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Integrated National Policy Approaches to Climate-Smart Agriculture

Insights from Brazil, Ethiopia, and New Zealand

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Front cover photo

Pastoral communities in Ethiopia are among the most vulnerable groups to climate change impacts. Photo credit Zerihun Sewunet / International Livestock Research Institute (ILRI)

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Abbreviations and acronyms

BNDES	Brazilian Development Bank
CBPWD	Community Based Participatory Watershed Development
CDM	Clean Development Mechanism
CIMGC	Inter-ministerial Commission on Global Climate Change
COMESA	Common Market for Eastern and Southern Africa
CONSEA	National Council on Food and Nutrition Security
CRGE	Climate-Resilient Green Economy Strategy
CSA	Climate-smart agriculture
DAP	diammonium phosphate
DNA	Designated National Authority
EDRI	Ethiopian Development Research Institute
Embrapa	Brazilian Agricultural Research Corporation
ERHS	Ethiopian Rural Household Survey
ESIF-SLM	Strategic Investment Framework for Sustainable Land Management
ETS	Emissions Trading System
FAO-EPIC	United Nations Food and Agriculture Organization/ Economic and Policy Innovations for Climate-Smart Agriculture
FCPF	Forest Carbon Partnership Facility
FNMC	National Climate Change Fund
FONTAGRO	Regional Fund for Agricultural Technology
GDP	Gross Domestic Product
GGGI	Global Green Growth Institute
GHG	Greenhouse Gas
GRA	Global Research Alliance on Agricultural Greenhouse Gases
GTP	Growth and Transformation Plan
HARITA	Horn of Africa Risk Transfer for Adaption Program
IBAMA	Brazilian Institute of Environment and Renewable Natural Resources
IPCC	Intergovernmental Panel on Climate Change
LAC	Land Administration Committee
INPE	Instituto Nacional de Pesquisas Espaciais
MAPT	Measurement and Performance Tracking
MAPS	Mitigation Action Plans and Scenarios
MERET	Managing Environmental Resources to Enable Transitions to more sustainable livelihoods
MoA	Ministry of Agriculture
MRV	Measuring, reporting and verification
NAMAs	nationally appropriate mitigation actions
NAPA	National adaptation programmes of action
NDVI	normalized difference vegetation index
NPCC	National Plan on Climate Change
NSD	National Soils Database
NZAGRC	New Zealand Agricultural Greenhouse Gas Research Centre
NZUs	New Zealand Units
OECD	Organization for Economic Co-operation and Development
PAS	Sustainable Amazon Plan
PES	Payments for ecosystem services
PBMC	Brazilian Panel on Climate Change
PFM	Participatory Forest Management
PGP	Primary Growth Partnership
PNMC	National Climate Change Policy
PNPB	Brazilian Biodiesel Production Program
PPCDAm	Action Plan for Prevention and Control of Legal Amazon Deforestation
Proalcool	Brazilian Ethanol Program

PSNP	Productive Safety Net Program
R&D	Research and Development
REDD	Reducing Emissions from Deforestation and forest Degradation
RMA	Resource Management Act
SLM	Sustainable Land Management
SLMACC	Plan of Action for Sustainable Land Management and Climate Change
SLMP	Sustainable Land Management Program
SNUC	National System of Nature's Conservation Units
UNFCCC	United Nations Framework Convention on Climate Change
UNDP	United Nations Development Programme
WFP	World Food Programme

Units of Measurement

B	Billion
CO_2e	Carbon dioxide equivalent
M	Million
Mg	Megagram
Mt	Millions of tons
MW	Megawatt

1. Introduction

Context

"Globally our food system is not sustainable, does not provide adequate nutrition to everyone on the planet and, at the same time, changes to our climate threaten the future of farming as we know it. Agriculture is both part of the problem and part of the solution to climate change (Beddington et al. 2012)."

Countries around the world are facing urgent agricultural challenges. The combination of a finite land base with growing populations and global consumption of food, fiber, and fuel is increasing competition among land uses. At the same time, unsustainable practices and climate change, exacerbated by weak systems for information and governance, threaten land productivity (FAO-EPIC 2013). In recent years, multilateral agencies and others have put forward the concept of 'climate-smart' agriculture (CSA) as an inherently multi-sectoral approach to synergistically achieve climate change adaptation, mitigation, and food security – a 'triple win' – while minimizing potential negative trade-offs. CSA is envisioned to support national food security and development through sustainable agricultural intensification, increased biophysical and socio-economic resilience, and net reduction in agricultural greenhouse gas (GHG) emissions (Branca et al. 2011).

In the absence of clear international policy signals and strong global agreements, countries are moving forward to test sustainability strategies through innovative policies and financing programmes. This paper explores how three countries – Brazil, Ethiopia, and New Zealand – are using integrated policy approaches to address the linked challenges of climate change, unsustainable agriculture, and food insecurity. To explore the major technical and institutional components that are fundamental to national CSA policy, each of these three countries are reviewed for their role in the global food and climate systems, their major national climate and agriculture policies, and their investments in capacity building and policy innovation.

'Climate-smart' agriculture at the national scale

While concepts are still evolving, national policy implementation of CSA is generally seen to include the following elements (FAO 2012a; FAO 2012b; FAO-EPIC 2013; Wollenberg et al. 2012):

1. Integrated, context-specific assessment of *drivers* of unsustainability and GHG emissions, potential CSA *interventions* – with emphasis on identifying synergies (e.g. diversified production and income sources) and trade-offs (e.g. biodiversity vs food production) – and major *barriers* to their implementation (e.g. weak information or legal systems);
2. Strengthening *institutions and infrastructure* that promote sustainable practices in farming, forestry, and fishing systems (e.g. cooperatives and community based initiatives), efficient, equitable food chains, and enhanced *governance* systems to manage common resources, strengthen land tenure, and improve ecosystem services;
3. Establishing a strategic framework for coordinating key actors (e.g. ministries, local governments, farmers, agribusinesses, international agencies) in development and implementation of *policy and market measures* (e.g. credit and market access) and *blended financing* sources (e.g. climate and development funds; public and private sources) to incentivize CSA practices (e.g. appropriate inputs) and to reduce and respond to disaster risk (e.g. insurance; social protection);
4. Building multi-scale capacity for *information systems* including research and development (R&D) (e.g. varieties and breeds suitable for future climate and vulnerable populations), advisory services (including risk assessment), information technologies, and monitoring and evaluation.

Many existing national policy goals and public programmes designed to increase agricultural production, improve livelihoods, and reduce environmental risks can become important pillars of a national CSA strategy. A review of pre-existing policies to identify necessary changes and investments is an important first step toward an integrated policy approach.

2. Brazil

Brazil in the global food and climate systems

With under 3% of the world's population living on just over 6% of global land area, Brazil's has a solid record of inclusive growth. Poverty levels have fallen from 20% of the population in 2004 to 7% in 2010. A major global producer and exporter of sugar, coffee, orange juice, soybean, beef, tobacco, ethanol, and broiler chicken, Brazil also provides ecological services of global importance (i.e. large biodiversity reserves; 13.5% of the world's potential arable land; 15.2% of the world's renewable water resources) (Pereira et al. 2012).

Impacts of climate change on Brazil

The Brazilian Amazon is a critical element of a stable global climate system and it stores 23% of the world's forest carbon, although large predicted increases in temperature and decreases in rainfall as well as more extreme weather events in the coming decades threaten the long-term viability of the Amazon forest (INPE-Met Office 2011; UNEP 2012; PBMC 2013).

Brazil is one of a handful of countries in the world that still has significant non-forested land with agricultural potential (e.g. cerrados). However conventional agricultural development of these areas would likely have negative effects on agro-pastoralists and biodiversity (Lambin and Meyfroidt 2011). Increases in Brazilian soybean production for global markets have contributed directly (e.g. conversion of forest to cropland in Mato Grosso) and indirectly (e.g. pasture land displacement into the Amazon) to deforestation in Brazil (Lambin and Meyfroidt 2011). Beef production represents 85% of Brazilian cattle (37% of this is in the Cerrado region). Extensive production is common and generates significant GHG emissions (IBGE 2006; Barioni 2013). Given legal controls on deforestation and competition with other land uses (e.g. croplands), intensification and improved productivity on degraded grasslands are projected to increase as demand for beef grows domestically and globally (Barioni 2013).

In 2005, Brazil was the fifth highest GHG-emitting country globally (World Bank 2011a). In 2010, Brazilian emissions represented 3.2% of the global total (UNEP 2012). Agriculture and deforestation cause the bulk of Brazil's domestic emissions – more than 70% of the total (World Bank 2011a) – and land use is projected to continue to be a major component (Soares Filho et al. 2011). With one of the largest bovine herds worldwide, methane emissions represent a significant component of Brazil's GHG emissions (La Rovere and Poppe 2012).

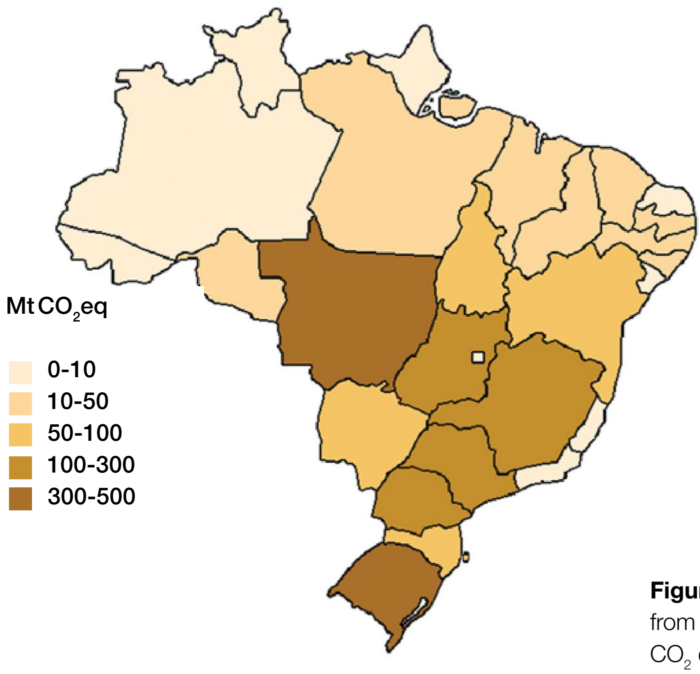

Figure 1. Total GHG emissions resulting from agricultural land use in Brazil, in CO_2 equivalent (millions of tons), by state (Soares Filho et al. 2011).

Potential agricultural mitigation opportunities in Brazil are estimated to be 134 to 163 million Mg CO_2e through a combination of improving low productivity grasslands, no-till agriculture, integrated crop-livestock-forestry, biological N-fixation, afforestation, and treatment of animal residues (Government of Brazil 2010; Barioni 2012). Higher productivity through broad adoption of intensive cattle ranching technologies on existing lands constitutes a major opportunity for reducing overall GHG emissions from Brazilian agriculture (Cohn et al. 2011). In a globalized food system, intensive agricultural production in Brazil (e.g. beef, soy, timber) can theoretically offset agricultural expansion in other places by helping to meet global food demand, thereby facilitating conservation of threatened forests and other natural lands (Lambin and Meyfroidt 2011).

As the host to the Rio Earth Summit and the first nation to sign the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, Brazil has actively engaged in international climate change dialogues. In 2009, the government voluntarily pledged to reduce national GHG emissions by 36 to 39% by 2020 relative to business as usual (La Rovere and Poppe 2012; UNEP 2012). Concerns about Brazil's ability to meet this pledge stem from data uncertainties for GHG emissions from land use (Roelfsema et al. 2013; Vieweg et al. 2012).

Major climate and agriculture policies

In **1999**, Brazil convened the Inter-ministerial Commission on Global Climate Change (CIMGC) to coordinate across government and to serve as the Designated National Authority (DNA), under the UNFCCC. In **2000**, the Brazilian Climate Change Forum, led by the President, was established to facilitate public, private, scientific, and civil society stakeholder engagement in climate change issues (La Rovere and Poppe 2012).

In **2000**, Federal Law 9.985 created the National System of Nature's Conservation Units (SNUC) (CPI 2012). In **2004**, Brazil implemented the inter-ministerial Action Plan for Prevention and Control of Legal Amazon Deforestation (PPCDAm). PPCDAm includes 200 initiatives for planning, sustainable use (including 35 million hectares designated conserved and indigenous lands), and monitoring of forested areas, targeted to regions experiencing high deforestation, supported by remote sensing and law enforcement for illegal logging (Evans 2013; Portal Brasil 2011; UNEP 2012). With leadership from the highest levels of government and participation across numerous ministries, PPCDAm takes an integrated approach to conservation with emphasis on territorial management, land tenure, monitoring, enforcement, and economic incentives for sustainable land use (CPI 2012).

In the **mid to late- 2000s**, over 180,000 square kilometers of federal and state areas in the Legal Amazon were given protected status and official recognition of indigenous lands was improved (CPI 2012). In **2007**, Presidential Decree 6.321 enabled legal action against municipalities with very high deforestation rates including denial of credit to a wide range of land use and commercial activities (CPI 2012).

In **2008**, the National Plan on Climate Change (NPCC) outlined society-wide actions focused on GHG mitigation, adaptation, research and development, and capacity building, assigning an ongoing coordinating role to the CIMGC. Late in **2009**, Congress and the President approved the National Climate Change Policy (PNMC) Law, which spelled out the voluntary target of 36 to 39% reduction in national GHG emissions by 2020. The National Climate Change Fund (FNMC, Federal Law nº12114) was created at the same time to provide loans and grants (up to €100 million per year) for implementation of climate change plans and policies (La Rovere and Poppe 2012). In 2010, Brazil outlined nationally appropriate mitigation actions (NAMAs) that it set as voluntary targets under the UNFCCC (Government of Brazil 2010).

Under the NPCC, the Sustainable Amazon Plan (PAS), and the National Water Resources Plan, cultivation of sugar cane is prohibited in protected areas such as the Amazon and Pantanal (World Bank 2011a). There is also an agro-ecological sugar caning law and an agro-ecological palm oil zoning law disallowing cultivation in degraded areas. These laws aim to manage competing land uses and address multiple objectives within and across the agricultural land, forest, water, and energy sectors (Meridian 2011).

In **2008**, under Resolution 3.545 of the National Monetary Council (CMN), new conditions were placed on rural agricultural lending by governmental development banks to all non-smallholders requiring proof that borrowers had complied with environmental laws and had proper land claims (CPI 2012). The Brazilian Development Bank (BNDES), which spends approximately USD 10B each year in the agriculture sector, restructured its lending guidelines to provide incentives for sustainability. BNDES requires lending to be conditional on satisfactory environmental protection measures which avoid deforestation and land and water pollution (Kissinger 2012; World Bank 2011a).

Brazil is supporting a suite of measures for land and water management and carbon sequestration such as the rural competiveness programme in Santa Catarina, Sao Paulo, and Rio (World Bank 2011a).

Agriculture sector

Beginning in the **1950s**, Brazilian policy promoted agricultural expansion, commodity export, and low domestic food prices (e.g. consumers paid ~50% less for food in 2011 than they did in 1975). Low food prices suppressed rural livelihoods and encouraged urban migration (Pereira et al. 2012). Recognizing the limits of continuous agricultural expansion, Brazil began to invest in modernizing the agriculture sector by subsidizing agricultural credit, increasing rural extension, and supporting R&D for regions with lower agricultural potential such as the Cerrado (Pereira et al. 2012). From **1976 to 2010**, production of sugar rose by 369%, ethanol by 4160%, grain and oilseeds by 240%, and sugarcane by 682%. From **1978 to 2010**, beef, pork, and poultry production grew nearly 500%. 'Land saving' effects of improvements in productivity are estimated at 525M hectares for beef and 78M hectares for grain, oilseeds, and sugarcane (Pereira et al. 2012).

In **2006**, 4.4M small family farms, representing 84% of all Brazilian farms, supplied the majority of domestically consumed commodities. These farms represented 74% of agricultural employment, but occupied only 24% of agricultural land. Concentration of land ownership and smallholder displacement in Brazil have increased,[1] spurred by public (e.g. subsidized credit for mechanization; investments in soy production) and private (e.g. dramatic increases in production; vertical integration) actions (HLPE 2011). Brazil has placed limits on land investments by foreign entities.

Consumers and conservation groups in export markets have pushed for supply chain moratoriums on Brazilian soy and beef produced on recently cleared land (Lambin and Meyfroidt 2011). The contribution of soy production to deforestation has declined following commitments by agricultural commodity traders to the **2006** Soy Moratorium that prohibits trading in soybeans grown in deforested areas (Rudorff et al. 2011; Kissinger 2012).

In **2009**, Law no. 12.187 enabled the formulation of sector-specific low-carbon development plans. It was followed by Federal Decree no. 7390 which outlined the suite of mitigation targets set under sectoral plans including (Kissinger 2012; La Rovere and Poppe 2012):

- 80% reduction in deforestation in the Amazon;
- 40% reduction in deforestation in savannahs;
- recovery of 15M hectares of degraded pastureland;
- establishment of integrated crop-livestock-forest systems on 4M hectares;
- low-till practices on 8M hectares;
- biological nitrogen fixation practices on 5.5M hectares;
- forest plantations on 3M hectares; and
- improved management of 4.4M cubic meters of animal waste.

Under the Ministry of Agriculture, a Low Carbon Agriculture Programme was established to support achievement of NAMAs in Brazil through information dissemination and other means. Launched in **2010** to support the agricultural sector plans through subsidized credit terms, the Low Carbon Agricultural Fund (LCAF) has not been well-used by Brazilian farmers and has been criticized for weakening standards (Angelo 2012).

Forest Code

With legal roots stretching back to the first half of the twentieth century, Brazil's Forest Code (Federal Law 4.771 in **1965**) provides for the maintenance of forest cover on private property in rural areas. Since 2001, it requires that 80% of original forest cover be retained on parcels in the Amazon region.[2] In 2012, the Forest Code was revised partly to recognize that pre-existing land uses were out of compliance (i.e. many parcels were more than 20% logged) and partly in response to pressures from the agricultural sector. The revision coincided with a decree compelling participation in a rural environmental registry to maintain eligibility for government support programmes. Creation of sectoral mitigation plans and the Low Carbon Agricultural Fund helped to neutralize opposition to the Forest Code.

Enforcement of the Forest Code

Enforcement of the Forest Code has required political will, institutional capacity, and technical resources such as satellite monitoring to detect illegal logging activities in near real-time (La Rovere and Poppe 2012; World Bank 2011a). While good spatial data is available for deforestation (Hansen et al. 2013), estimating changes in GHG emissions is challenged by incomplete data for biomass densities of different forests and savannahs (La Rovere and Poppe 2012).

In the last decade, Brazil has seen dramatic reductions in annual forest loss from a high of over 4M hectares in 2003 to less than 2M hectares in 2010 (Hansen et al. 2013). During 1996 to 2005, 1.95M hectares were cleared each year in the Amazon; in 2007 this rate was 1.2M hectares and 0.7M hectares in 2008. However, INPE reports that deforestation rates in the Amazon jumped 28% in 2013 (INPE 2014), and recent Forest Code reforms may constrain the policy drivers for forest protection (Barioni 2012; Evans 2013).

Biofuels

Established in the **1970s** in response to changes in international oil and sugar markets, the Brazilian Ethanol Program (Proalcool) sought to stabilize the country's energy supply. Proalcool originally targeted smallholder farmers and 'mini-distilleries', but subsequently ushered in large subsidies for ethanol production and consumption and R&D investments. Large-scale, capital-intensive agricultural sectors have been the primary focus for both Proalcool and the Brazilian Biodiesel Production Program (PNPB). PNPB was launched in **2004** officially to promote regional development through small-scale family farms, although smallholders

[1] Notably, there is a very active agrarian reform movement in Brazil that is calling on the government to provide unused lands to landless farmers.

[2] Historical evolution of the Brazilian Forest Code. Available at: http://www.canaldoprodutor.com.br/forestcode/time-line

have had limited involvement in the programme which has concentrated in wealthier regions (Maroun and Schaeffer 2012).

Compulsory addition of ethanol, combined with technology advances in **2003**, which enabled 'flex-fuel' motors, led to doubling of ethanol addition to gasoline in Brazil. This is generally seen as mitigating GHG emissions (except when biofuels are grown on converted natural land) even though this was not an original policy objective (Maroun and Schaeffer 2012). Brazil continues to underwrite its ethanol industry, which feeds both domestic and international markets (HLPE 2011). Over the next four years, USD 38B in subsidized credit will be made available (Murphy and Ewing 2012).

Financing

The Amazon Fund, established in **2009** with a USD 1B grant from Norway and managed by the Brazilian Development Bank (BNDES), will be supplemented by other international donors and is projected to receive USD 21B by **2021**. It has begun issuing grants to avoided deforestation projects in the Amazon (it does not generate offset credits; up to 20% of funds can support monitoring and enforcement) and will expand to include adjacent regions (La Rovere and Poppe 2012). The Amazon state, which has important economic activity through the free enterprise zone in Manaus, has a programme for small cash payments to small-scale landholders to maintain trees on their land ("forest guards").

The domestic carbon offset market in Brazil has remained small, private, and lacking in commercial standards and legal specifications. The **2009** Federal Decree no. 7390 enables establishment of a domestic carbon market in support of sectoral mitigation goals, but there has been little progress in this direction (La Rovere and Poppe 2012). As the third largest national host to Clean Development Mechanism (CDM) projects (mostly renewable energy and a few forestry projects), this form of financing is seen as important to achieving voluntary GHG reduction targets (La Rovere and Poppe 2012).

Historically low deforestation rates in the Brazilian Amazon (a 76% reduction since 2004 according to the Brazilian government) coincided with declining agricultural commodity prices (e.g. meat, soybeans). However rising price trends beginning in **2006** did not reverse the declining trend in deforestation indicating that policies had a major effect, which is estimated at 600M tons of carbon in avoided emissions from 2005 to 2009 (CPI 2012; UNEP 2012). The Climate Policy Initiative (2012) has concluded that, while changes in agricultural prices played an important role, environmental policies in Brazil avoided deforestation on 6.2M hectares in 2005-2009, half of the deforestation that would have occurred in the absence of these policies (CPI 2012).

Forest-based mitigation projects

Although the Reducing Emissions from Deforestation and forest Degradation (REDD+) mechanism is still being defined within the UNFCCC, Brazil has been at the forefront of experimentation with REDD-style forest-based mitigation projects including agricultural intensification to reduce deforestation pressure such as the "REDD for Amazon Smallholders" initiative, which engages 350 farm families in emissions reductions and regional land use planning (Martins et al. 2011). Experimentation with incentive-based avoided deforestation (e.g. REDD; payments for ecosystem services) suggests that it will need to be complemented by land tenure regularization and command-and-control approaches. The latter directly address illegal logging and land grabbing and may be more cost effective, but could also negatively impact social groups that are economically dependent on agricultural expansion (Börner et al. 2011).

Capacity building and policy innovation in Brazil

Research

Integrated strategies for agricultural mitigation and food security implemented by INPE (Instituto Nacional de Pesquisas Espaciais), Embrapa (Brazilian Agricultural Research Corporation), and related ministries have been recognized for utilizing:

- a multi-scale landscape approach (i.e. forests and agricultural lands),
- a full spectrum of technologies (e.g. mapping and estimating mitigation potential; tracking sectoral emissions against baselines),
- strategic planning and technical innovation (e.g. multi-cropping, pasture restoration),
- farmer incentives, and
- private sector engagement.

Public sector agricultural R&D has developed crop varieties, inputs, and practices suitable to tropical agricultural. This investment has been critical for the significant improvements in productivity and livelihoods achieved in areas with low agricultural potential as well as in making Brazil a major player in global food trade and enabling some reduction in agricultural expansion. The decentralized, specialized, results-oriented Embrapa model has emphasized human resource development (Pereira et al. 2012).

Monitoring and reporting

Brazil's activity under the UNFCCC has included robust, multi-institutional engagement in preparation of National Communications, which have pioneered methods for reporting of land-based emissions. Led by the Ministry of Science and Technology, Brazil produced its first National Communication to the UNFCCC in **2004**. This revealed the significant contribution of land use to national GHG emissions and catalyzed the eventual engagement of the agricultural sector in climate change mitigation. In **2010**, Brazil submitted a second National Communication to the UNFCCC. Using Intergovernmental Panel on Climate Change (IPCC)-adapted methods, GHG emission inventories are now prepared by several states and cities and the Brazilian Panel on Climate Change (PBMC) engaged 200 scientists to produce a 2012 Brazilian Climate Change Assessment Report. A number of large Brazilian enterprises have instituted internal climate change guidelines (La Rovere and Poppe 2012; PBMC 2013).

Modernization of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), the federal agency charged with environmental enforcement, and enforcement tactics (e.g. confiscation of illegal assets, area-based trade embargos, and liability extended up the supply chain and to local municipalities) have been important elements of forest protection strategies (UNEP 2012).

Brazil is a focus country for several international programmes designed to improve technical and institutional capacity for climate change related inventories. Operated by the World Resources Institute, the "Measurement and Performance Tracking (MAPT)" project supports the development of national monitoring, reporting and verification (MRV) systems for NAMAs in six partner countries and Brazil has one of five national teams working under the "Mitigation Action Plans and Scenarios (MAPS)" programme, which promotes scenarios and modeling in support of NAMAs (Hänsel et al. 2012).

Nutrition security

In **2006**, the National Food and Nutrition Security System was created by the Organic Law for Food and Nutrition Security which guarantees the human right to food. Cash transfers to support food access are distributed to highly vulnerable groups through the Bolsa Familia programme. In **2009**, this right was included via Article 6 in the Federal Constitution, in **2010** the National School Meal Program was given legal status, and in **2011** a report by the National Council on Food and Nutrition Security (CONSEA) unveiled a monitoring methodology for rights-based public programmes (HLPE 2012).

3. Ethiopia

Ethiopia in the global food and climate systems

The Federal Democratic Republic of Ethiopia is characterized by highly diverse ecosystems, culture, climate, and agriculture and high socio-economic dependence on its land resources (FDRE 2008). Ethiopia is undergoing a period of major economic growth and annual Gross Domestic Product (GDP) growth projections range from 8% (International Monetary Fund) to 11% (Ethiopian government) (Abebe 2012). Yet, of 84M Ethiopians, almost one third live below the poverty line (UNDP 2012). Over 84% of Ethiopians make their living through agriculture, which constitutes half of the country's GDP and more than 90% of Ethiopian exports.

As child mortality rates drop and life expectancy rises, pressure has grown to use more land for food production (Admassu 2012). Farming on marginal lands and inappropriate practices and technologies are widespread. Land degradation affects over 40M hectares and ~70% of Ethiopia's highland population. Each year, 1.9B tons of soil are lost to erosion, 110B cubic metres of water are lost as runoff, soil nutrient loss costs USD 100M, and net deforestation equals 0.2M hectares (Tadesse 2012). Massive rural community mobilization activities have been underway in the last few years to counter these trends and reclaim degraded lands, however the reduction in erosion loss has not been robustly quantified.

Very low agricultural productivity (i.e. 80% of cultivated land yields less than 1 ton/hectare, while the remaining 20% yields 1.5 tons/ hectare) contributes to food insecurity, poverty, low agro-biodiversity, and low resilience to weather extremes and economic shocks (Tadesse 2012). Significant extension efforts have helped to boost the nation's average cereal yield to nearly 2 tons/hectare. Ethiopia is home to more than 50M cattle and nearly 100M other livestock animals, which generate significant GHG emissions (65 Mt CO_2e in 2010, more than 40% of total emissions) especially methane and nitrous oxide (Abebe 2012). The main crops in Ethiopia are teff, maize, and wheat. (Admassu 2012). GHG emissions from crop production include ~10 Mt CO_2e per year from fertilizer use and ~3 Mt CO_2e per year from nitrous oxide emissions from crop residues (Abebe 2012).

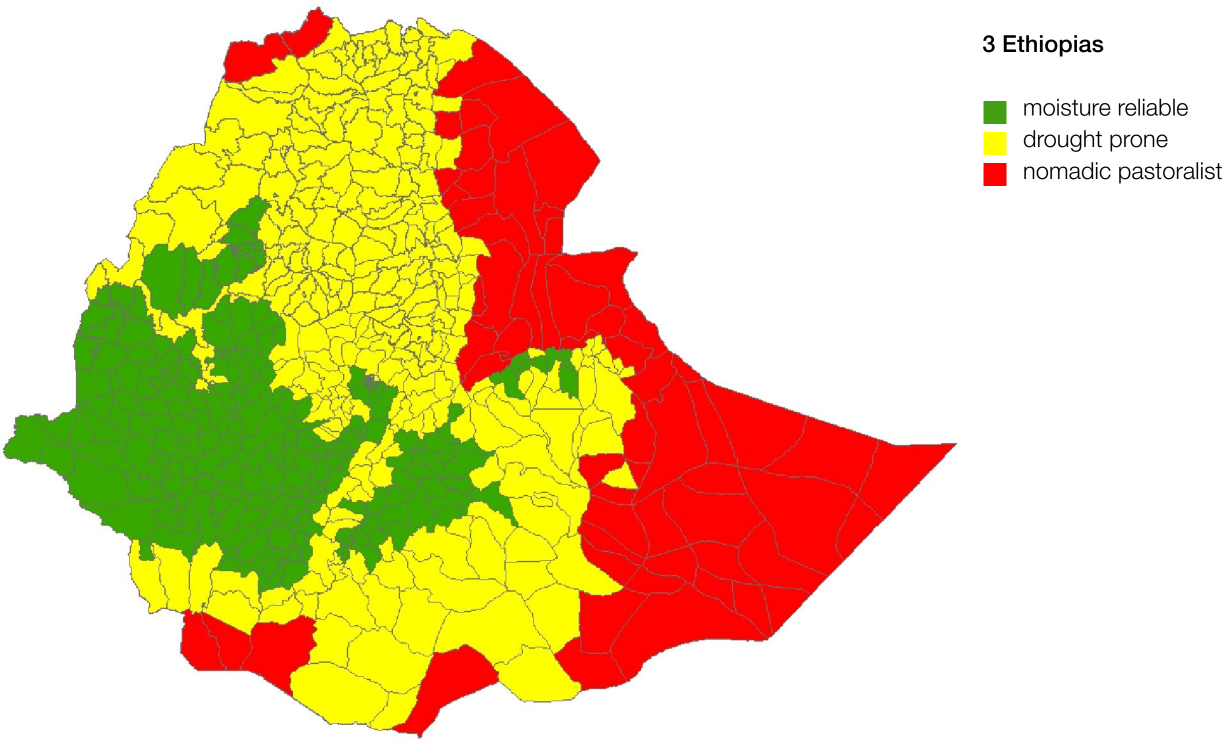

Figure 2. Main climatic zones of Ethiopia as designated by the Ministry of Agriculture and Rural Development based primarily on potential productivity and secondarily on species composition and plant community distribution (World Bank 2008).

Impacts of climate change on Ethiopia

Higher average temperatures and changing rainfall patterns are already affecting Ethiopia and persistent drought has exacerbated food insecurity and the need for international food aid (Miles 2014). Changes in temperature, in disease and parasite pressure, and in the quantity and quality of pastures will have direct and indirect impacts on livestock production and the pastoralist communities that depend on them (Abebe 2012). A regional climate impacts review by the IPCC highlighted threats to rainfed agriculture in Ethiopia from precipitation changes including the potential for greater soil erosion and crop damage in the event of intense rainfall. While different models have generated divergent climate change impact projections, there is evidence that heat stress and other factors are likely to reduce yields of wheat, an important food and cash crop (Admassu 2012). Like many lower-income countries, limited infrastructure and institutional capacity constrains Ethiopia's ability to adapt to climate change.

With an estimated potential hydropower capacity of 45,000 MW, Ethiopia has ambitions to generate 37,000 MW by 2037. With expanding plans for exporting electricity in the region, Ethiopia is establishing itself as a key regional renewable energy provider and solidifying an important source of hard currency. This is raising concerns about hydropower impacts, in combination with climate changes, on indigenous people and natural water bodies (Woldegebriel 2013).

The Ethiopian government has identified 3.6M hectares of rural land for agricultural investment. So far, only 470,000 hectares have been leased, mostly to foreign investors for industrial crop production. Although investment priority is given to local people, most are discouraged by the high capital requirements. As a result, these farmlands are increasingly leased out for large-scale commercial agriculture, often to investors from the Middle East, South Asia, and Europe, with some documented benefits for employment and business opportunities (Baumgartner 2013). There is also evidence of negative impacts of this practice. For example, a 12,000-hectare commercial agriculture lease, in place since 2008 in the Bako Tibe district of the Oromiya regional state, resulted in declines in income and food security for households, which lost access to customarily owned grazing and cultivation plots (Bekele 2013). Due to poor performance, about 200,000 hectares of the leased land have been retaken by the government.

Major climate and agriculture policies

Climate-Resilient Green Economy Strategy (CRGE)

Launched in **2011** at the 17th Conference of the Parties (COP-17) in South Africa, Ethiopia's Climate-Resilient Green Economy Strategy (CRGE) aims to achieve middle-income country status and resilience to climate change by **2025** through 'carbon-neutral' growth (FDRE 2011). Under the CRGE, Ethiopia will align bottom-up and top-down policies to ensure investment in high-quality infrastructure, sound institutions, sustainable and efficient resource management, open and competitive markets, and accessible financial systems (i.e. availability of credit) (Abebe 2012). The four CRGE pillars include (Abebe 2012; UNDESA 2012):

1. increased food security and farmer income and lower GHG emission through improved crop and livestock production practices;
2. improved economic and ecosystems services, including carbon sequestration, in forestry;
3. renewable and clean power generation; and
4. leapfrogging to modern and energy-efficient technologies in transport, industry, and buildings.

Development of the Climate-Resilient Green Economy Strategy

Development of the CRGE was guided by awareness of the significant negative environmental impacts (e.g. land degradation; doubling of GHG emissions to 400 Mt CO_2e in 2030) and natural resource constraints (e.g. carrying capacity for cattle) as well as financial challenges (e.g. cost of fuel imports) and technology 'lock-in' associated with a conventional economic development path (Abebe 2012). Recognizing the central importance of sustained high growth rates in agriculture for food security and the Ethiopian economy, the CRGE encourages greater productivity of farmland and livestock instead of agricultural expansion or increasing livestock numbers.

The 20-year CRGE strategy will require USD 150B allocated roughly equally toward capital and operational expenses. At an annual cost of USD 7.5B, the CRGE will be approximately 25% of Ethiopia's annual GDP (UNDESA 2012). The CRGE strategy is focused on mobilizing international climate finance from both public and private sources (FDRE 2011; UNDESA 2012). These will include development grants and 'pay-for-performance' GHG mitigation deals (through bi- and multilateral arrangements) and sale of emission credits in offset markets such as the CDM, Emissions Trading System (ETS), and voluntary carbon markets (UNDESA 2012). The United Nations Development Programme (UNDP) plans to establish a Multi-Donor Trust Fund within the Ministry of Finance and Economic Development, MoFED (UNDESA 2012). Ideally, climate finance will be complemented by investments in infrastructure, energy, and other 'green' development activities (Abebe 2012).

Technical and inter-ministerial bodies informed and guided the CRGE strategy design and have been given key implementation roles. In September **2012**, a national CRGE Facility, charged with engaging stakeholders and channeling finance, was officially launched (Abebe 2012). The Ethiopian government has given overall responsibility for CRGE to the Environmental Council, which is chaired by the Prime Minister and has representation by federal ministries, presidents of national regional states, and non-governmental entities (e.g. trade unions; private sector groups). Under the Environmental Council, there is a Ministerial Steering Committee, a Technical Committee and eight sectoral subcommittees (UNDESA 2012). The Ethiopian Ministry of Environment and Forestry (MoEF) and Ministry of Finance and Economic Development (MoFED) share responsibility for administering the CRGE and its governing subsidiary body. By partnering with different institutions on technical training in support of the CRGE (i.e. GHG inventories, baseline assessment, methodology for adaptation and mitigation), the government of Ethiopia built broad-based capacity through the CRGE design process (Abebe 2012).

Agriculture is one of six 'green economy' sectors included in the CRGE strategy, based on a study undertaken for Ethiopia by the Global Green Growth Institute (GGGI) and Ethiopian Development Research Institute (EDRI) (Abebe 2012; UNDESA 2012). Livestock, soil, and forestry initiatives, which represent more than 80% of the estimated 255 Mt CO_2e abatement potential in the CRGE, will be the responsibility of the Ministry of Agriculture (MoA). Soil initiatives emphasize improved management of water, nutrients, crops, and residues. Forestry initiatives include afforestation and reforestation as well as efficient fuelwood stoves. Livestock initiatives emphasize stabilizing herd sizes, increasing cattle value chain efficiency (e.g. dairy cooperatives), promoting poultry consumption, and mechanization.

The CRGE strategy provides a mechanism for 'fast tracking' high priority projects (e.g. livestock efficiency, forest restoration). Of 150 candidate green growth initiatives, 60 have been included in the CRGE strategy based on three criteria:

1. relevance and feasibility in local contexts;
2. potential to contribute to targets in the national five-year Growth and Transformation Plan (GTP); and
3. cost-effective abatement potential (UNDESA 2012).

The GTP, spanning **2010 to 2015**, plans for 11 to 14% growth for the economy as a whole and doubling of agricultural production from 2010 to 2015.

Under the CRGE, efforts to reduce deforestation and soil-based GHG emissions will emphasize implementation of low-emission crop production techniques (e.g. efficient crop cultivars, organic fertilizers) and constraining expansion of agricultural land through improved management of inputs and residues and reclamation of degraded cropland through irrigation (Abebe 2012). Increased productivity and efficiency in the livestock sector will be pursued by improving animal health, growth, and marketing, encouraging lower-emitting protein sources (e.g. increasing poultry consumption by 30%), replacing draft animals with mechanical equipment (where this results in net reduction of GHG emissions), and managing rangelands to increase productivity and carbon content (Abebe 2012).

Over the next 5 to 10 years, "no and low regrets" actions to respond to climate variability will include baseline mapping of agro-climatic zones and regional adaptation plans. Medium-term (i.e. 5 to 15 year) strategies for increasing climate resilience will focus on vulnerability analysis (i.e. climate hazards, affected groups), integrating climate risks into growth and sector development plans, and enhancement of knowledge bases and institutional capacity. Planning for climate resilience in 2025 and beyond will emphasize analysis of climate change scenarios (including risks to agriculture, the food chain, livelihoods, and the macro-economy) and synthesis of climate-resilient development pathways (Abebe 2012).

Productive Safety Net Program (PSNP)

In **2005**, in pursuit of the Millennium Development Goal for reducing poverty and hunger, the Ethiopian government launched a nationwide food security programme and the Productive Safety Net Program (PSNP), one of the largest social protection schemes in Africa. Targeted to areas that had received continuous food aid, the PSNP has provided cash and in-kind transfers to 8 million chronically food-insecure Ethiopians in 7 of 10 regions (HLPE 2012). Most PSNP beneficiaries receive support in exchange for contribution to public works projects such as establishment of area enclosures, woodlots, hillside terraces, and water systems (World Bank 2011b).

The PSNP has been successful in achieving food self-reliance for 1.4M households, reducing degradation of millions of hectares of land, and enhancing household and community assets. This has helped households reduce their need to sell land and livestock, to prematurely harvest crops, to migrate for low-paid work, or to take on loans in order to meet food needs (Slater et al. 2006). The PSNP has also been instrumental in maintaining food access in drought-affected areas (HLPE 2012).

Managing Environmental Resources to Enable Transitions to more sustainable livelihoods (MERET)

By engaging food-insecure communities in landscape rehabilitation in six regions of Ethiopia, the MERET programme works to increase incomes and community resilience to weather extremes and economic shocks (WFP 2012). Operated by the United Nations World Food Programme and the Government of Ethiopia, the MERET programme (Dieng 2012; WFP 2012):

- supplies 3 kg of cereal per workday to each participant for up to three months;
- provides equipment and technical guidance for projects that improve water and soil resources in degraded areas, such as, tree planting, terracing, well building, and rainwater harvesting;
- supports income generation through horticulture, beekeeping, livestock production, and other activities; and
- emphasizes appropriate technology, social transfers, and community ownership.

Since **2003,** more than 300,000 hectares have been rehabilitated and food security has increased by 50% in participating communities (Dieng 2012). MERET has contributed to improvements in environmental services (e.g. reliable sources of irrigation water, increased cultivable area) and diversification of agricultural products, livelihoods, and diets (WFP 2012). Renamed MERET PLUS (MERET through Partnerships and Land Users Solidarity) in **2007**, programme emphasis shifted to community-driven enhancement of biophysical and social assets, diversification, technical innovation, and empowerment of women.

Community Based Participatory Watershed Development (CBPWD)

To increase the effectiveness of piecemeal efforts by different agencies to reduce land degradation, in **2005**, the Ethiopian government, under MoA, launched the Community Based Participatory Watershed Development (CBPWD) strategy (Abebe et al. 2005). The CBPWD became the official framework for all related programmes (e.g. PSNP, regional state programmes) and efforts by communities, technicians, and experts working to rehabilitate degraded lands in support of rural livelihoods, water resources, and biodiversity. It has been adopted by many stakeholders and has also influenced the implementation of the PSNP, particularly for efforts to build community assets.

With funding from the World Bank and Norway, the Sustainable Land Management Program (SLMP) was devised to complement the CBPWD by encouraging scaling up of successful strategies for improving smallholder productivity and reducing degradation in agricultural landscapes. Five major targets have been selected for SLMP (Tadesse 2012):

1. SLM practiced on ~140,000 hectares of communal and individual land in designated watersheds;
2. 60% of targeted households have increased productivity for dominant crops and livestock;
3. 96,000 households are assisted with SLM practices resulting in 60% adoption rate;
4. 43% of development agents and 70% of *woreda* experts surveyed use SLM information from the MoA knowledge management system in project areas; and
5. a base map of normalized difference vegetation index (NDVI) created for intervention areas and used to assess percentage change at the watershed scale (Tadesse 2012).

SLMP implementation has been supported by development of a manual, community-level training, a monitoring and evaluation framework, and baseline information (i.e. soils; socio-economic conditions). Improvements in the enabling environment include expanded participation, technical support and financing from partners and stakeholders, and increased community awareness and enthusiasm (Tadesse 2012).

Strategic Investment Framework for Sustainable Land Management (ESIF-SLM)

Launched in **2009**, the Ethiopian Strategic Investment Framework for Sustainable Land Management (ESIF-SLM) was developed by MoA with stakeholder support, as an alternative vehicle for scaling up best practices through multi-sectoral partnerships and harmonized investments (FDRE 2008). Coordination of the ESIF occurs through a Steering Committee (composed of high-level ministry officials and a donor representative), a Technical Committee (composed of mid-level ministry officials and development partners), the SLM Secretariat, and regional and *woreda* level SLM platforms (FDRE 2008).

Under ESIF-SLM, a wide range of traditional practices (many in existence in Ethiopia for over 400 years) and modern land management practices have been documented and screened, resulting in a defined set of sustainable, effective and scalable techniques (Tadesse 2012). Examples include gully rehabilitation, livestock enclosures, agroforestry, use of nitrogen-fixing vegetation, and compost application (Tadesse 2012).

REDD+ and Forest-based Mitigation

In November **2012**, Ethiopia received a USD 3.4M REDD+ readiness grant from the World Bank's Forest Carbon Partnership Facility (FCPF)[3]. As a component of the CRGE strategy, development of a national REDD+ programme is anchored in Participatory Forest Management (PFM), which emphasizes decentralization and community engagement in monitoring and safeguard reporting (Boyle and Murphy 2012). Conventional measurement methodologies have been integrated with community-based participatory monitoring and local patrolling and assessment. This has contributed to reductions in illegal grazing and logging and increased forest regeneration and biodiversity (Boyle and Murphy 2012).

Ethiopia is home to the first forestry project in Africa to be awarded temporary Certified Emission Reduction credits under the United Nations Clean Development Mechanism (CDM). Through the Humbo Assisted Natural Regeneration project, managed by World Vision Ethiopia, reforestation on nearly 3,000 hectares has generated 73,000 tCERs, which have been purchased by the World Bank's BioCarbon Fund[4]. Project participants are using farmer-managed natural regeneration (e.g. resprouting of native species, limiting cattle grazing) in lieu of traditional land uses such as fuel collection (World Bank 2012). Project management is intended to transition from World Vision to the Farmers' Forest Cooperative Union. Supported by a technical team and a local government office, this organization aggregates smaller community forest development cooperative societies and assists them with institutional governance, land tenure rights, and financial management (Shames et al. 2012).

Capacity building and policy innovation in Ethiopia

Policy reform and gender equality

Since **2003**, land registration in Ethiopia has been managed at the community level. Findings from the Ethiopian Rural Household Survey (ERHS) indicate that this has contributed to increased awareness of the land registration process among women, especially when women are represented on the local Land Administration Committee (LAC). Together with changes in the Family Code in **2000**, increased awareness of land registration has shifted perceptions toward more equal division of land and livestock among divorcing spouses (Kumar and Quisumbing 2012). Government training and deployment has resulted in tens of thousands of rural health extension agents teaching rural women about improved nutrition, health, and family planning.

[3] http://www.forestcarbonpartnership.org/fcp/ET
[4] http://blogs.worldbank.org/climatechange/how-small-grant-helped-lead-way-greener-landscape-humbo-ethiopia

In **2006**, the Government of Ethiopia published a progressive land administration and use proclamation. This policy secured farmers' ownership and use rights for rural land and specified equal land ownership rights for women, leading to official land titles for hundreds of thousands of female-headed households. These titles have become an important form of collateral for government-sponsored micro-lending (Gebeyehu 2013). Women's food security has also benefited from cooperatives and micro-enterprises, which give them access to credit to undertake income-generating activities. Household surveys in the Tigray region (1998-2010) indicate that land certification contributed to enhanced calorie availability, especially in female-headed households (Hosaena 2013).

Soil fertility mapping

As an investment toward improved agricultural extension and smallholder productivity, the Ethiopian Soil Information System (EthioSIS) was initiated in **2011**. A National Soils Database (NSD) and soil fertility map of Ethiopia is being developed, through a combination of remote sensing and in-field sampling, to determine soil nutrient deficiencies and develop tailored fertilization regimes (ATA 2012). To address high dependence on imported fertilizers, in **2012**, the Ethiopian government launched the establishment of three diammonium phosphate (DAP) and five urea fertilizer production plants; the first of these will start production by **2015**. The NSD and soil fertility map, together with major new fertilizer demonstrations conducted in Ethiopia between 2011 and 2013, prompted MoA to endorse the dissemination of six new fertilizer types (primarily blends) that complement DAP and urea, which are already in use in the mapped areas, beginning in **2014**. Four fertilizer blending plants are also being established under the ownership of cooperative unions (Prof Tekalign Mamo, personal communication).

Index insurance

Through an international partnership that is fostering the rural commercial insurance market in Ethiopia, a pioneering weather-based index insurance programme, using satellite-based rainfall estimates, has awarded payments for drought-induced crop loss to over 12,000 Northern Ethiopian farmers. Begun in **2009** as the Horn of Africa Risk Transfer for Adaption Program (HARITA), the renamed R4 Rural Resilience Initiative enrolled 18,000 households in **2012** and enables farmers to cover part of their insurance premium cost with labor (IRI 2012).

NAPA projects

Under the UNFCCC, developing countries can develop national adaptation programmes of action (NAPAs) to guide near-term responses to climate change[5]. Ethiopia has initiated NAPAs that test a range of strategies including crop insurance, early warning systems, a climate change R&D center, efficient use of water and wetlands, pasture management, carbon sequestration, disease prevention and agroforestry (UNFCCC 2012).

[5] http://unfccc.int/national_reports/napa/items/2719.php

4. New Zealand

New Zealand in the global food and climate systems

New Zealand is a geographically isolated island nation of 4.4M people with highly diverse climate zones. Farming is predominantly pastoral and rainfed with an increasing role for horticulture. Of total land area, 39% is in pasture, 1.6% in horticulture and cropping, and 6.6% in planted production forest (New Zealand Government 2007).

Most agricultural products are exported and must be transported long distances. New Zealand represents 6% of world production of sheep meat, but 75% of global trade. New Zealand represents 3% of world dairy production, but 33% of global trade. The United Kingdom was an important and reliable market until it joined the European Community, catalyzing policy experimentation in New Zealand including in agricultural subsidies. In 2008, New Zealand's trade context changed with the signing of a free trade agreement with China. The New Zealand government puts major emphasis on biosecurity policy to maintain low pest and disease burdens (Montgomery and Melville 2012).

Impacts of climate change on New Zealand

Increasing variability in temperature, precipitation, and seasonality, especially in dryland pastoral and arable sectors, is anticipated to result in yield increases in some years and unprecedented production downturns in other years. Costs associated with weather extremes are forecast to rise. There is concern and uncertainty regarding cumulative impacts of back-to-back climatic events on production and infrastructure, pest and disease outbreaks, and supply shocks (Clark et al. 2012). However, New Zealand's adaptive capacity is supported by existing technologies and management practices for crop and livestock production (Dynes et al. 2010).

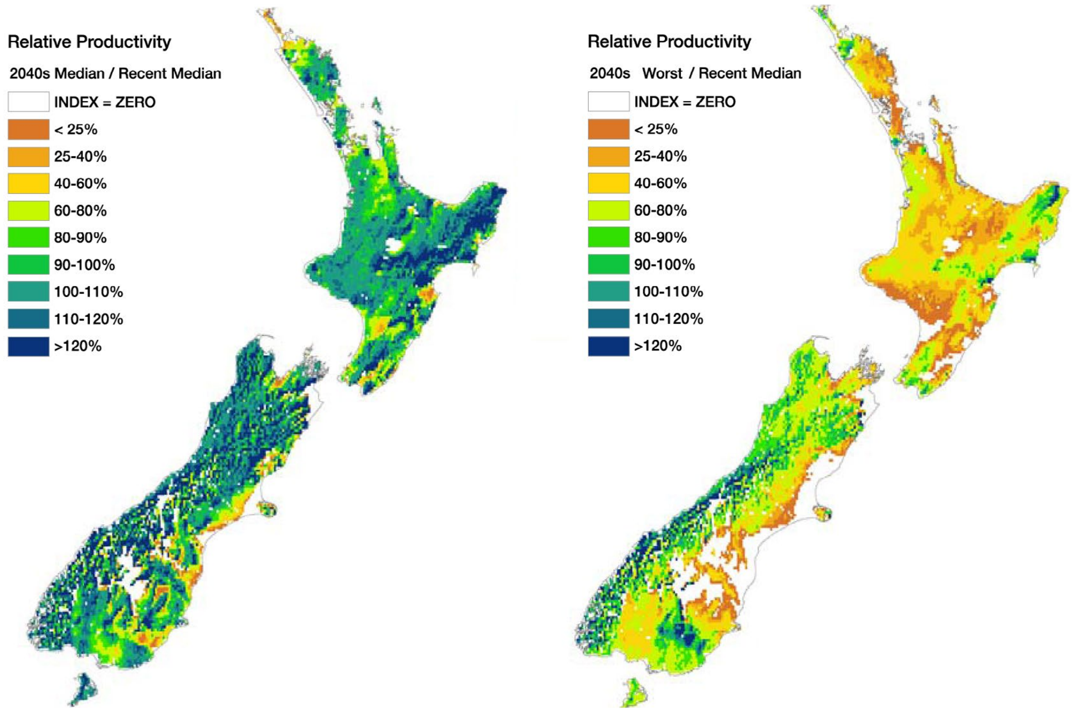

Figure 3. Relative agricultural production projections for the period 2030-2049 in New Zealand based on IPCC AR4 models and metabolizable pasture growth estimates for: (a) median year, and (b) worst year (Wratt et al. 2008).

Agriculture contributes 47% of national GHG emissions and since 1990 agricultural emissions have increased by 9%. Over the 1990 to 2010 period, emissions intensity in the agricultural sector has been reduced: lamb by -37%, beef by -28%, and milk by -19% (Montgomery and Melville 2012). In comparing net GHG emissions from production and transport for dairy, lamb, and apples, "emissions were lower when produced in New Zealand and transported by sea to the United Kingdom than when produced in the United Kingdom. The length of time that food is stored prior to retail can add substantially to GHG emissions (Kasterine 2010)."

Agriculture and forestry activities currently "offset" a sizable proportion of New Zealand's total emissions, but the land sector is projected to become a net source of GHGs as the nearly 2M hectares of plantation forests move into a harvesting period (which would be followed by another replanting period).

In 2002, New Zealand ratified the Kyoto Protocol, taking on an obligation to reduce GHG emissions back to 1990 levels. To meet Kyoto obligations in the first commitment period (2008-2012) and beyond, the government has developed and revised various policy packages.

Major climate and agriculture policies

Agricultural subsidies

Since the **1960s** when agricultural subsidies were almost non-existent, New Zealand's policy has undergone dramatic shifts (Montgomery and Melville 2012). In the **1970s**, subsidies were implemented to protect producers from overseas shocks and agricultural policy was directed toward increasing production levels. During **1980-84**, the level of subsidies was further increased to compensate for high costs and low commodity prices. In **1984**, most agricultural subsidies were withdrawn and agricultural policy shifted to emphasize increasing efficiency and allowing the sector to respond to market signals. As of **2010**, New Zealand has the lowest level of agricultural support among developed nations at 1% compared to Australia (4%), USA (9%), the Organization for Economic Co-operation and Development (OECD) average (22%), and the European Union (23%) (OECD 2010).

A combination of deregulation and withdrawal of subsidies has been considered effective and, at this point in time, there is strong political support for the shift away from subsidies. Over time, productivity and GHG emissions intensity in the agricultural sector have improved. For example, removal of lamb subsidies led to management changes and adoption of technologies (e.g. pregnancy testing in ewes to increase lamb production). Compared to 1990, New Zealand sheep farms in 2009 produced slightly more lamb meat, but from a 43% smaller flock (Montgomery and Melville 2012).

Emissions Trading Scheme (ETS)

In **2008**, New Zealand's Emissions Trading Scheme[6] (ETS), a price-based mechanism for GHG emission reduction covering all emitting industries and sectors, was implemented. New Zealand was the first country to include agriculture and forestry in its emissions trading scheme and the agricultural sector is currently obligated to report GHG emissions. The ETS uses self-assessment for monitoring, reporting, and verifying emissions.

Under the ETS, all sectors except agriculture must surrender New Zealand Units (NZUs) to match their GHG emissions by the end of **2013**, but may buy NZUs from the government for a fixed price of New Zealand Dollar (NZD) 25 or from domestic and international carbon markets at market prices. The forestry sector will receive NZUs for increases in forest carbon stock, but must surrender NZUs (one for every ton) if carbon stocks fall (e.g. due to harvesting or burning). Other sectors currently surrender only one NZU for every two tons of emissions produced.

Recognizing that farmers will already incur higher costs as obligations for emission reductions in fuel and electricity are implemented, a requirement for farmers to surrender emissions credits under the ETS may only be introduced if agricultural emissions reduction technologies are available and New Zealand's trade partners make more progress on tackling their emissions in general.

While there is currently a lack of mitigation technology for agriculture, the ETS gives a long-term signal to the agricultural sector and requires farmers to gain experience in reporting agricultural GHGs (Montgomery and Melville 2012). The government of New Zealand has increased support for farm energy audits and energy efficiency planning and has provided support to rural renewable energy through use of unused forestry residue and development of biomass for biogas facilities (Andrew 2012).

Adverse Event Policy

New Zealand experienced several major adverse events in recent years. The 2007-08 drought had an economic cost of NZD 2.8B representing 1.5% of total GDP. Severe floods impacted the Manawatu region in 2004, the Bay of Plenty in 2005, the Wairarapa region in 2006, Hawkes Bay and Clutha, Northland in 2007, the Huranui region in 2008, and the Southland region in 2010 (Montgomery and Melville 2012).

[6] http://www.climatechange.govt.nz/emissions-trading-scheme/about/questions-and-answers.html

Several studies have assessed likely climate change impacts in New Zealand. The **2008** EcoClimate Report produced by the Hadley Centre in the United Kingdom used the HadCM2 model to derive impacts on pastoral production, finding that droughts are likely to become more frequent (Wratt et al. 2008). In **2012**, a report on "The Impacts of Climate Change on Land-based Sectors and Adaptation Options" evaluated possible farmer responses to a changing climate by modeling representative farms across all major production groups including dairy, sheep, beef, broad acre cropping, apples, kiwifruit, wine, and forestry (Clark et al. 2012).

New Zealand has a national Adverse Event Policy that is intended to achieve a more objective response to floods, droughts, and other weather-related impacts. While recognizing that social and financial assistance is needed in extreme and unpredictable circumstances, the policy is designed to be a last resort that does not remove incentives for climate risk mitigation efforts by farmers (e.g. retirement of drought and flood prone land).

Discouraging maladaption

By adopting a policy stance in which the government does not automatically pay for reconstruction, New Zealand seeks to discourage maladaptation in the agriculture sector (Montgomery and Melville 2012).

The Adverse Event Policy sets out objective criteria and allowable responses for small, medium, and large scale events and establishes a 'buffered' decision process (e.g. the national cabinet needs to declare a large scale event). Criteria are related to the availability of risk management options for farmers, the likelihood of an adverse event, the scale of physical impact, and the degree of economic and social impact. For an adverse event that is deemed to be small scale, farmers can delay tax payments related to forced sales of livestock and receive other forms of assistance related to farm employees. For medium scale events, farm owners can receive welfare payments (i.e. 75% of unemployment benefits) and financial and technical advising. For large scale events, special recovery measures provide for 50% reimbursement to farmers for restoration of uninsurable infrastructure, re-establishment of pasture and forests, and assistance with assessing and restoring affected areas. Since 1984, only three large-scale events have been declared by the national cabinet.

Regional initiatives in New Zealand

The Resource Management Act (RMA) enables local government to implement a nutrient trading programme in one region of New Zealand. The Taupo Nutrient Trading[7] programme is a cap-and-trade scheme designed to reduce agricultural nitrogen load to Lake Taupo by 20%. The Lake Taupo Protection Trust administers an NZD 81.5M fund to protect lake water quality and will purchase nitrogen discharge allowances (NDA) and/or farmland. Initial allowances are allocated based on stocking rates, meat and wool production, fertilizer use, and other parameters (Montgomery and Melville 2012).

The Horizons One Plan in the Manawatu-Wanganui region implements an integrated planning approach for dealing with water quality and use issues, erosion, and biodiversity with clear connections between air, land, water, and coastal resource management (Horizons Regional Council 2012). This initiative represents a more holistic policy approach for climate change and agriculture with private sector collaboration (Montgomery and Melville 2012).

Private sector partnerships

In New Zealand, farmers' groups have made tangible investments in research on productivity and climate change mitigation through a number of initiatives in which government and the agriculture sector each contribute 50% of the funding support. During **2002-2012**, the Pastoral GHG Research Consortium invested NZD 45M in developing methane and nitrous oxide mitigation technologies representing the most comprehensive approach to pastoral livestock globally and the first effort to map the rumen methanogen genomic sequence (Montgomery and Melville 2012). Through Pastoral 21, five pilot farms across New Zealand will demonstrate through farmer field days how improved genetics can achieve a NZD 110 increase in profitability and a 20% increase in production per hectare as well as a 30% reduction in nitrogen and phosphorus loss.

The Primary Growth Partnership (PGP) invests in research and innovation to boost the economic growth and sustainable productivity of New Zealand's primary, forestry, and food sectors. Projects have focused on integrating value chains for dairy and red meat and innovating steep-land plantation harvesting. (Andrew 2012; Montgomery and Melville 2012). A PGP-funded assessment tool for nitrogen and GHG loss that has been tested on over 200 dairy farms is now being disseminated by a private company, Fonterra, to more than 90% of New Zealand's dairy producers. Fonterra has hired over 20 Sustainable Dairy Advisors to help farmers to understand model results and implement improved nutrient management practices.

[7] https://www.niwa.co.nz/sites/default/files/import/attachments/trading.pdf

Capacity building and policy innovation in New Zealand

Domestic research investments

New Zealand has been a world leader in developing feasible technologies and practices to reduce agricultural GHG emissions. The Plan of Action for Sustainable Land Management and Climate Change (SLMACC) is a partnership among land managers, Māori, and local government to address agricultural GHG emissions reduction, management of deforestation and carbon sinks in forests, and estimation of and adaptation to climate change impacts (Andrew 2012; Montgomery and Melville 2012). Integrated public-private strategies for adaptation, mitigation, and agricultural business development will be achieved through a combination of government investment of over NZD 175M in a variety of climate change initiatives for the agricultural sector and joint work programmes for forestry, agriculture, horticulture, and arable farming sectors developed by agriculture stakeholders (New Zealand Government 2007).

Launched in **2010**, the mission of the New Zealand Agricultural GHG Research Centre (NZAGRC) is "to provide knowledge, technologies, and practices which enable agricultural activities to continue to create wealth from agriculture for New Zealand in a carbon constrained world." Funded by the New Zealand government (NZD 48.5M over 10 years), the NZAGRC harmonizes the activities of numerious research institutes which had been in increasing competition for research funding and aspires to become a major international research center for agricultural GHG mitigation (Montgomery and Melville 2012). With a **2012** budget of almost NZD 5M, NZAGRC is mobilizing over fifty lead scientistis and an array of postdoctoral and graduate students to develop solutions for methane and nitrous oxide emissions, soil carbon storage, and low-emissions farm systems design (NZAGRC 2012).

Agriculture has a strong presence in New Zealand's tertiary institutions and, in **2010**, 6% of tertiary graduates were in agricultural or veterinary courses. There are a variety of agricultural learning centers in New Zealand (the largest are located in Lincoln, Massey, and Taratahi) and farmers have ample opportunity to take advantage of training such as 'short courses' in nutrient management. The government no longer provides a public rural extension service, however, it is estimated that, through private sector organizations, there is one rural professional for every 23 farms in New Zealand (Montgomery and Melville 2012).

International research leadership

Within the UNFCCC, New Zealand has advocated for attention to agriculture (both adaptation and mitigation) and for building a robust scientific foundation for policy (Montgomery and Melville 2012). In **2009** at COP-15, New Zealand initiated the concept for the Global Research Alliance on Agricultural Greenhouse Gases (GRA) and has since served as a chair for the Alliance Council and continues to host the Secretariat. The voluntary GRA network is open to any interested government. More than 40 member countries are collaborating and investing in research on agricultural productivity and GHG emissions reduction through five scientific groups: paddy rice, livestock, croplands, soil carbon, and inventory and measurement (Andrew 2012; GRA 2011; Meridian 2011). The GRA platform enables shared research that reflects the global diversity of crop types and management practices and their interaction with livestock production and agroforestry (GRA 2011).

Beginning in **2011**, a partnership among New Zealand, the Inter-American Development Bank (IADB), and the Regional Fund for Agricultural Technology (FONTAGRO) is implementing a collaborative climate change mitigation project with five countries where livestock agriculture is a major contributor to GHG emissions: Argentina, Chile, Colombia, the Dominican Republic and Uruguay (IADB 2011). New Zealand and FONTAGRO are now embarking on two additional projects: one with Colombia, Peru, Ecuador and Bolivia that focuses on dairying in the Andes; and another on silvo-pastoral systems in Central America with Costa Rica, Panama, Nicaragua and Honduras. Anchored in the GRA, these projects and the partnership will build capacity for livestock mitigation research and strengthen research networks in the Latin American and Caribbean region.

5. Lessons from three national examples

Progress toward integrated national policy approaches to CSA

Recognizing the linked threats of climate change, unsustainable agriculture, and food insecurity to their national wellbeing, Brazil, Ethiopia, and New Zealand have explicitly pursued integrated policy approaches for agriculture and related sectors. These three countries differ dramatically in the size of their populations, economies, and land base, as well as their farming systems and political structures, yet for all three, agriculture is a critical component of international trade, climate change mitigation potential, and national culture. All three countries are pursuing agricultural development that relies on greater crop and livestock productivity rather than agricultural expansion or increasing livestock numbers.

In the case of **Brazil**, a nation that has experienced dramatic socio-economic and environmental changes in recent decades and is a major player in international commodity markets and policy processes, a series of national policies have demonstrated a genuine stewardship commitment for globally significant carbon and biodiversity reserves (e.g. PPCDAm; Forest Code). Catalyzed by a national pledge to the UNFCCC and numerous domestic legal and financial mechanisms designed to reduce GHG emissions from land use, Brazil is pursuing a diverse set of climate change mitigation opportunities that emphasize sustainable agricultural intensification. As a major food exporter, signals from international markets regarding environmental concerns (e.g. deforestation in the Amazon region) have helped to shape agricultural sector policies and research agendas. As a global leader in R&D, Brazil has built an impressive knowledge base, which has been combined with technology (e.g. monitoring and enforcement innovations) and policy (e.g. sectoral plans, financing, lending restrictions) to promote more sustainable, higher-yielding production practices. Brazil has seen deforestation rates in the Amazon reach historically low rates, aided by presidential leadership, an integrated forest conservation strategy that engaged 14 ministries and multiple stakeholders, large-scale support by global donors, and a mix of policy measures that included both restrictions (including new laws and enforcement of existing laws) and incentives (UNEP 2012). To achieve broad adoption of CSA, Brazilian policy makers will need to continue to counteract the legacy of historical land use and agricultural commodity policies and revise contemporary policies that encourage extensive production methods and low agricultural investment. At the same time, policies will need to respond to pressing economic and social development needs and continue to link agriculture and climate change policies to food security.

In the case of **Ethiopia**, a nation with high economic growth rates and the potential to be a major regional hydropower supplier is already experiencing climate changes that threaten food security for millions of people and faces an urgent need to tackle low agricultural productivity, land degradation, and poverty while also reducing GHG emissions from its large livestock sector. With the Climate-Resilient Green Economy Strategy, Ethiopia has signaled its intention to effectively marshal national and international funds toward an integrated approach to low-carbon development anchored in sustainable agricultural intensification. Processes for operationalizing the CRGE Strategy strongly emphasize a multi-scale 'whole of government' policy design and multi-sector coordination on climate change and agriculture. As a global leader in testing and scaling up community-based development programmes that link food security safety nets, land restoration, and enhancement of productive assets (i.e. PSNP, MERET, SLMP), Ethiopia has attracted support from global donors by developing tangible targets, staged implementation plans, and mechanisms to encourage scaling up. To increase agricultural productivity, Ethiopia has made investments in soil mapping, tailored fertilization regimes, and domestic fertilizer supply and has also promoted both traditional and 'modern' farming methods and created mechanisms for evaluating their efficacy. Empowerment of women has resulted from a combination of policy shifts in land ownership and use rights, government-sponsored micro-lending, and nutrition and health education programmes. To build on successful, participatory programmes that increase economic and food security of smallholders and achieve broad adoption of CSA, Ethiopian policy makers will need to carefully plan for use of hydropower and other natural resources and enact policies that foster synergies among yield increases, GHG emission reductions, and resilience to climate variability.

In the case of **New Zealand**, an agriculture-dependent developed nation already experiencing significant economic impacts from climate change, the national policy mix demonstrates a commitment to minimizing agricultural subsidies and maladaptive signals to agricultural producers (e.g. Adverse Event Policy). In the first nation to include agriculture and forestry in its national emissions trading scheme, New Zealand's farm sector is gaining experience in monitoring and reporting agricultural GHG emissions, making investments in public-private research into sustainable agricultural intensification technologies and practices, and seeing major gains in emissions intensity. Through an evolutionary policy process that has accounted for both economic and environmental concerns, robustly engaged the private sector and local government, and linked project-based activities to national initiatives, New Zealand has made fundamental policy shifts that have resulted in an agriculture system that is much better equipped to operate efficiently and to respond to climate change. It has worked to translate and amplify its experience through a growing network of international partners in the Global Research Alliance on Agricultural Green House Gases. To maintain a thriving export agriculture sector and international leadership on agricultural mitigation technologies while promoting broad adoption of CSA domestically, policy makers in New Zealand will need to skillfully navigate a dynamic international trade environment while perpetuating a national commitment to reduce market distortions and internalize GHG emissions in agriculture.

Notably, all three of the countries in this study have used the UNFCCC as a platform for launching key initiatives. At the 2009 Copenhagen climate summit, Brazil voluntarily pledged to reduce national GHG emissions by over one-third, relative to business as usual, and New Zealand launched the collaborative Global Research Alliance on Agricultural Green House Gases. At the 2011 Durban climate summit, Ethiopia announced its CRGE Strategy to achieve middle-income country status and resilience to climate change by 2025.

Comparison of national examples with central elements of CSA policy implementation

To assemble an integrated set of national policies that fosters CSA, governments will need context-specific assessments, strong institutions and governance systems, coordination frameworks, and multi-scale information systems. The three countries profiled in this study made investments in each of these categories (Table 1).

Each of these countries utilized a unique mix of policy interventions with different levels of emphasis on:

- structured coordination mechanisms for policy development, technical research, and CSA adoption;
- partnerships with private sector and global donors;
- comprehensive policy strategies vs evolutionary policy integration;
- use of legal and financial sanctions vs technical and financial assistance programmes;
- policy targets vs market signals; and
- agricultural R&D vs monitoring and enforcement.

Presumably, the policy mix in any given nation will reflect a complex set of drivers and circumstances. This will commonly include pressing domestic priorities, such as food security and improved livelihoods, and national objectives within international policy and economic contexts, such as equitable commitments to global climate change mitigation. **Brazil** invested in research to support sustainable intensification while creating legal and enforcement mechanisms to protect forest areas as a response to unrestrained agricultural expansion driven by market demand. **Ethiopia** partnered with international institutions to create innovative participatory watershed development programmes as a way to help smallholder farmers working marginal land to break out of a poverty cycle. **New Zealand** weaned itself from agricultural subsidies while partnering on R&D with the private sector as a way to embed adaptation in an agricultural sector threatened by climate change and international trade dynamics.

Other governments that pursue an integrated CSA policy approach will naturally anchor their strategies in a pragmatic understanding of their national political economy, natural resource conditions, and financial and institutional capacities. Governments can select from an array of policy instruments ranging from regulatory mechanisms to economic incentives to public investments and educational campaigns. For some nations, the biggest successes for food security, economic development, and climate change mitigation may emerge from efficiency gains in agricultural supply chains. In many cases, implementation of CSA-promoting policies may be adapted to the particular realities of sub-national regions.

Table 1. Examples of CSA-related policies in Brazil, Ethiopia, and New Zealand

Brazil	Ethiopia	New Zealand
(1) Assessment of drivers, potential CSA interventions, and implementation barriers with emphasis on identifying synergies and trade-offs.		
• Climate Change Assessment Report (2012). • UNFCCC National Communications (2004, 2010).	• IPCC regional climate impacts review. • Global Green Growth Institute study. • Ethiopia Rural Household Survey.	• EcoClimate Report – climate change impacts / adaption options in land sector (2008). • Study of net GHG emissions for agricultural exports (2010).
(2) Strengthening institutions and infrastructure that promote sustainable practices in farming, forestry, and fishing systems, efficient, equitable food chains, and enhanced governance systems to manage common resources, strengthen land tenure, and improve ecosystem services.		
Coordination: • Inter-ministerial Commission on Global Climate Change (1999). • Brazilian Climate Change Forum (2000). **Financing:** • National Climate Change Fund – loans / grants (2009). • Resolution 3.545 – environmental compliance for agricultural loans (2008). • Brazilian National Development Bank – sustainable lending guidelines (2008). • Low Carbon Agricultural Fund – subsidized credit for sectoral plans (2010). • Amazon Fund – avoided deforestation grants (2009).	**Coordination:** • MERET programme (2003). • Productive Safety Net Program (2005). • Community Based Participatory Watershed Development strategy (2005). • Environmental Council – CRGE coordination. • NAPAs – test crop insurance, early warning systems, etc. **Financing:** • Strategic Investment Framework for Sustainable Land Management – multi-sectoral investments (2009). • CRGE Facility – mobilize stakeholders, finance, (2012). • Multi-Donor Trust Fund. • Forest Carbon Partnership Facility – REDD+ readiness grant (2012).	**Coordination:** • Agricultural subsidy removal. • Adverse Events policy. **Financing:** • Primary Growth Partnership – public-private sustainability R&D, value chains. • Pastoral GHG Research Consortium (2002). • Pastoral 21 – sustainable intensification pilot farms. • New Zealand Agricultural GHG Research Centre – harmonize public research investments (2010).
(3) Establishing a strategic framework for coordinating key actors in development and implementation of policy and market measures and blended financing sources to incentivize CSA practices and to reduce and respond to disaster risk.		
Plans / targets: • National System of Nature's Conservation Units (2000). • Inter-ministerial Action Plan for Prevention and Control of Legal Amazon Deforestation (2004). • National Plan on Climate Change (2008). • National Climate Change Policy Law (2009). • Sectoral mitigation targets (2009). • NAMAs targets (2010). **Enforcement:** • Forest Code – maintain private forests (1965/ 2001/2012). • Soy moratorium (2006). • Sanctions for deforesting municipalities (2007). • IBAMA modernization of environmental enforcement.	**Plans / targets:** • 5-year Growth and Transformation Plan – double agricultural production (2010). • Sustainable Land Management Programme – targets for scaling up. • Climate-Resilient Green Economy Strategy – low-carbon development plan (2011). • Regional adaptation plans. **Enforcement:** • Family Code (2000), land administration and use proclamation – secured use / ownership rights (2006).	**Plans / targets:** • Kyoto Protocol ratification (2002). • Plan of Action for Sustainable Land Management and Climate Change – multi-sector adaptation / mitigation investment partnership. • Horizons One Plan – integrated, public-private regional natural resources management. **Enforcement:** • Emissions Trading Scheme (2008). • Taupo Nutrient Trading.
(4) Building multi-scale capacity for information systems including R&D, advisory services, IT technologies, and monitoring and assessment.		
• Low Carbon Agriculture Programme – information to support NAMAs. • REDD and PES pilots. • R&D by INPE, Embrapa.	• Ethiopian Soil Information System – national database, fertility map (2011). • CRGE baseline mapping, vulnerability analysis.	• Global Research Alliance on Agricultural Green House Gases (2009). • Sustainable Dairy Advisors – private sector research dissemination. • Energy audits. • ETS self-assessments.

6. Recommendations

This survey of policy interventions in Brazil, Ethiopia, and New Zealand sheds light on the central elements of an integrated national CSA policy approach. These three countries illustrate the major technical and institutional components that governments will need to support as well as strategies governments can use to garner assistance from international institutions.

National policy makers

Context-specific assessments: drivers, interventions, and barriers

When policy approaches are grounded in a clear understanding of the drivers of unsustainable agriculture, they are more likely to effectively promote practices and technologies that increase production per hectare and improve social and environmental conditions (Beddington et al. 2012). National policy makers can marshal domestic resources and international partnerships to commission comprehensive assessments that enable stakeholders to accurately gauge the potential of CSA as a foundation for a resilient agriculture sector that contributes to socio-economic wellbeing and international mitigation goals.

Projecting the short- and long-term outcomes of financial investments and policy actions under alternative development scenarios is a foundational step. This can assist leaders in evaluating how different land sector policies are likely to affect yield gaps, GHG emissions, and vulnerability to climate change. The three countries profiled in this paper identified and invested in synergies, however many policy processes become mired in tradeoffs between the interests of different stakeholder groups and between near-term investment costs and longer-term benefits of CSA.

While tradeoffs among economic, social, and environmental concerns cannot always be avoided, policy makers can carefully examine the cumulative effect of national and sub-national policies on agricultural production and land use decisions, identify and promote interventions that encourage CSA, and build support for minimizing policies that incentivize extensive, low-yield, low-investment agriculture. The global demand for food, fiber, and fuel will continue to rise in the coming decades and nations with the ability to deliver a steady supply of high-quality agricultural commodities and value-added products will be well-positioned in international markets.

Robust estimates of costs and benefits (and beneficiaries) under current and climate-smart agriculture regimes can be complemented by assessment of barriers to scaling up CSA approaches and policy levers that can empower key social groups to take action (e.g. micro-lending to women; land tenure shifts).

Strong institutions and governance systems: coordination and financing

Integrated CSA policy cannot be accomplished without broad participation from political leaders, ministries, domestic constituencies, and international partners. Therefore, it is important to create transparent, structured frameworks in which stakeholders know they will be able to raise issues vital to their interests and will also be called upon to compromise with other interest groups. Building the foundation for transformative policy shifts requires stable platforms where public and private sector champions regularly interact, exchange information and perspectives, and negotiate the details of policy development.

With the impacts of a changing climate already being felt in different ways around the world, the perspectives and policy positions of stakeholder groups (e.g. concerns among farmers and agribusinesses about stable production and natural resource availability) may begin to shift in ways that open the door to innovative policies that support CSA. At the same time, there is growing evidence that CSA approaches can generate synergistic benefits for adaptation, mitigation, and food security. As entrenched political arrangements shift, policy makers may be able to build enthusiasm for integrated policy approaches among domestic constituencies, agribusinesses, and international partners.

National governments can take the lead in harmonizing public and private R&D investments in sustainable agricultural intensification by establishing mechanisms for private sector participation in research programmes (with clear rules regarding intellectual property and public access) and rural advisory activities. Bi- and multilateral partnerships with international research centers and research funders can maximize investment in high-priority knowledge needs for locally appropriate CSA practices and technologies (e.g. climate-resilient crops and livestock, integrated farm management strategies).

Coordination frameworks: plans, targets, and enforcement

To arrive at an integrated set of national policies that promotes uptake of CSA, policy makers should put greater emphasis on changing policies that impose disincentives for CSA adoption on agricultural producers (e.g. many types of subsidies and land concessions; weak tenure laws) rather than policies that seek to counteract policy signals either through incentives (e.g. sustainable lending) or prohibitions (e.g. zoning). In countries where poverty and food insecurity affect large segments of the population, an integrated policy approach will require attention to building productive assets and local governance capacity to support diversified agriculture in rural communities.

By establishing frameworks and platforms for coordination, national governments can more effectively leverage the contributions of private and civil sector actors to increasing the practice of CSA. These can encompass market incentives (e.g. price premiums to producers), financial mechanisms (e.g. sustainability criteria for lending), technical assistance programmes (e.g. producer support programmes), and public campaigns. Similarly, sustainable commodity initiatives (e.g. Roundtable for Sustainable Soy), intergovernmental collaborations (e.g. Common Market for Eastern and Southern Africa, COMESA), and international treaty processes (e.g. the Trans-Pacific Partnership) can be channels through which government agencies can work toward a constructive enabling environment for CSA uptake, either by increasing incentives or removing disincentives affecting agricultural supply chains.

Countries that demonstrate a genuine commitment and capacity to meet current and future socio-economic development aspirations while protecting natural resources and mitigating GHG emissions will be more successful in garnering financial and technical support from global donors and translating that support into interventions that enable productive, resilient, low-emitting agriculture. Multi-scale ‘whole of government’ models may be important for designing and implementing new CSA-supportive policies while reducing maladaptive signals from existing land sector policies. Staged implementation plans for CSA adoption and tangible targets for adaption, mitigation, and food security outcomes are valuable for aligning efforts across different sectors and stakeholder groups. These need to be complemented by monitoring capabilities and legal and enforcement mechanisms.

Multi-scale information systems

National governments can collaborate with appropriate international partners to produce practical information for the agriculture sector including spatially-explicit recommendations for combining tested methods and technologies to sustainably increase yields, reduce GHG emissions, and boost adaptive capacity. Recognizing that innovation emerges from farmers’ fields as well as research centers, rural advisory programmes should accommodate multiple sources of knowledge.

The ability to document and report on outcomes of improved methods and technologies is essential for producers to benefit from incentive programmes (e.g. offset markets, subsidized credit) and for ‘late adopters’ to be informed about potential benefits of CSA approaches. Financial and opportunity costs associated with testing and establishing CSA-supportive policies are likely to be more apparent to stakeholders than benefits which may be distributed over time and space and accrue to new beneficiaries. Therefore, information systems are needed to estimate the full range of benefits and costs so that informed policy debates are possible.

International institutions

International institutions, global donors, and agribusinesses are actively shaping discussions about integrated approaches to climate change, unsustainable agriculture, and food insecurity. Many of these entities focus their efforts on informing and assisting national governments through training, financing, technology transfer, and other modes. International institutions can best reinforce adoption of CSA approaches in national policies in a coordinated way rather than primarily through bilateral interactions. Numerous international platforms are available for harmonizing activities and programs. Capacity building through regional institutions and knowledge hubs represents another mode for coordinated assistance.

Integrated national policy approaches will be aided by clear, consistent signals from multilateral agencies, global donors, and international conventions. They will be further encouraged by international trade agreements that accommodate agriculture as a pathway for poverty reduction and food security and agricultural commodity markets that reward CSA production practices.

Global Alliance for Climate-Smart Agriculture

Members of the newly emerging Global Alliance for Climate-Smart Agriculture – including governments, multilateral agencies, farmers and other agricultural supply chain actors, researchers, and civil society – are committing to "sustainable increases in the productivity of food systems, by a sustainable use of natural resources, the adaptation of people's livelihoods that are threatened by climate change, and agricultural practices that contribute to reduced emissions and less deforestation as a result of agriculture."[8]

Nations that produce food at levels that are important for meeting domestic and international consumption are making an essential contribution to core human needs. At the same time, high levels of agricultural production contribute to global climate change. Countries have obvious interests in fostering an agriculture sector that is productive, climate-resilient, and supports national needs for food, fiber, and fuel, however the incentives for national-level action toward reducing global GHG levels are less clear in the absence of serious and shared international commitment. For many countries, agriculture represents a significant proportion of national mitigation potential and international mechanisms should provide financial incentives and recognition under international conventions.

[8] http://www.fao.org/climate-smart-agriculture/85725/en/

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As countries around the world face urgent agricultural challenges, the concept of 'climate-smart' agriculture (CSA) has been put forward to synergistically achieve climate change adaptation, mitigation, and food security. This paper explores how three countries are using integrated policy approaches to CSA. Brazil invested in research to support sustainable intensification while creating legal and enforcement mechanisms to protect forest areas as a response to unrestrained agricultural expansion driven by market demand. Ethiopia partnered with international institutions to create innovative participatory watershed development programs as a way to help smallholder farmers working marginal land to break out of a poverty cycle. New Zealand weaned itself from agricultural subsidies while partnering on R&D with the private sector as a way to embed adaptation in an agricultural sector threatened by climate change and international trade dynamics. Governments are encouraged to put greater emphasis on changing policies that impose disincentives for CSA adoption than on introducing new incentives or prohibitions that counteract negative policy signals. Integrated national policy approaches will be aided by clear, consistent signals from multilateral agencies, global donors, and international conventions and trade agreements that promote agriculture as a central part of the solution for climate change, unsustainable resource use, and food insecurity.

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