & Tapio-Biström, M. 2010. *Global survey of agricultural mitigation projects*. Mitigation of Climate Change in Agriculture Series No. 1. Rome, FAO.

Shimizu Corporation. 2011. *Feasibility Study on Sustainable Peatland Management in Indonesia under NAMAs. Peatland mitigation in coastal lowlands*.

Smith,P., Martino, D., Cai, Z., Gwary, D., Janzen, H., Kumar, P., McCarl, B., Ogle, S., O'Mara, F., Rice, C., Scholes, B. & Sirotenko, O. 2007. Agriculture. In B. Metz, O.R. Davidson, P.R. Bosch, R. Dave &L.A. Meyer (eds.) *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Stabile, M., Azevedo, A. & Nepstad, D. 2012. *Brazil's Low Carbon Agriculture Program: Barriers to Implementation.* Amazon Environmental Research Institute (available at http://www.gcftaskforce.org/documents/brazil's_low-carbon_agriculture_program.pdf)

The Nature Conservancy. 2012. *Climate Finance Readiness: Lessons learned in developing countries*. Arlington, USA.

Tennigkeit, T., Wilkes, A., Yaeger, C. 2013. Policy Brief: Nationally Appropriate Mitigation Actions for Grassland and Livestock Management in Mongolia. Manila, Asian Development Bank.

Tubiello, F. 2011. *Linking Climate Change Financing and Sustainability*. Rome, FAO.

UN (United Nations). 2012. The Future We Want. Outcome document of Rio+20, the UN Conference on Sustainable Development. (available at http://www.uncsd2012.org/content/documents/727The%20Future%20We%20Want%2019%20June%201230pm.pdf)

UNDP. 2011. *Preparing Low Emission Climate Resilient Development Strategies*. New York, USA.

UNEP. 2012. *NAMA Finance Study: Examples from the UNEP Bilateral Finance Institutions Cliamte Change Group*. Nairobi

UNFCCC. 2010. Appendix II - Nationally appropriate mitigation actions of developing country Parties. (available at http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php)

UNFCCC. 2012b. NAMA seeking support for Preparation from Uruguay. (available at http://unfccc.int/files/cooperation_support/nama/application/pdf/nama_support_preparation_uruguay_biogas.pdf)

UNFCCC. 2012c. Submission of more information by developing country Parties, subject to availability, relating to nationally appropriate mitigation actions, including underlying assumptions and methodologies, sectors and gases covered, global warming potential values used, support needs for implementation of nationally appropriate mitigation actions and estimated mitigation outcomes. (available at http://unfccc.int/resource/docs/2012/awglca15/eng/misc02.pdf)

van Tillburg, X., Würtenberger, L., de Coninck. H. & Bakker, S. 2011. *Paving the way for low-carbon development strategies*. ECN (Energy research Centre of the Netherlands), Petten, The Netherlands.

van Tilburg, X. & Würtenberger, L. 2012. Ambitious NAMAs and national climate governance. In G. Hänsel *et al* (eds.) *Annual Status Report on Nationally Appropriate Mitigation Actions*. pp. 20-24. Ecofys, ECN, GIZ, CCAP (Center for Clean Air Policy).

Wilkes, A., Tennigkeit, T. & Chagunda, M. 2012. Supporting dairy sector development in Malawi through NAMas: Addressing design features in the development context. Policy brief. Unique, CDKN & SRUC (Scotland's Rural College).

Winkler, H., Saplding-Fecher. R., Mwakasonda. S. & Davidson, O. 2002. Sustainable Development Policies and Measures: Starting From Development to Tackle Climate Change. In K. Baumert, O. Blanchard, S. Llosa & J. Perkaus (eds.) *Building on the Kyoto Protocol: Options for Protecting the Climate.* WRI.

Winkler, H., Höhne, N. & den Elzen, M. 2008. Methods for quantifying the benefits of sustainable development policies and measures (SD-PAMs). *Climate Policy* 8: 119-134.

World Bank. 2012. *Turn down the heat. Why a 4°C warmer world must be avoided*. Washington, DC.

Würtenberger, L. 2012. *Financing Supported NAMAs*. Ecofys & ECN.

Zanella, M.A. & Cardoso, L.V. 2011. Agri-environmental Policies in Brazil and Perspectives for Evaluation, Session 5 of the OECD Workshop on the Evaluation of Agri-environmental Policies, held 20-22 June 2011, Braunschweig, Germany. . (available at http://www.oecd.org/tad/sustainableagriculture/48169582.pdf)

Annex 1: Overview of agricultural NAMAs

Country	Communication of the action			Agricultural sub-sector	Stage of development (1-8 indicates from concept (1) to implementation (8))								GHG baseline emissions and reductions estimated?	Implementing agency specified?	Costs specified?
	NAMA submission only	National plan only	both		1	2	3	4	5	6	7	8			
Brazil	x			Reduction of Amazon deforestation	x								yes	no	no
	x			Reduction of Cerrado deforestation	x								yes	no	no
			x	Restoration of grazing land						x	x	x	yes	yes	no
			x	Integrated crop-livestock system						x	x	x	yes	yes	yes
			x	No-till farming			x						yes	yes	no
			x	Biological N2-fixation			x						yes	yes	no
		x		Planted forests			x						yes	yes	no
		x		Animal waste treatment			x						yes	yes	no
Cambodia		x		Sustainable agriculture		x							no	yes	no
Central African Republic	x			Sustainable crop- and grassland management	x								no	no	no
Chad	x			Crop intensification and improvement	x								no	no	no
Colombia		x*		Potato crops		x							no	no	yes
Congo DR	x			Crop improvement and extension	x								no	no	no
Costa Rica		x		Improved livestock management	x								yes	no	no
		x		Improved crop management									no	no	no
		x*		Fertilizer and agrochemical reduction in the coffee sector				x					yes	no	partly
Côte d'Ivoire	x			Sustainable land use	x								no	no	no
Dominica		x		Irrigation powered by renewable energy	x								no	no	no
Eritrea	x			Agricultural soil carbon enhancement	x								no	no	no
	x			Sustainable land use planning	x								no	no	no

Country	Communication of the action			Agricultural sub-sector	Stage of development (1-8 indicates from concept (1) to implementation (8))								GHG baseline emissions and reductions estimated?	Implementing agency specified?	Costs specified?
	NAMA submission only	National plan only	both		1	2	3	4	5	6	7	8			
Ethiopia	x			Cropland management		x							no	no	no
	x			Agroforestry		x							no	no	no
		x		Ethanol / biodiesel production			x						yes	yes	yes
		x		Change herd mix for more efficient feed conversion				x					yes	yes	yes
		x		Better feed, breeds, management, lower age at off-take				x					yes	yes	yes
		x		Reduce draught animals population				x					yes	yes	yes
		x		Improved range management				x					yes	yes	yes
		x		Improved agronomic management of soils				x					yes	yes	yes
		x		Increase yields (better seeds, fertilizers, agronomic practices)				x					yes	yes	yes
		x		Irrigation in arid lands				x					yes	yes	yes
Ghana	x			Sustainable land management	x								no	no	no
	x			Crop switching	x								no	no	no
	x			Post-harvest practices	x								no	no	no
Group of African States	x			Agricultural production, value chains and enabling environment	x								no	no	no
Guyana		x		Redirecting agricultural expansion from forests							x		yes	yes	yes
Indonesia			x	Sustainable peat land management				x					yes	yes	yes
			x	Restoration of degraded agricultural land	x								no	yes	no
			x	Development of carbon sequestration projects in agriculture	x								no	yes	no
Jordan	x			Cropland management	x								no	no	no
	x			Livestock production chain management	x								no	no	no
Kenya		x		Agroforestry				x					yes	yes	yes
		x		Conservation tillage			x						yes	yes	no
		x		Fire reduction in crop- and grasslands			x						yes	yes	no

Country	Communication of the action			Agricultural sub-sector	Stage of development (1-8 indicates from concept (1) to implementation (8))								GHG baseline emissions and reductions estimated?	Implementing agency specified?	Costs specified?
	NAMA submission only	National plan only	both		1	2	3	4	5	6	7	8			
FYR Macedonia		x		Enabling conditions for GHG emission reduction	x								--	yes	no
		x		Mitigation technologies							x		yes	yes	yes
		x		Carbon finance capacity building	x								--	yes	no
		x		Mitigation technologies and capacity building	x								--	yes	no
Madagascar	x			Crop improvement and fertilization	x								--	yes	no
Malawi	x			Sustainable agricultural practices				x°					no	no	no
	x			Enabling conditions for adaptation/mitigation	x								no	no	no
Mexico		x		Rangeland management			x						yes	no	no
Mongolia			x	Livestock management				x					yes	yes	yes
Morocco	x			Cropland management	x								yes	no	no
Papua New Guinea	x			n/a	x								no	no	no
Rwanda		x		Soil fertility management		x							no	no	no
Sierra Leone	x			Sustainable land management and agroforestry	x								no	no	no
	x			Bio-energy in agriculture	x								no	no	no
South Africa		x		Climate-smart agriculture	x								yes	no	no
Swaziland	x			Agricultural production, value chains and enabling environment	x								no	no	no
Tunisia	x			Sustainable land management		x							no	no	no
	x			Water management in agriculture and efficiency		x							no	no	no
Uruguay	x			Low emission technologies (biogas) in production and value chains	x								no	yes	yes

**= sub-national plan only; °= feasibility analysis done for dairy subsector only*

This review of national greenhouse gas (GHG) mitigation planning in the agriculture sector provides national policy makers and others in the agriculture sector with an overview of national mitigation planning processes to aid them in identifying the relevance of these processes for promoting agricultural development. It also gives policy makers and advisors involved in low-emission development planning processes an overview of mitigation planning in the agriculture sector and highlights the relevance of agriculture to national mitigation plans and actions.

The review provides an overview of agreements under the United Nations Framework Convention on Climate Change (UNFCCC) on GHG mitigation in developing countries. It examines 32 low-emission development strategies (LEDS) from 18 developing countries and 62 nationally appropriate mitigatioin actions (NAMAs) in the agriculture sectors of 30 countries. It describes the status of development of the NAMAs, the agricultural activities proposed and the alignment of the NAMAs with other policies and policy goals. The report summarizes the status of and trends in national agricultural mitigation planning, the barriers and risks involved, and the opportunities and potentials for agricultural NAMAs. It also suggests an approach to NAMA development in the agriculture sector based on 12 basic building blocks.

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