Centre for Climate Change Economics and Policy

An ESRC Research Centre

Sustainability Research Institute
AN ESRC RESEARCH CENTRE

Integrating mitigation and adaptation in climate and land use policies in Brazil: a policy document analysis

Monica Di Gregorio, Leandra Fatorelli, Emilia Pramova, Peter May, Bruno Locatelli and Maria Brockhaus

February 2016

Centre for Climate Change Economics and Policy Working Paper No. 257

Sustainability Research Institute

Paper No. 94

CIFOR Working Paper No. 194

E·S·R·C ECONOMIC & SOCIAL RESEARCH COUNCIL

UNIVERSITY OF LEEDS

LSE THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCE

The Centre for Climate Change Economics and Policy (CCCEP) was established by the University of Leeds and the London School of Economics and Political Science in 2008 to advance public and private action on climate change through innovative, rigorous research. The Centre is funded by the UK Economic and Social Research Council. Its second phase started in 2013 and there are five integrated research themes:

1. Understanding green growth and climate-compatible development
2. Advancing climate finance and investment
3. Evaluating the performance of climate policies
4. Managing climate risks and uncertainties and strengthening climate services
5. Enabling rapid transitions in mitigation and adaptation

More information about the Centre for Climate Change Economics and Policy can be found at: http://www.cccep.ac.uk.

The Sustainability Research Institute (SRI) is a dedicated team of over 20 researchers working on different aspects of sustainability at the University of Leeds. Adapting to environmental change and governance for sustainability are the Institute's overarching themes. SRI research explores these in interdisciplinary ways, drawing on geography, ecology, sociology, politics, planning, economics and management. Our specialist areas are: sustainable development and environmental change; environmental policy, planning and governance; ecological and environmental economics; business, environment and corporate responsibility; sustainable production and consumption.

More information about the Sustainability Research Institute can be found at: http://www.see.leeds.ac.uk/sri.

Table of Contents

List of Acronyms

Acronym	English Name	Portuguese Name
ABC Plan	Sectoral Plan for the Mitigation and Adaptation of Climate Change for Low Carbon Emissions Agriculture	Plano Setorial de Mitigação e de Adaptação às Mudanças Climáticas para a Consolidação de uma Economia de Baixa Emissão de Carbono na Agricultura
AFL	Agroforestry systems	Sistemas Agroflorestais
APP	Permanent Preservation Areas	Área de Preservação Permanente
ARPA	Amazon Region Protected Areas	Áreas Protegidas da Amazônia
CAR	Rural Environmental Registration	Cadastro Ambiental Rural
CDM	Clean Development Mechanism	Mecanismo de Desenvolvimento Limpo
CGEE	Center for Strategic Studies and Management in Science, Technology and Innovation	Centro de Gestão e Estudos Estratégicos
CIM	Inter-Ministerial Committee on Climate Change	Comitê Interministerial sobre Mudança do Clima
COEP	National Network for Social Mobilization	Rede Nacional de Mobilização Social
EbA	Ecosystem-based Adaptation	Adaptação baseada em ecosistemas
EMBRAPA	Brazilian Corporation for Agricultural Research	Empresa Brasileira de Pesquisa Agropecuária
ENREDD	National REDD+ Strategy	Estratégia Nacional para REDD+
ES	Ecosystem Services	Serviços Ecossitêmicos
FBMC	Brazilian Forum on Climate Change	Fórum Brasileiro de Mudanças Climáticas
NCCF	National Climate Change Fund	Fundo Nacional sobre Mudança do Clima
GEx	Executive Group on Climate Change	Grupo Executivo sobre Mudança do Clima
GHG	Greenhouse Gases	Gases de Efeito Estufa (GEE)
GPTI	Executive Committee of the Permanent Inter-ministerial Working Group	Grupo Permanente de Trabalho Interministerial
GT REDD+	Inter-ministerial Working Group on REDD+	Grupo de Trabalho Interministerial sobre REDD+
INDC	intended Nationally Determined Contribution	
iLPF	Integrated Crop-Livestock-Forest Systems	Integração Lavoura-Pecuária-Floresta
IPAM	Amazon Environmental Research Institute	Instituto de Pesquisa Ambiental da Amazônia

Macro-ZEE	Ecological-economic macro-zoning of the Legal Amazon	Macrozoneamento Ecológico-Econômico da Amazônia Legal
MAPA	Ministry of Agriculture and Food Supply	Ministério da Agricultura, Pecuária e Abastecimento
MDA	Ministry of Agrarian Development	Ministério do desenvolvimento agrário
MMA	Ministry of the Environment	Ministério do Meio Ambiente
PAN(-Brasil)	National Action Plan to Combat Desertification and the Mitigation of the Effects of Drought	Plano de Ação Nacional de Combate à Desertificação e Mitigação dos Efeitos da Seca
PAS	Sustainable Amazon Plan	Plano Amazônia Sustentável
PBMC	Brazilian Panel on Climate Change	Painel Brasileiro de Mudanças Climáticas
PES	Payments for Environmental Services	Pagamentos por Serviços Ambientais
P-iLPF	National Policy on Agriculture-Forest-Livestock Integration	Política Nacional de Integração Lavoura-Pecuária-Floresta
PLANAPO	National Policy and National Plan on Agroecology and Organic Production	Política Nacional de Agroecologia e Produção Orgânica e Plano Nacional de Agroecologia e Produção Orgânica
PNA	National Plan on the Adaptation to Climate Change	Plano Nacional de Adaptação à Mudança do Clima
PNFP	National Policy on Planted Forests	Política Agrícola para Florestas Plantadas
PNMC	National Plan on Climate Change	Plano Nacional sobre Mudança do Clima
PPA	Pluri-Annual Plan	Plano-Plurianual
PPCDAm	Action Plan for Prevention and Control of Deforestation in the Legal Amazon	Plano de Ação para a Prevenção e Controle do Desmatamento na Amazônia Legal
PPCerrado	Action Plan for the Prevention and Control of Deforestation and Fires in the Cerrado	Plano de Ação para Prevenção e Controle dos Desmatamentos e das Queimadas no Cerrado
PROAGRO	Multiple crop insurance programme in agriculture (for agribusinesses)	Programa de Garantia da Atividade Agropecuária
PROAGRO MAIS	Multiple crop insurance programme in agriculture (for family farming)	Programa de Garantia da Atividade Agropecuária da Agricultura Familiar
REDD+	Reducing Emissions from Deforestation and Forest Degradation	Reduções de emissões de gases de efeito estufa provenientes do desmatamento e degradação florestal
Rede CLIMA	Brazilian Research Network on Global Climate Change	Rede Brasileira de Pesquisas sobre Mudanças Climáticas Globais
RL	Legal Reserve	Reserva Legal

SBF	Secretariat of Biodiversity and Forests (under MMA)	Secretaria de Biodiversidade e Florestas
SISNAMA	National Environment System	Sistema Nacional do Meio Ambiente
SEAF	Insurance for Family Agriculture Program liked to the National Program for the Strengthening of Family Agriculture (PRONAF)	Seguro da Agricultura
SMCG	Secretariat of Climate Change and Environmental Quality (under MMA)	Secretaria de Mudanças Climáticas e Qualidade Ambiental
SNUC	Brazilian National System of Protected Areas	Sistema Nacional de Unidades de Conservação
TF	REDD+ and Climate Change Task Force	Força Tarefa sobre REDD e Mudanças Climáticas
UNFCCC	United Nations Framework Convention on Climate Change	Convenção-Quadro das Nações Unidas sobre Mudança do Clima
ZEE	Ecological and Economic Zoning	Zoneamento Ecológico-econômico
ZARC	Agricultural Climatic Risk Zoning Programme	Zoneamento Agrícola de Risco Climático

Abstract

This paper investigates climate policy integration and coherence in land use policies in Brazil. Unlike other policy analyses a key aim is to assess 'internal policy coherence' in the climate change domain, or the extent to which positive and negative interactions between mitigation and adaptation are taken into account in policy formulation. The paper is based on a systematic content analysis of major federal level climate change and land use policies. The results indicate a stronger focus on climate change mitigation compared to adaptation in all land uses. Integrated approaches that consider mutually supportive mitigation and adaptation actions are called for in key climate change policies, but so far such linkages remain largely unexplored in sectoral policies. While some progress in this regard occurred in the agricultural sector, this has not translated into actual policy actions that are of use to small-scale producers. In the forest domain the focus remains almost exclusively on climate change mitigation. Three main recommendations are drawn. First, more knowledge about locally specific climate change impacts, resilience, capacity and measures for climate change adaptation is needed in order to increase the opportunities to pursue mutually beneficial approaches to climate change mitigation, adaptation and development, in particular in the forestry sector. Second, policy makers need to address more explicitly potential trade-offs between mitigation and adaptation in both policy formulation and implementation. Third, policy action on how to achieve mutually beneficial outcomes and avoid trade-offs between mitigation and adaptation needs to be operationalised into concrete policy objectives within sectoral policies and into practices that apply not just to agriculture and livestock systems, but to forested landscapes as well.

Keywords: Climate change; climate policy integration; policy coherence; forest; agriculture; mitigation; adaptation; Brazil,

Submission date 25-11-2015 Publication date 22-02-2016

About the Authors

Monica Di Gregorio is a Lecturer in Environmental Politics and Governance at the Sustainability Research Institute at the University of Leeds, UK and an Associate of the ESRC funded Centre for Climate Change Economics and Policy (CCCEP) and of the Center for International Forestry Research. Her main research interests relate to environmental politics, policy and natural resource governance. Her recent research focuses on climate change policies in the land use sector.

Leandra Fatorelli is a postdoctoral researcher at the Sustainability Research Institute at the University of Leeds, UK and an Associate of the ESRC funded Centre for Climate Change Economics and Policy (CCCEP). Leandra holds a PhD in Sustainable Development on smallholders perceptions about environmental change in the Brazilian Amazon. Her main interests include research on environmental change, climate change mitigation and adaptation, natural resource management and governance. She is currently involved in research on synergies between mitigation and adaptation policies and REDD+.

Emilia Pramova is a researcher with the Center for International Forestry Research. Her research focuses on the synergies between climate change adaptation and mitigation, and the policies and networks related to ecosystem services. She has conducted research in the Asia Pacific Region and in South America. Emilia has a Masters degree in Sustainable Resource Management and a background in psychology and communications.

Peter H. May is an Associate Professor of the Department of Development, Agriculture and Society of the Federal Rural University of Rio de Janeiro. He received a PhD in Resource Economics from Cornell University. He is author and editor of a number of books in the areas of ecological economics, agroforestry, and payment for ecosystem services including The Subsidy from Nature, Pricing the Planet and Natural Resource Valuation and Policy in Brazil (Columbia University Press) and Economia do Meio Ambiente: Teoria e Prática (Elsevier). Peter May is past President of the International Society for Ecological Economics-ISEE and founder of the Brazilian Society for Ecological Economics-ECOECO.

Bruno Locatelli is a scientist with CIRAD (French Agricultural Research Centre for International Development), currently seconded to CIFOR (Center for International Forestry Research). He holds a PhD on Environmental Sciences, Economics, Geography. His main research interests are ecosystem services and adaptation to climate change.

Maria Brockhaus is a Senior Scientist at the Center for International Forestry Research. Her background is in agricultural economics and forest policy. In her research she focuses mainly on policy, institutional change and social network analysis. Since 2009 she has been leading the research component on REDD+ policies in CIFOR's Global Comparative Study (GCS) on REDD+.

The Center for International Forestry Research (CIFOR) advances human wellbeing, environmental conservation and equity by conducting research to inform policies and practices that affect forests in developing countries. CIFOR helps ensure that decision-making that affects forests is based on solid science and principles of good governance, and reflects the perspectives of developing countries and forest-dependent people. CIFOR is one of 15 centres within the CGIAR.

The Graduate Program in the Social Sciences in Development, Agriculture and Society (CPDA) is a training and research center in the Department of Development, Agriculture and Society at the Federal Rural University of Rio de Janeiro, Brazil (DDAS/UFRRJ). CPDA is a multi-disciplinary programme bringing together social scientists working on various aspects of sustainable development in rural economies.

Integrating Mitigation and Adaptation in Climate and Land Use Policies in Brazil

Monica Di Gregorio[*ab], Leandra Fatorelli[**a], Emilia Pramova[***b,] Peter May[****c,] Bruno Locatelli[*****bd] and Maria Brockhaus[******b]

[a] Sustainability Research Institute, School of Earth & Environment, University of Leeds, Leeds, West Yorkshire LS2 9JT, UK.

[b] Center for International Forestry Research, Bogor, West Java, Indonesia

[c] CPDA, Universidade Federal Rural do Rio de Janeiro (UFRRJ), Rio de Janeiro, Brazil

[d] CIRAD, French Agricultural Research Centre for International Development, Montpellier, France

[*] Corresponding author: m.digregorio@leeds.ac.uk

Tel: +44(0) 113 34 31592

[**] Co-author: l.Fatorelli@leeds.ac.uk

[***] Co-author: emilia.pramova@gmail.com

[****] Co-author: peterhmay@gmail.com

[*****] Co-author: b.locatelli@cgiar.org

[******] Co-author: m.brockhaus@cgiar.org

1. INTRODUCTION

Brazil has taken the lead in climate policy design and implementation in Latin America with the adoption of the National Plan on Climate Change (PNMC) in 2008 and its climate change law, the National Policy on Climate Change, in 2009 (Hall 2012, p.38). These regulations define climate change targets, priority sectors for mitigation and adaptation and necessary financial mechanisms. Land use systems, agriculture and forestry are at the heart of these policies, because of their vulnerability to climate change as well as their potential contribution to mitigation efforts. The vulnerability of ecosystems to climate change impacts in Brazil and the interactions between deforestation and global warming can lead to drastic changes, including the intensification of droughts and savannization of parts of the Amazon (Marengo et al. 2013, Tomasella et al. 2013). Land use changes are also the main source of carbon emissions, with 80% of total carbon emissions in 2005 coming from land use changes and agriculture. Forest and agriculture are also the sectors that are supposed to contribute the majority (80 %) of Brazil's emission reduction targets by 2020 (Nepstad et al. 2008, Government of Brazil 2009b, CMGC 2010).

Apart from devising general climate change policies, the literature indicates that effective policy implementation requires integrating climate change objectives into sectoral policies. This process has been variously labelled as climate policy integration or climate mainstreaming (Kok and de Coninck 2007, Swart and Raes 2007, Adelle and Russel 2013, Brouwer et al. 2013). Less evidence is available on the need to devise policies able to effectively manage the interactions between the two climate change objectives of mitigation and adaptation in land use systems (Locatelli et al. 2015a). There are some justifications to separate efforts to pursue them. Adaptation and mitigation often operate at different spatial and temporal scales and involve different policy actors and priority sectors (Klein et al. 2005, Tol 2005). For example, mitigation benefits global climatic conditions in the long term, while adaptation provides both short and long term benefits at the local level (Swart and Raes 2007, Locatelli et al. 2011).

Yet, in land use systems interactions between adaptation and mitigation are particularly important. The implications are that in sectors such as forestry and agriculture it is likely to be advantageous to consider the two climate change objectives together (Barker et al. 2007, Verchot et al. 2007, Locatelli et al. 2011). Adaptation actions can have positive, negative or neutral effects on mitigation and vice-versa (Locatelli et al. 2015a) (Table 1). For example, adaptation strategies, such as water savings and soil conservation can maintain and sequester carbon (Maraseni et al. 2012). Yet, increasing nitrogen fertilization, energy-intensive irrigation, or expansion in peatland can increase carbon emissions (Moser 2012). Similarly, carbon payments can contribute to local adaptation through diversification of livelihoods and improved economic resilience to climate shocks (Campbell 2009a). Yet, other mitigation measures, such as the development of fast growing tree monoculture aimed at maximising carbon sequestration may reduce options for ecological adaptation (Ravindranath 2007). In order to be able to address negative interactions and facilitate the realization of mutually beneficial outcome it is necessary to take these interactions into account (Locatelli et al. 2011, Duguma et al. 2014).

Table 1: Examples of adaptation (a) actions with positive (+) and negative (-) impacts on mitigation (+A+M), or mitigation (m) actions with impacts on adaptation (+M +A) from forest and agriculture

Positive interactions (co-benefits)		Negative interactions (trade-offs)	
a→ +A +M *	m→ +M +A	a → +A -M	m → +M - A
AGRIC: Changes in fertilizer and pesticide use, water saving and soil conservation can maintain and sequester carbon (Maraseni et al. 2012)	FOREST: Carbon payments can diversify livelihoods and improve economic resilience to climate shocks (Campbell 2009b)	AGRIC: adaptation in agriculture (nitrogen fertilization, energy-intensive irrigation, expansion in peatland) can increase carbon emissions (Moser 2012)	FOREST: Maximizing carbon may reduce options for ecological adaptation (fast growing tree monocultures) (Ravindranath 2007) FOREST: Maximizing carbon may reduce options for ecological adaptation (fast growing tree monocultures) (Ravindranath 2007)
AGRIC&FOREST: Successful agricultural adaptation can reduce conversion of forests (Lobell et al. 2013)	AGRIC&FOREST: Conserving carbon also protects other ecosystems functions and services that facilitate adaptation (e.g. microclimate regulation, wood and fodder as safety nets) (Locatelli et al. 2011)	FOREST: Adaptation measures in forestry can decrease carbon stocks or increase the vulnerability of carbon stocks in the long term (e.g. shortening plantation rotation, suppressing fire) (Rosenzweig and Tubiello 2007)	FOREST &AGRIC: Forest and biofuel plantations for climate change mitigation may impede the adaptation of communities (decreased food security, competition for land) (Smith and Olesen 2010)

*: a: adaptation objective, m: mitigation objective, →: results in, +: positive outcome, -: negative outcome, A: adaptation outcome, M: mitigation outcome

This paper aims to assess the extent to which the Brazilian climate change policy architecture displays an integrated policy approach to climate change mitigation and adaptation in relation to land use. It investigates the level of policy integration of the climate governance structure - including institutions and mandates of key policy actors - and the level of policy coherence of policy outputs – major climate change and land use policies. Unlike other climate policy analyses, a key interest is to assess 'internal policy coherence' in the climate change domain, or the extent to which positive and negative interactions between mitigation and adaptation are taken into account in policy formulation, as opposed to 'external policy coherence' alone, which relates instead to the extent to which

mitigation or adaptation are mainstreamed into sectoral policies, with little concern about integration with two climate change objectives[1].

The next section presents the main theoretical approach we used to study climate policy integration and coherence. This is followed by the presentation of the data collection and analytical methods. The results section first depicts the main evolution of climate change institutions, governance structures and mandates of key policy actors and then presents the detailed results of the content analysis of 36 federal level policy documents that assesses the extent to which climate change and sectoral policies take into account the interactions between climate change mitigation, adaptation and non-climate objectives. The discussion and conclusion draw implications for the potential and provide recommendation for enhanced climate change policy integration and policy coherence of climate change mitigation and adaptation in the land use sector in Brazil.

2. CLIMATE POLICY INTEGRATION AND POLICY COHERENCE

In practice, climate change mitigation and adaptation policy objectives in the land use sector are often pursued separately and decision-making processes are rarely integrated (Duguma et al. 2014). In addition, most studies on climate policy integration have focused on mainstreaming either mitigation or adaptation into sectoral policies (Kok and de Coninck 2007, Mickwitz et al. 2009, Adelle and Russel 2013). Only a few studies have specifically looked at the integration between mitigation and adaptation policy objectives (Klein et al. 2005, Swart and Raes 2007, Thuy et al. 2017).

The terms 'policy integration', 'policy coherence' and 'mainstreaming' have not always been used in consistent ways in the environmental and climate policy literature and there are slightly different interpretations of these overlapping meanings (Jordan and Lenschow 2010, Nunan et al. 2012, Adelle and Russel 2013, den Hertog and Stroß 2013). In this paper, we follow Nilsson et al.'s (2012) distinction between policy integration and policy coherence. According to their conceptual framework, policy integration refers to the integration of governance arrangements and policy making processes. In our case, we focus on the climate change policy architecture at the federal level in Brazil, which includes the policy actors responsible for the development and implementation of climate change mitigation and adaptation policies, their mandates and the governance arrangements that facilitate climate change policy coordination among key policy actors in the land use sector. Policy coherence refers to policy outputs and outcomes, or the extent to which multiple policy objectives and associated implementation arrangements are consistent and mutually supportive. Den Hertog and Stroβ define it as the 'synergic and systematic support towards the achievement of common objectives within and across individual policies' (den Hertog and Stroß 2013: 4 cited in Nilsson 2012).

[1] The paper is part of a series of three case studies on Brazil, Indonesia and Peru which use the same conceptual framework and methods of analysis. As a consequence in the introduction, the theoretical framework and methods sections there are considerable similarities across the 3 case study. The other two studies are by Pramova et al. (2015) and Di Gregorio et al. (2015).

To analyse policy integration we investigate its administrative dimension, which can be distinguished between horizontal and vertical types. Horizontal environmental policy integration refers to interactions across different policy domains at one level of governance. Dominance of horizontal environmental policy integration often sees the ministry of the environment having a lead role and a mandate to support cross-sectoral coordination. Vertical policy integration has been used by some scholars to refer to interactions within one administrative sectoral domain, meaning 'up and down within the arena of ministerial sectoral responsibility' (Lafferty and Hovden 2003, p.13). Strong vertical integration includes cases where governments take the lead with e.g. a supervisory and monitoring role over ministries, while each sectoral ministry remains responsible for mainstreaming climate change objectives in its sectoral policies. Another definition of vertical integration refers, more broadly, to interactions across levels of governance (global, national, local) (Nunan et al. 2012). This interpretation is closer to the understanding of 'vertical interplay' referred to by Young (2002), which explores the interactions between e.g. national, provincial and district level policy processes and institutions.

To study policy coherence we assess the interactions within as well as across policy domains. In relation to policy coherence we are interested in investigating interactions between the two climate change policy aims and actions of mitigation and adaptation, as well as between these and non-climate objectives and actions related to land use policies. We label the former as internal policy coherence, which generally refers to interactions within a single policy domain - and the latter as external coherence referring to interactions across different policy domains (May et al. 2006, Nilsson et al. 2012).

We suggest that climate change policy coherence requires to formulate and implement policies, so that they:

a) reduce negative interactions (trade-offs) and seek to exploit positive interactions supporting mutually beneficial practices (synergies) between climate change mitigation and adaptation. We refer to this as internal climate change policy coherence.

and

b) reduce negative interactions (trade-offs) and seek to exploit positive interactions supporting mutually beneficial practices (synergies) between climate change (mitigation or adaptation) and non-climate objectives. We refer to this as external climate change policy coherence.

Policy integration and policy coherence are in practice closely linked, because well integrated governance arrangements and policy processes will facilitate policy coherence of outputs, which will contribute to better integrated outcomes (Nilsson et al. 2012). Horizontal and vertical forms of policy integration are also primarily analytical distinctions and in practice these processes are intertwined (Nunan et al. 2012).

Our approach does not suggest that any one of the policy objectives - reducing carbon emissions, addressing climate change adaptation or pursuing non-climate objectives - should take precedent over the others, meaning that it should have 'principled priority' as expressed in some of the environmental policy integration literature (Lafferty and Hovden 2003). This literature suggests that effective integration requires the prioritization of environmental over other policy objectives, because in the absence of such an approach environmental protection aims are unlikely to be achieved (Lafferty and Hovden 2003). The climate policy integration literature, however, takes a

'weaker' approach to policy integration (Adelle and Russel 2013). One of the reasons is that in practice, climate change objectives do not take precedent over development objectives. In fact, most climate change policies state the need to balance climate change objectives with development needs (Kok et al. 2008). This means, however, that when trade-offs arise among multiple objectives, policy actors do not just try to minimize negative interactions among multiple goals, but have also to decide how to balance remaining conflicts. Consequently, internal climate policy coherence of mitigation and adaptation does not necessarily imply that joint outcomes are always to be favoured, as prioritizing only win–win measures could lead to neglecting other measures that can effectively contribute to either adaptation or mitigation separately (Moser 2012). Whether a balance is achieved between multiple objectives remains an empirical question. Next we present the methods used to analyse policy integration and policy coherence.

3. METHODS

The research design includes the analysis of the national climate change policy architecture and of the content of main climate change and land use policies. The analysis of the climate change policy architecture investigates the organizational and institutional structure of the climate change policy domain and the mandates of the main institutional actors involved in the development of climate change policies. The analysis of climate change and land use related policies is based on qualitative thematic coding and aims at investigating policy coherence, or the extent to which policies take or not into account interactions between mitigation, adaptation and non-climate objectives.

The selection of documents for the policy analysis focused on the main national level laws, regulations, strategies, plans and major programmes from federal government institutions with regulatory mandates, and multi-sectoral working groups or semi-independent bodies with a mandate to devise strategies or plans in the following sectors: climate change, forestry, agriculture, environment and biodiversity and development policies as they relate to agriculture and forests. In total we coded 36 policy documents related to climate change or land use systems from 1973 to 2015 (see annex 1 for a full list of policy documents analysed).

We coded the policy documents using a directed coding approach, which identifies in advance of the coding an initial list of categories to be coded (Weber 1990, Hsieh and Shannon 2005). We selected a number of concepts as main categories based on a literature review of synergies between mitigation and adaptation in the land use sector (Locatelli et al. 2015a). All text passages that discussed any of the predefined categories were coded accordingly and any further text that was relevant to synergies and did not fall under these initial categories was coded under a new category. We coded the documents using NVivo software (QSR International Pty Ltd 2012).

Relevant categories used in this particular analysis include different types of interactions between adaptation, mitigation and non-climate domains, types of co-benefits, actions facilitating synergies, the sectors or policy domains involved (agriculture, forestry, energy, environment & biodiversity, disaster management, gender, governance, health, infrastructure, livelihoods, sustainable development, tourism and water). We also coded passages that referred more generally to ecosystem services, linkages between sustainable development and climate change and references to mainstreaming of climate change into development.

The central category of 'types of interactions' identified all text passages that mentioned respectively positive and negative interactions between mitigation and adaptation and between these and non-

climate change policy domains. Positive interactions were classified under six different categories expressing co-benefit relationships, plus one expressing integration. Another category indicated that both mitigation and adaptation are pursued, but without explicit mention of interactions. The categories are[2]:

Positive interactions:

a. Adaptation actions or aims that result in mitigation co-benefits
b. Adaptation actions or aims that result in non-climate co-benefits
c. Mitigation actions or aims that result in adaptation co-benefits
d. Mitigation actions or aims that result in non-climate co-benefits
e. Non-climate actions or aims that result in adaptation co-benefits
f. Non-climate actions or aims that result in mitigation co-benefits
g. Integrated actions considering both adaptation and mitigation aimed at enhancing mutual benefits
h. Actions and aims pursuing both adaptation and mitigation, without specific reference to interactions or mutual benefits

We classified six types of negative interactions (trade-offs):

Negative interactions:

a. Adaptation actions or aims that result in negative impacts on mitigation
b. Adaptation actions or aims that result in negative impacts on non-climate domains
c. Mitigation actions or aims that result in negative impacts on adaptation
d. Mitigation actions or aims that result in negative impacts on non-climate domains
e. Non-climate actions or aims that result in negative impacts on adaptation
f. Non-climate actions or aims that result in negative impacts on mitigation

When coding the type of interaction, we coded according to what was explicitly mentioned or according to whether the context of the text passage indicated implicitly a reference to an interaction. For example, if an adaptation strategy mentioned reforestation, the mitigation co-benefit was coded if it was described as such in terms of e.g. carbon sequestration, reduction of greenhouse gases (GHG) and other related concepts. Likewise, adaptation co-benefits were coded when there was mention of e.g. resilience, reduction of vulnerability, decreased drought risk, protection from flood, etc. Forest fire prevention measures described as aiding mitigation being included in a section/chapter on adaptation would also be coded as an interaction. Integrated actions or aims refer to instances where it was clear that there was a joint mitigation and adaptation objective. We use the resulting evidence to draw implications about the extent to which policies take into account the interactions between adaptation, mitigation and non-climate objectives and the extent to which the policy architecture and policy priorities consider or not integrated approaches.

[2] See Annex 2 for a more detailed description of interactions.

4. CLIMATE CHANGE POLICY ARCHITECTURE RELATED TO FORESTS AND AGRICULTURE IN BRAZIL

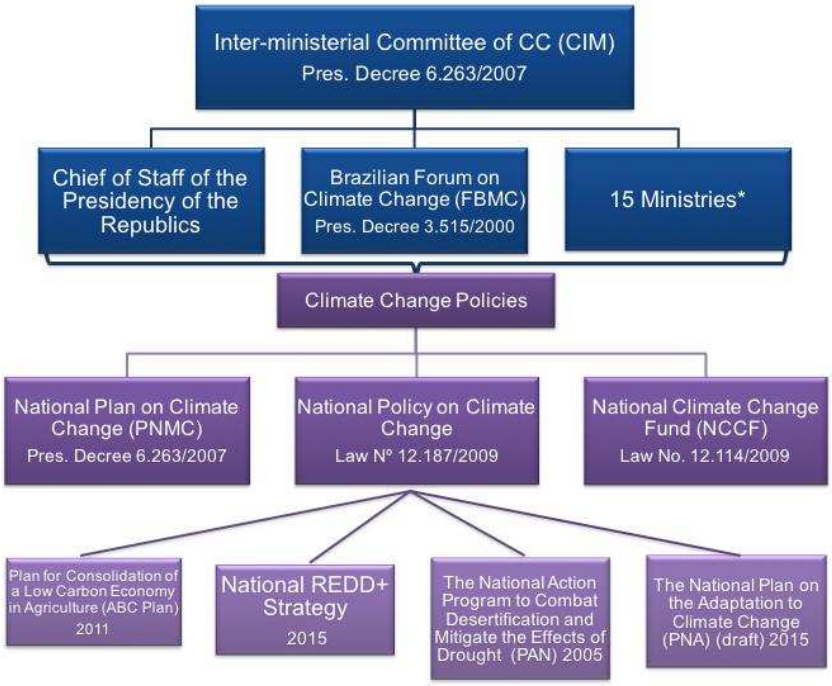
This section investigates two aspects of the climate change policy architecture. The first is the organizational structure of the climate change policy framework encompassing lead institutions, their mandate and cross-sectoral linkages, which we refer to as the climate change governance arrangements. The second aspect investigates the main objectives of the key climate change policies related to the land use sector and how the different objectives relate to each other.

4.1 Climate Change Governance Arrangements

Efforts to specifically combat climate change in Brazil started with the establishment of the Inter-ministerial Commission on Climate Change (CIMGC) in 1999 and the Brazilian Forum on Climate Change (FBMC) in 2000. CIMGC was established to coordinate discussion on climate change and integrate government policies. FBMC is a multi-stakeholder forum that includes state, business, NGOs and civil society organizations. Its aim is to raise awareness and mobilize society to discuss and make decisions on climate change action (Decree No. 3.515/2000). Up to 2007, CIMGC, which was chaired by the Minister of Science, Technology and Innovation, was the main policy actor determining climate change policy decisions. At the time, the control over climate policy decisions resided primarily with government.

In 2007, the Inter-Ministerial Committee on Climate Change (CIM) was established comprising FBMC, 17 federal bodies and the Chief of Staff to the Presidency of the Republic. The latter is also the head of FBMC and coordinator of CIM. Their main task of CIM was to develop the National Plan on Climate Change (PNMC) (Pres. Decree No. 6.263/2007). In 2008 the Amazon Fund was established (Pres. Decree No. 6.527/2008) to collect contributions for investments in preventing, monitoring and fighting against deforestation, support conservation and contribute to GHG emission reductions in the Amazon biome. The Amazon Fund is closely linked to the Sustainable Amazon Plan (PAS) and the Action Plan for the Prevention and Control of Deforestation in The Legal Amazon (PPCDAm), has a multi-stakeholder Guidance Committee and is managed by the Brazilian Development Bank (BNDES) (Government of Brazil 2008b). In 2009 a federal decree established the National Policy on Climate Change (Law No. 12.187/2009) and the creation of the National Climate Change Fund (NCCF) (Law No. 12.114/2009) (WWF 2011, Gebara and Thuault 2013).

Figure 1: National Climate Change Organizational Structure and Main Policy Outputs in the Land Use Sector



*: Ministry of Agriculture, Livestock and Supply; Ministry of Science, Technology and Innovation; Defense Ministry; Ministry of Education; Ministry of Finance; Ministry of National Integration; Ministry of Health; Ministry of Cities; Ministry of Foreign Affairs; Ministry of Mines and Energy; Ministry of Agrarian Development; Ministry of Development, Industry and Foreign Trade; Ministry of the Environment; Ministry of Planning, Budget and Management; Ministry of Transport. The original version contained additionally the Strategic Issues Secretary of the Presidency of the Republic., but this ministry was abolished in 2015 cabinet reshuffle.

The National Plan on Climate Change addresses four key themes aimed to tackle climate change: (I) mitigation; (II) vulnerability, impact and adaptation, (III) research and development; and (IV) enhancement of skills and dissemination. The plan includes the development of legal and economic instruments to ensure enforceability of actions under the four themes (Government of Brazil 2008a). The sectoral focus for mitigation and adaptation actions is distinct, with mitigation focusing on forest, agro-livestock systems, energy, waste, construction, industry and transport and adaptation action focusing on health, water resources, coastal and marine areas, agro-livestock systems, human settlements and natural ecosystems. Areas of overlap – agro-livestock systems, coastal areas, natural ecosystems and water resources – represent the areas where policy integration between mitigation and adaptation is more likely to be pursued. Forests are primarily considered for their mitigation potential, as opposed to how impacts of climate change might affect ecosystems and livelihoods.

4.2 Mitigation and Adaptation Objectives in the National Climate Change Policy

The main mitigation objective of the National Policy on Climate Change, announced by President Luis Inácio (Lula) da Silva at COP 15 in Copenhagen in 2009, is the voluntary commitment to reduce emission of greenhouse gases by between 36.1% and 38.9% by 2020 compared to the projected business-as-usual emissions in the same year (Government of Brazil 2008c, Government of Brazil 2009a). In addition, the policy indicates two key aims in the forestry sector: achieving zero net loss of forest cover by 2015 and zero illegal deforestation. These aims are to be pursued through the integration of policies on climate change and the much longer established policies aimed at preventing and controlling deforestation.

The National Policy on Climate Change specifies a number of actions to achieve mitigation targets and they all relate in one way or another to land uses and land use changes. They include: 80% reduction of deforestation in the Amazon biome and 40% in the Cerrado biome by 2020, recovery of degraded pastures, extension of livestock-crop-forest integration projects, expansion of direct planting and forest plantations, improved treatment of animal waste and increases in the use of charcoal from planted forests in the steel industry (Government of Brazil 2008c). Brazil's submission of the intended Nationally Determined Contribution (INDC) to the UNFCCC in December 2015 confirms the commitment and adjusted the mitigation objective to 37% GHG emission reductions below 2005 levels by 2025 and an indicated contribution to 43% by 2030 (Federative Republic of Brazil 2015).

Climate change adaptation objectives and related actions are not specified in detail in the law on the National Policy on Climate Change. The law promotes the development of scientific knowledge on climate change impacts and vulnerabilities and of appropriate technologies, processes, and practices to address adaptation as well as mitigation. In terms of funding it includes the use of financial and economic instruments to promote both mitigation and adaptation and the promotion of international cooperation to fund climate change efforts and of additional measures to combat climate change such as training, technology development, implementation, research and communication (Art. 5 Section VI, VII, X). The law also explicitly includes 'integrated climate change mitigation and adaptation strategies at local, regional and national level' (Art.5 Section IV, Page 2). The INDC has also a section on climate change adaptation, which refers back to the National Adaptation Plan released in 2015 highlighting the promotion of research and technology and the implementation of knowledge management systems (Federative Republic of Brazil 2015).

Within the National Policy and the National Plan on Climate Change, much like in the INDC submission, the guidelines and efforts to address climate change mitigation are much more advanced than those addressing climate change adaptation. Mitigation aims display specificity of objectives, measures, targets and clear timelines, which is not the case for adaptation. The need to develop better knowledge on adaptation is highlighted in the policy documents as a prerequisite to move the adaptation agenda forward.

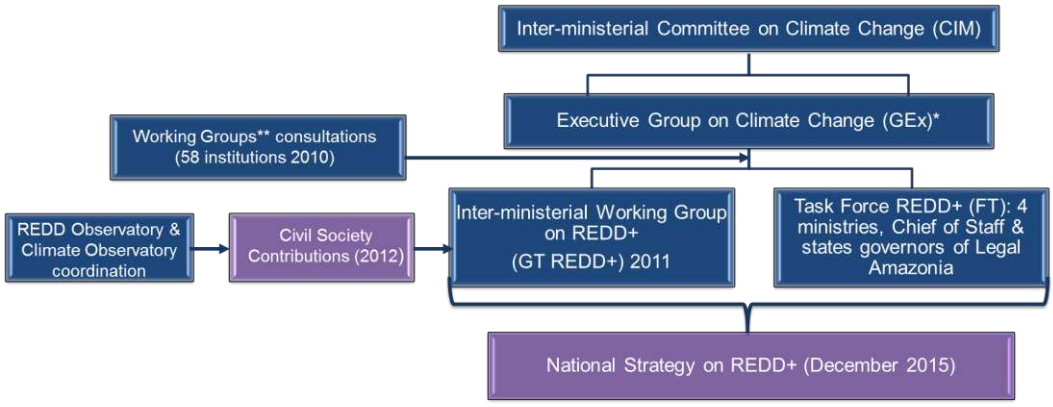
4.3 Climate Change Mitigation and Forest Policies

Brazil used to have the highest rates of deforestation worldwide. Yet, deforestation decreased by around 70% between 2005 and 2013 (Nepstad et al. 2014). A mix of command and control and incentive based policy measures contributed to this decrease. They include improvements in the enforcement of forestry and property laws, the increase in the number of protected areas, a reduction in credit and measures impacting the beef and soy supply chains. Starting in 2004, the program on Detection of Deforestation in Real Time (DETER) and the Plan for the Protection and Control of Deforestation in the Amazon (PPCDAm) facilitated forest monitoring and collaboration among ministries and with enforcement agencies. A few years later the soy moratorium was introduced forbidding soy grown on land cleared after 2006 to be sold. Together with the expansion of protected areas and indigenous territories across the deforestation belt these policies helped to reduce deforestation. In addition, the programme on Critical Municipalities, which suspends credit to farms in municipalities were deforestation is high, has also been very effective in mobilizing local governments to address deforestation in their territory (Nepstad et al. 2014).

With the commitment of the National Climate Change Policy in 2008 to reduce deforestation by 80% in the Amazon by 2020, came new initiatives that provide positive incentives to combat deforestation. With over 1 billion US$ the Amazon Fund is the largest source of climate finance in Brazil supporting forest based climate change mitigation projects through payments based on performance. By 2013, 50 projects had been approved comprising 772 million R$. Of these, 222 million R$ have been disbursed to initiatives ranging from supporting the Rural Environmental Registration (CAR) process, to strengthening prevention and response to forest fires, to conservation and strengthening of environmental controls (BNDES 2014). While improved enforcement made a large contribution to combating deforestation, legal revisions relaxing the rules of the Forest Code also denote the presence of a strong lobby resisting anti-deforestation policies (Soares-Filho et al. 2014).

The most recent federal level policy development was the release of the National REDD+ Strategy in December 2015. The strategy was developed by the Executive Group on Climate Change (GEx) - under CIM - the Interministerial Working Group on REDD+ (GT REDD+) and the REDD+ Task Force (TF) over the course of five years (Figure 2).

Figure 2: Policy Formulation of the National REDD+ Strategy



*GEx - Ministry of Environment (coordination), Chief of Staff of the Presidency, Ministry of Agriculture, Livestock and Food Supply, Ministry of Science, Technology and Innovation, Ministry of Foreign Affairs of Brazil, Ministry of Agrarian Development, Ministry of Mines and Energy, Ministry of Development, Industry and Foreign Trade, and the Brazilian Forum on Climate Change.

**WG1 – Coordination, Institutional Arrangements, Participation; WG2 - Benefits Sharing, Tenure Rights, Safeguards; WG3 - Resources Sources and Financial Mechanisms

GT REDD+ was created in 2011 and worked on the strategy on the basis of recommendations developed through dialogues led by Ministry of the Environment (MMA) with civil society and sectoral institutions. In 2012 the REDD+ Task Force led by Chief of Staff, the state governments of the Legal Amazon, the Ministries of Finance, of External Relations, of Science, Technology and Innovation and of the Environment agreed on key aspects of the strategy. The presence of both GT REDD+ and the TF ensured input of experts within and outside government and the inclusion of different levels of government in the development of the strategy. In addition, civil society provided further input to the GT REDD+. These efforts resulted in the release of a draft document in December 2013. Still, some disagreements remained between the federal institutions and Amazon state governments with regard to benefit sharing (GCF 2014). The draft was then elaborated further, in part to ensure compliance with UNFCCC decisions and the final REDD+ strategy was released in October 2015, shortly before COP21 in Paris.

The main objective of the National REDD+ Strategy is to "contribute to climate change mitigation through the elimination of illegal logging, the conservation and restoration of forest ecosystems and the development of sustainable forest low carbon economy, generating economic, social and environmental benefits". It aims to reduce emissions by 80% in the Amazon and by 40% in the Cerrado compared to the between 1999-2008 average (Government of Brazil 2015, p.17).

The strategy establishes new governance arrangements to implement the REDD+ strategy, general and specific objectives, mechanisms to raise financial resources, and implementation measures. The National Commission for REDD+, comprising 7 ministries 2 state government, 1 municipality and 2 civil society representatives, was established in 2015. It is responsible for the coordination, support and monitoring implementation of the strategy. It is assisted by the Executive Secretariat, a number of Consultative Thematic Chambers (still to be specified) and a Technical REDD+ Working Group (Presidency of the Republic of Brazil 2015).

The national REDD+ strategy does not include the development of a 'new' specific REDD+ policy. Instead, it aims at integrating climate change mitigation objectives into pre-existing policies on preventing and combating deforestation, which have been operating in Brazil since the last decade. The coordination of policies on climate change, biodiversity and forests is at the heart of the plan for action, together with the delivery of effective MRV systems and the collection and distribution of results-based payments. Coordination includes the development of an 'impact matrix' to analyse the effectiveness of different policies in contributing to REDD+ objectives. Fundraising will follow performance based ex post approaches and the Green Climate Fund should ensure adequate and predictable funding. Unlike many other REDD+ countries, in the INDC, Brazil has opted to reject the use of international offsetting mechanisms. This might not just limit international funding sources, but is likely to increase disagreement between federal and state governments. Between 2008 and 2010 five states of the Legal Amazon (Acre, Amapá, Amazonas, Mato Grosso and Pará) signed MoU's with US states aimed at future carbon trading. The REDD+ strategy also addresses REDD+ safeguards, and emphasises the multiple objectives of REDD+, including biodiversity and socio-economic improvements, but does not discuss climate adaptation under the safeguards. It also does not define any specific benefit sharing mechanism and only indicates a vague commitment to equity and for benefits to reach all stakeholders.

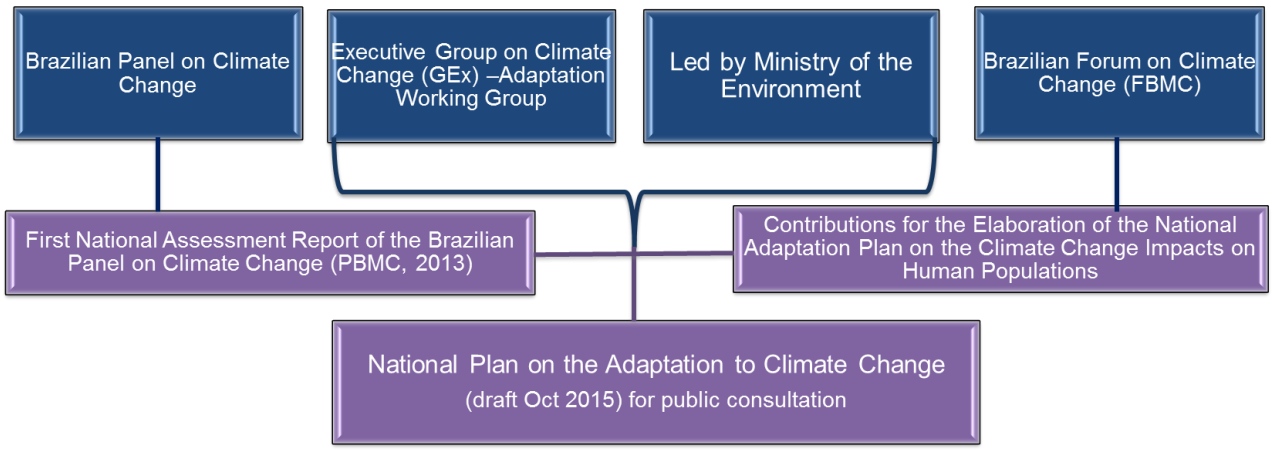
4.4 Climate Change Adaptation and Mitigation in Land Use Planning and Agriculture

A. The National Plan for the Adaptation to Climate Change

A draft of the National Plan on the Adaptation to Climate Change (from now on referred to as National Adaptation Plan or PNA) was released for public consultation on the 9th of October 2015 in advance of the Paris COP 21 meeting, although the launch had originally been planned for December 2014.The plan is also mentioned in the Pluri-Annual Plan (PPA 2012-2015) as one of the sub-programs under climate change. The development of the PNA has been coordinated by the Adaptation Working Group created in 2012 under the Executive Group (Gex) of the CIM and led by the Ministry of Environment (MMA) and the Ministry of Science, Technology and Innovation (MCTI). The working group's mandate includes the establishment of the objectives, the governance arrangements and proposed actions for climate change adaptation. The process entailed the input of specialized thematic networks on water, biodiversity, coastal zones, and federal climate

arrangements, various multi-stakeholder bodies including the FBMC's Working Group and Climate Change, Poverty and Inequality (COEP 2011a, COEP 2011b), the assessment reports of the Brazilian Panel on Climate Change (PBMC), ICLEI Brazil and Observatório do Clima's work on ecosystem-based adaptation, the technical expertise of Center for Monitoring and Early Warning of Natural Disasters (CEMADEN), and the scientific publications of experts from the Brazilian Research Network on Global Climate Change (Rede Clima) (Figure 3).

Figure 3: Policy Formulation of the National Adaptation Plan



The main objective of the PNA is to "promote the management and reduction of climate risk in terms of the adverse effects of climate change, to take advantage of emerging opportunities, avoid damages and build instruments that allow the adjustment of the natural, human, productive systems as well as of infrastructure" (GEx-CIM and MMA 2015a, p.6).

With regards to policy integration the PNA adopts eight general guideline principles for integrating climate change risk management into public policies which are relevant to both external and internal integration. The first principle calls for coherent and complementary cross-level governance measures (across federal, state and municipal level). Other principles refer to horizontal governance in climate change adaptation and the need to facilitate integrated cross-sectoral approaches to adaptation, the promotion of Ecosystem-based Adaptation (EbA), the need to integrate and align adaptation with national development planning, with particular attention to poverty reduction and addressing inequality, as well as the implementation of integrated measures of adaptation and mitigation (labeled as 'co-benefits').

The plan is organized around sector and theme categories to help identify specific sectoral, regional and territorial vulnerabilities and identify priorities in each area. For each category there is a specific adaptation strategy. The categories are: agriculture, biodiversity and ecosystems, cities, natural disasters, industry and mining, infrastructure, (energy, transport and urban mobility), people and vulnerable communities, water resources, health, food security and nutrition and coastal zones. Four of these, food security, nutrition, water resources and energy, are considered priority areas for the management of climate risk. The main aims within the agricultural sector are to analyse the vulnerability of the sector to climate change, support actions to improve resilience of agroecosystems, and the development and transfer of technology for adaptation. They also include the support of revisions to the ABC plan. The responsibility for adaptation in the agricultural sectors resides with MAPA and EMBRAPA and the plan includes the establishment of two new institutions - a Center for Climate Smart Agriculture (Centro de Inteligência Climática da Agricultura) and a Communication and Early Warning Network (Rede de Comunicação e Alerta) – and the

development of support contingency plans for the agricultural sector in relation to climate change risk.

Within the agricultural sector the PNA refers to existing policies that contribute to adaptation in agriculture, some of which we discuss later in more detail. They are the ABC Plan, the Agricultural Climatic Risk Zoning Programme (ZARC), the agricultural storage and processing policies that address climate impacts on prices, the general agriculture insurance programme PROAGRO, the programmes PROAGRO MAIS and SEAF targeting smallholders, and the National Policy and Plan on Agroecology and Organic Production (PLANAPO). Finally, the PNA mentions the Forest Code (Lei Nº 12.651/2012) as a policy contributing to adaptation aims in relation to conservation and improvement of water flows, as well as the Integrated Crop-Livestock-Forest Systems (iLPF) and the National Policy on Planted Forests (PNFP).

During the first stages of the development of theme categories, agriculture and food security and nutrition were considered as a single theme, but they were later divided into two separate theme categories as the Adaptation Working Group considered them as distinct themes with different, but overlapping characteristics. The food security and nutrition theme focuses specifically on vulnerability of populations and resilience of food production systems. It advocates agroecological farming approaches as the most suitable to support agricultural resilience of smallholders.

In relation to the theme of biodiversity and the environment, the strategy was developed by the MMA's Secretariat of Biodiversity and Forests (SBF) and the Secretariat of Climate Change and Environmental Quality (SMCG). Implementation involved numerous bodies of the National Environment System including IBAMA, the Chico Mendes Institute for Biodiversity Conservation (ICMBIO), and the Brazilian Forestry Services.

Apart from the strong focus on Ecosystem-based Adaptation (EbA), much emphasis is on biodiversity and plans that include the monitoring of ecosystem services - mitigation of GHGs being one of them - in 50 federal conservation units under the responsibility of the ICMBIO under the MMA. The EbA approach is one explicit way to bring together adaptation and mitigation measures, contributing to internal climate policy integration. There is also a strong focus on the link between ecosystem services and the development of economic incentives to maintain these services. The main objective is to make conservation and biodiversity policies effective in contributing to climate change objectives, including maintaining and increasing the provision of ecosystem services, reduce ecosystem fragmentation and reduce the susceptibility to forest fires (GEx-CIM and MMA 2015b).

The PNA discusses some of the main climate change impacts on the different biomes, but seems to focus actions around adaptation in the Cerrado and Caatinga as opposed to the Amazon biome, where the focus is instead more on climate change mitigation and forests. This is reflected in the section on the theme 'people and vulnerable communities', where the measures of action to improve adaptive capacity of sensitive groups in the Amazon biome does not include any new policies or measures that focus exclusively on adaptation. Instead it refers back to existing policies and measures such as the agrarian reforms, and support measures such a Bolsa Família, and Bolsa Verde, and PPCDAM to maintain sustainability and combating deforestation, which also contribute to adaptation aims. In comparison, for the Cerrado there is a much more specific focus on undertaking new vulnerability studies, mapping priority areas for the reduction of vulnerability, addressing extreme events and new adaptation research led by EMBRAPA and INPE (GEx-CIM and MMA 2015b, p.256). This is also evident in relation to the creation of new protected areas, with adaptation

to be prioritized in the Caatinga, Cerrado, Pantanal and Pampa biomes and in costal and marine protected areas.

While the PNA is still in draft form, other policies, programmes and initiatives that reduce vulnerability to climate variability and risk in agriculture, have existed in Brazil since the 1960s. Increased adaptation action occurred since the establishment of the Brazilian Corporation for Agricultural Research (EMBRAPA) in 1972 under the Ministry of Agriculture and Food Supply (MAPA). Most programmes have as their main aim the support of agricultural development, the development of new technologies to increase productivity, the diversification of agriculture and to address agricultural losses due to climatic conditions. Examples of climate change related actions in agriculture include the introduction of new cultivars and combination of crops, improvement in soil management, changes in farming calendars, and agriculture financing (Valdes et al. 2010).

B. Land use planning and climate change

Land use planning instruments also contribute to adaptation action in agriculture and were first mentioned in the National Environmental Policy (Law 6.938/1981). During the nineties, a working group on Ecological and Economic Zoning (ZEE), the National Coordination Commission and the Ecological-Economic Zoning Programme for the Legal Amazon were established and capacity building efforts started. Since 2000 the Federal Government enhanced the role of ZEE with the inclusion in the Pluri-Annual Plans and through a federal decree (Decree 4.297/2002) to regulate its policy instruments. In 2006, the Ministry of Environment together with the ZEE Consortium launched a guideline document for ZEE implementation at federal and state levels, which is in now in its 3rd edition. This document recognises the tension between fighting deforestation and the intensification of land use for agribusiness. However, the ZEE does not include any specific climate related guidelines for zoning purposes. This changed in 2010, with the release of the Decree approving the Ecological-Economic Macro-Zoning of the Legal Amazon (Macro-ZEE) (Decree 7.378) developed by the Ministry of Environment, the Consortium ZEE-Brazil and the Amazon states. The latest document on zoning in Brazil clearly refers to climate issues and places the Amazon biome at the centre of climate change concerns. Overall the strategies of the Macro-ZEE seem consistent and aligned with the objectives of the National Policy on Climate Change. There is a clear effort to connect proposed zoning actions with mitigation efforts related to fighting deforestation and land use change and to reduce vulnerability to climate change through actions focused on ecosystem services including biodiversity, water and PES. However, ZEE is restricted in its applicability to adaptation and mitigation planning, since it is more of a land use guidance tool than a measure to restrict application of funds or expansion of frontiers. One particular way in which ZEE is actually counterproductive to REDD+ is the allowance in the national Forest Code to reduce forest cover up to 50% on properties in Amazon forest segments of states' territories if the state has passed a ZEE law. Alternatively, REDD+ could provide an incentive to restore more.

One key policy is the Agricultural Climatic Risk Zoning Programme (ZARC) launched by MAPA in 1995 developed with the technical expertise of EMBRAPA. The programme addresses climate risk in agriculture and identifies the best distribution of key crops in relation to both soil and climatic conditions in order to reduce production losses. It is a tool for agricultural policy and risk management and implemented in 24 Brazilian states (Zullo Jr et al. 2013). It used to be based on historical climate data that include soil characteristics, crop cycle data and water demand to quantify climate risk. Today ZARC uses also climate change projections (Zullo Jr et al. 2006, Pinto et al.

2008) to understand prospective impacts on the main cash crops. The programme includes an annual analysis of 44 crops and it aims to support climate risk management in agriculture for financial institutions, insurance companies, farmers and technicians, indicating the timing, period and areas of low climate risk, avoiding losses and increasing productivity and incomes for specific crops. The ZARC is also a reference tool for agricultural credit (Zullo Jr et al. 2015). ZARC takes into account Forest Code rules in terms of the prohibition to plant in conservation areas, but it is not explicitly integrated to the ZEE. Yet ZARC, very much as ZEE, remains primarily a land use guidance tool, as opposed to a climate change adaptation tool, indicating that climate change adaptation efforts in agriculture remain limited today. None of the zoning tools mention climate change mitigation.

C. Agricultural policies and the potential for bridging mitigation and adaptation

At present the most explicit climate change adaptation policy efforts in the land use sector relate to the development of integrated sectoral plans for mitigation and adaptation mandated by the PNMC. These includes, the Action Plan for Prevention and Control of Deforestation in the Legal Amazon (PPCDAm), which started in 2003 and is now in its 3rd phase, the Action Plan for the Prevention and Control of Deforestation and Fires in the Cerrado (PPCerrado), and the ABC Plan and its related credit line ABC Programme. The PPCerrado and the ABC Plan were released in 2011 (Government of Brazil 2012, Obermaier and Rosa 2013).

Another agricultural policy to explicitly mention both climate change adaptation and mitigation is the National Plan for Agroecology and Organic Production (PLANAPO), developed under the Ministry of Agrarian Development (MDA) (Decree Nº 207 7.794/2012). The policy and plan aim to support the expansion of agroecological and organic agriculture with guidelines and funding sources. This policy brings together aims of sustainability, food security, environmental justice and climate mitigation and adaptation (Câmara Interministerial de Agroecologia e Produção Orgânica 2013). Yet, the problem is limited in terms of resources.

The ABC Plan is more well resourced and with its main focus on climate change mitigation it aims to 'stimulate sustainable practices in agriculture that reduce GHG emissions and increase carbon sequestration' (Government of Brazil 2012, p.38). The more specific objectives include the implementation of the Brazilian mitigation commitment signed at COP 15, the promotion of efforts to achieve zero illegal deforestation, the adoption of sustainable practices in agriculture and the support for new research on adaptation of crops to climate change. Led by the MAPA and the MDA , the main mitigation actions under the plan are increased restoration of degraded pasture, integrated crop-livestock-forest systems, no-till approaches, biological nitrogen fixation, planted forest and treatment of animal waste. The main adaptation instrument is the development and implementation of a programme for climate smart agriculture that includes the production of future climate change scenarios, vulnerability assessments, early warning systems, improved resilience of production systems and rural communities, and research and development on new crop varieties and pest risk analysis. The financial mechanism for the ABC plan, the ABC Programme (Programme for the Reduction of Greenhouse Gas Emissions in Agriculture) was established in 2010 and provides a credit line of up to one million R$ per year to producers (Banco Central do Brasil 2010). Yet, the goal of the ABC Programme mentions only climate change mitigation and not adaptation. Thus, while the ABC Programme provides financial resources, in the form of low-cost credit, to support intensification of agro-livestock practices and application of best practices, unlike the Plan, the

Programme itself does not explicitly consider the linkages between mitigation and adaptation. There is also a small credit line for ABC organic.

Implementation of the ABC plan has been slow. A study by the Amazon Environmental Research Institute (IPAM) identified barriers including, uncertainty on the impacts of revisions of the Forest Code, weak state level institutions, lack of confidence in REDD+, lack of knowledge about integration and intensification, limited spread of certification programs, lack of technical assistance and access to low-interest credit and high costs of compliance for environmental legislation for small and medium producers (Stabile et al. 2012). In addition, the number of producers and projects developers trained remains very low (20,000 between 2011 and 2013) compared to the overall targets surpassing 900,000 producers. The reason seem to be budget and staff constraints within MAPA and MDA, despite substantial resources being committed by the National Treasury (Observatório do Plano ABC 2014). In the Amazon biome access to ABC provisions requires Rural Environmental Registration (CAR, Resolution 3545/08 BACEN) and financial and technical knowledge barrier make it difficult for small producers to complete the registration. In 2012-2013 only 48% of allocated resources had been distributed and in May 2015 only 40% of all possible registrations have been completed (Agencia Brasil 2015, Garrett and Rausch 2015). Better integration between the ABC plan and PRONAF (National Programme for Family Farming Assistance) has been called for in order to improve access to ABC plan resources for smallholders (Observatório do Plano ABC 2014). Also, compared to the amount of finance for regular credit programs supporting agriculture, credit to support low-emission

Within the land use sector, the ABC plan holds the most potential for the development of integrated actions for climate change mitigation and adaptation. Yet, it's financial mechanism focusing exclusively on mitigation, could reduce opportunities to better exploit synergies between the two. In the forest policy domain the climate policy coding and investigates in much more detail how climate change and key land use policies treat positive and negative interactions between mitigation, adaptation and non-climate objectives.

5. CLIMATE CHANGE POLICY COHERENCE IN FORESTS AND AGRICULTURE

5.1 Positive Interactions between Mitigation and Adaptation

A. Overview on Interactions

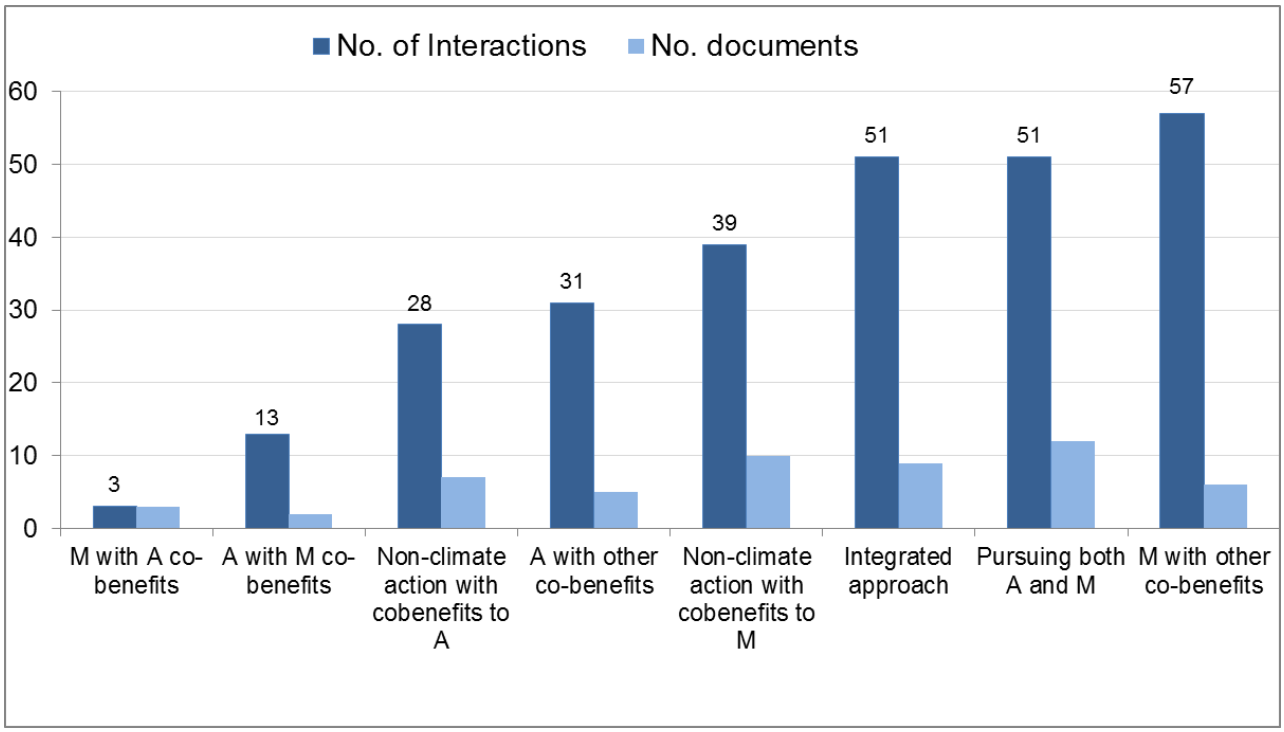
Out of all positive interactions mentioned in the policy documents the vast majority refers to mitigation actions/aims that contribute to benefits in non-climate domains, such as other environmental, social, and economic development objectives. The vast majority of these are found in the PNMC. This is followed by integrated approaches, which recognize mutual benefits from mitigation and adaptation action, and undertaking both mitigation and adaptation actions and aims, but without expressly mentioning interactions between the two – labeled as 'pursuing both mitigation and adaptation'. Non-climate actions that contribute to mitigation, such as payments for ecosystem services from conservation activities follow with just under 40 mentions (Figure 4).

Interactions between adaptation and non-climate objectives appear around half the times than interactions between climate change mitigation and non-climate objectives. Adaptation with

mitigation co-benefits – are mentioned 13 times but in only 2 of the policy documents, the vast majority of which appears in the National Adaptation Plan (11). In comparison, discussion of co-benefits of mitigation for adaptation is almost completely neglected with only 3 mentions across all policy documents.

Overall, these results indicate that discussion of integrated approaches is quite prominent in some of the policy documents, while discussion of co-benefits between mitigation and adaptation are the least frequent, in particular co-benefits from mitigation action to adaptation. Integrated approaches are primarily discussed in four policy documents. The majority is mentioned in the main joint mitigation and adaptation policy developed so far in the land use sector (the ABC Plan), which is closely followed by the PNA. The other two documents are the 2012-2015 and the 2016-2019 PPA. The latter two reflect efforts to integrate mitigation and adaptation jointly in national development plans. Yet, integrated approaches are hardly mentions in the REDD+ strategy draft (3 mentions).

Figure 4: No of text passages and no of documents referring to different types of positive interactions

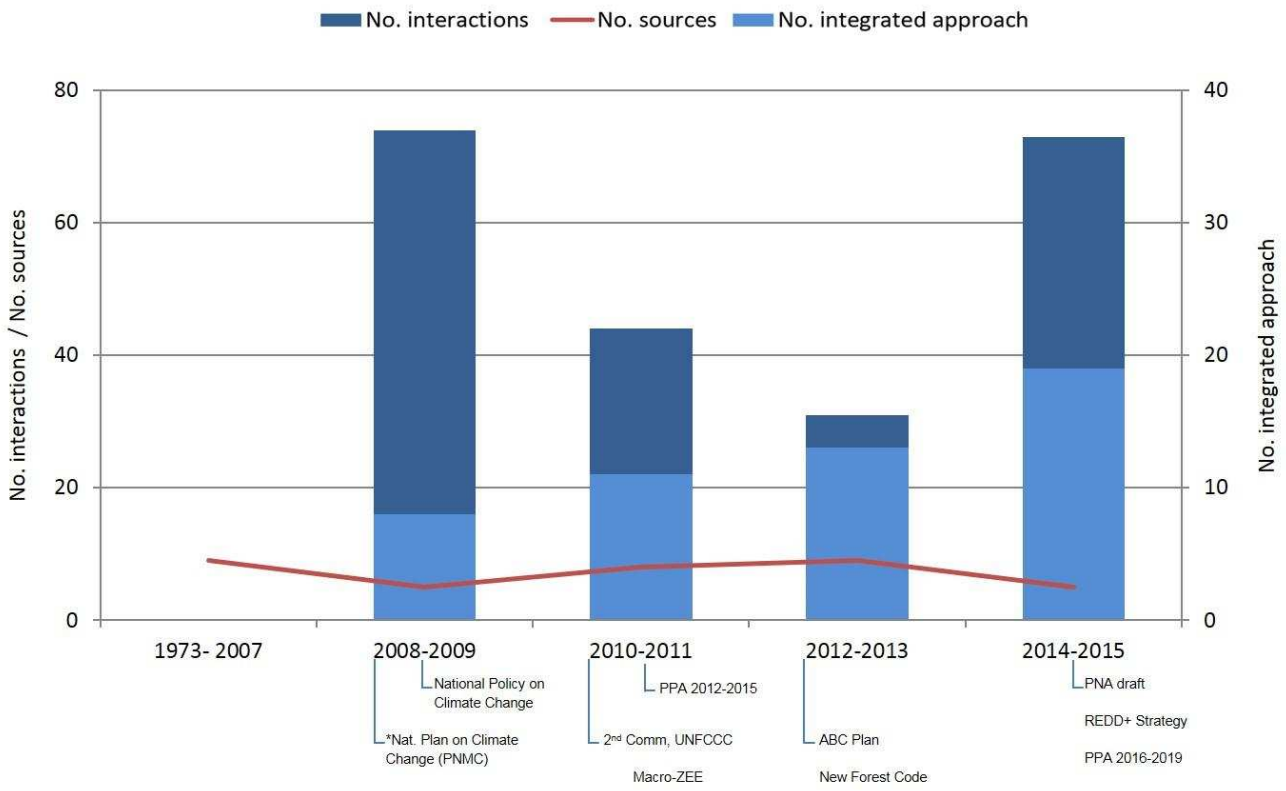


A= adaptation; M= mitigation

Positive interactions between mitigation and adaptation as well as with other sectors start to be explicitly discussed after 2007. In 2008 with the release of the National Policy on Climate Change and then the PNMC mentions of interactions reaches a first peak. It then decreases over time to around one third in 2012-3, despite a slight increase in the number of policy documents released. Between 2010 and 2013 the main references to linkages between mitigation and adaptation are found in the 2nd Communication to the UNFCCC in the first sectoral climate change policy in the land use sector, the ABC plan. References to interactions resume again in 2014-2015 with the release on PNA, the National REDD+ Strategy and PPA 2015-2019. Out of all positive interactions, references to integrated approach show a steady increase over time, clearly indicating increased attention to joint mitigation and adaptation planning as time progresses (Figure 5).

In the following sections we look more closely at the mentions of different types of interactions and how and in relation to which sectors or focus areas interactions are discussed[3].

Figure 5: No. of text passages and no. of documents referring to all types of positive interactions



*: policies with highest interaction counts within each period

B. Co-benefits of Mitigation

The most numerous references to interactions relate to mitigation co-benefits to non-climate objectives (57 text passages). Within these passages, reference to specific sectors or areas occurs 107 times. The most mentioned sectors are: sustainable development (27) and environment & biodiversity (27), energy (17), agriculture (10) and forestry (9) (Figure 6).

The vast majority of these mentions are contained in two documents: the PNMC (40 text passages) followed by the Summary of Information on REDD+ Safeguards (10 text passages)[4]. This is in stark

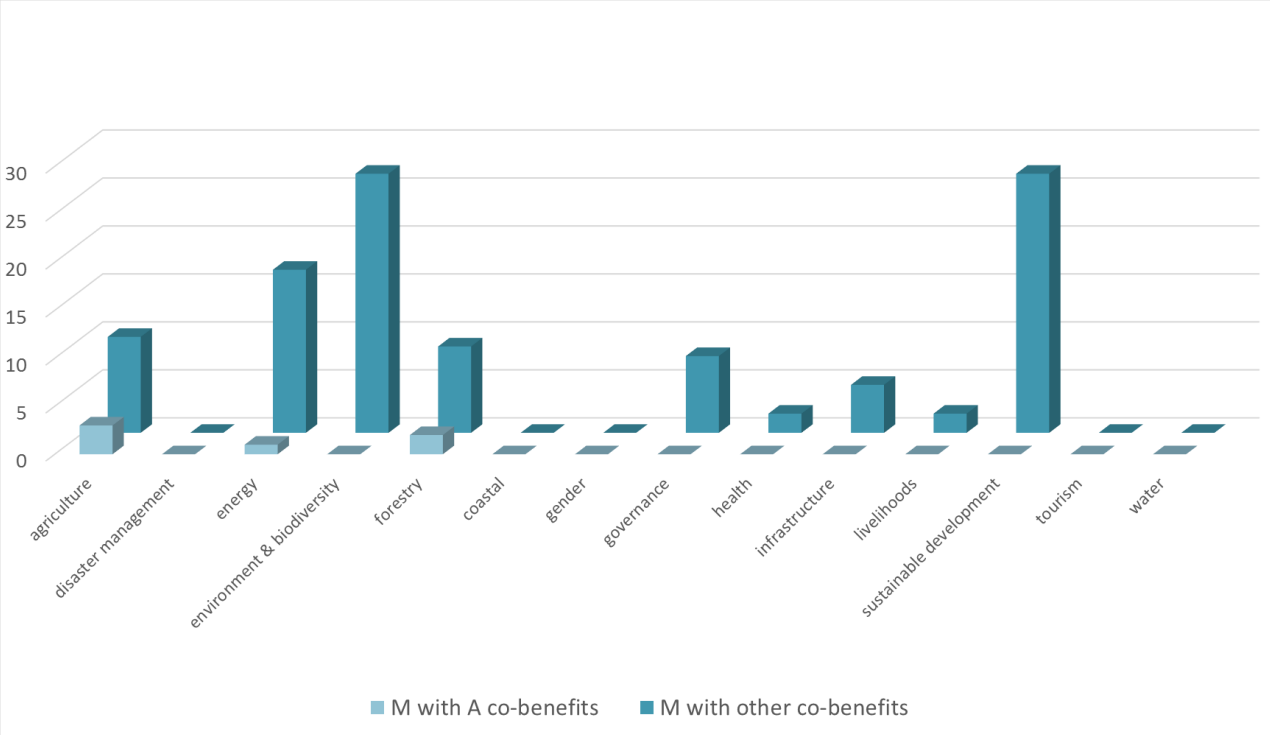
[3] Note that counts by sector might differ from overall interactions counts, as 1 mention of interaction can refer to no specific or multiple sectors.

[4] The Summary of Information on REDD+ Safeguards is an international level document submitted to the UNFCCC by Brazil in advance of COP21, which synthesises the main safeguards that Brazil had already in

contrast with the national REDD+ strategy itself, which does not discuss any specific co-benefits from climate change mitigation (and unlike the 2013 draft version). The PNMC passages discuss primarily co-benefits of mitigation contributing as well to economic and sustainable development objectives in the energy and forestry sectors. The REDD+ safeguard document stressed instead the need to ensure that mitigation actions contribute to be economic and sustainable development and poverty alleviation as well as other environmental and biodiversity objectives.

The three text passages in the Second Communication to the UNFCCC that refer to non-climate co-benefits, mention co-benefits related to the energy sector, economic development and forest conservation and management. The one text passage on co-benefits from mitigation actions in the Macro-ZEE policy of the Legal Amazon describes potential co-benefits of CDM projects to the Amazonian communities, namely improvements in environmental sustainability, in the economy and jobs generation, income distribution, technological development, regional integration and cross-sectoral articulation.

Figure 6: Co-benefits of mitigation by sector*



*: Counts by sector might not match counts of text mentions of interactions as one text mention can refer for more than one or no specific sector.

Only 3 text passages explicitly refer to mitigation actions with co-benefits to climate change adaptation, and they refer to forestry, low emission agriculture and integrated forest-agricultural system and energy use. In particular, the PNMC considers the Integrated Crop-Livestock-Forest

---

place from 2006-2010 and were included in REDD+ related policies such as PPCDAM, Amazon Fund procedures etc

Systems (iLPF) and agroforestry systems (AFL) - part of the ABC plan - as programmes aimed at carbon sequestration, which at the same time facilitate climate change adaptation through rehabilitation of soils. The policy on Forest Rehabilitation and Implementation of Agroforestry mandates that reforestation has to provide alternative economic opportunities as well as enhance food and energy security. The second mention is in the ABC plan and refers to no-tillage systems, which apart from reducing emissions are indicated as an adaptation measures contributing to maintain soil cover and support diversification of crops. The plan indicates that these should be linked to conservation agriculture. The third reference to mitigation co-benefits to adaptation in the 2nd Communication to the UNFCCC and discusses the interactions between deforestation and climate change. It refers to evidence from research that suggests that mitigation actions that reduce deforestation also contribute to reduce vulnerability of forests to climate change. Yet, the point is also made that there are less options to address forest adaptation needs in natural forest compared to forests that are more intensively managed. Overall, the low number of text passages describing mitigation actions with co-benefits to adaptation, suggests that policies and plans that focus specifically on mitigation – including the REDD+ strategy – fails to address possible interactions with climate change adaptation.

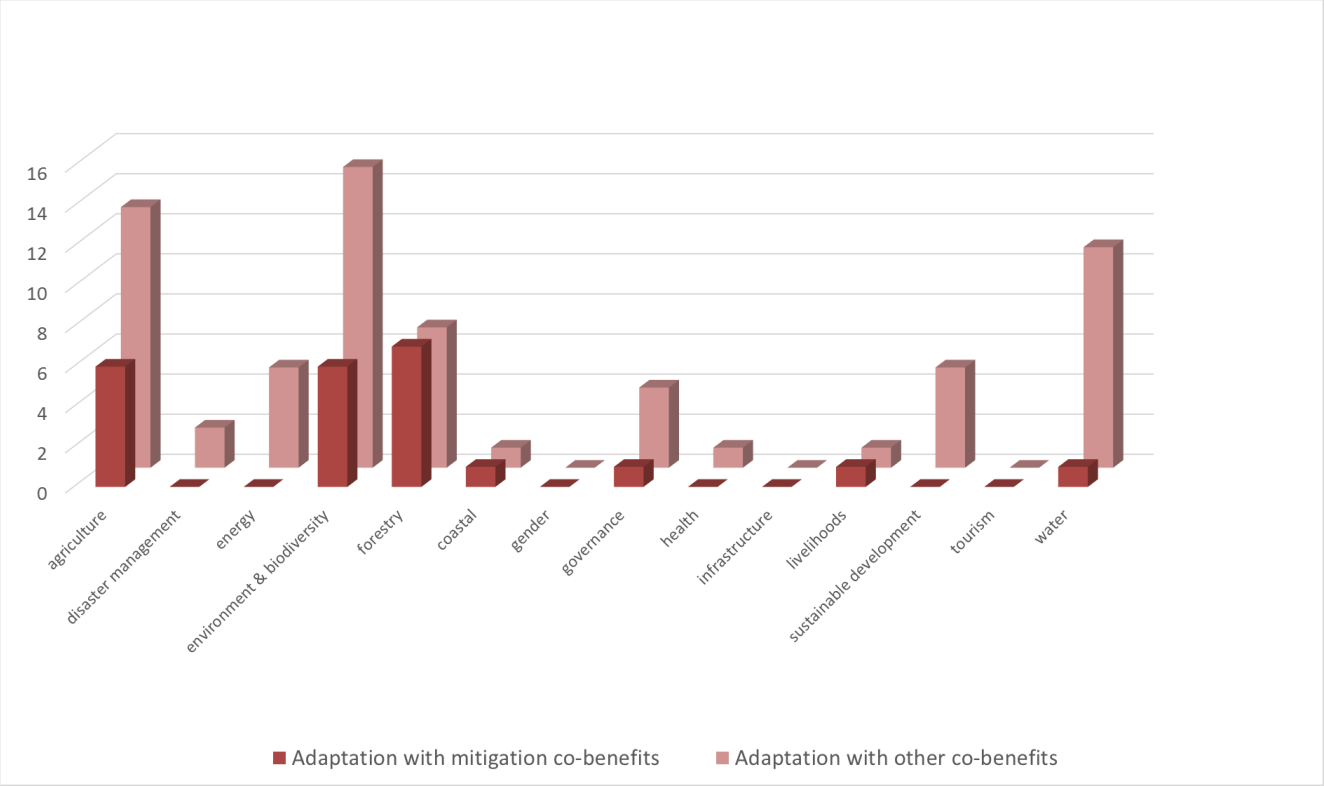
C. Co-benefits of adaptation

Co-benefits from adaptation refer predominantly to benefits to non-climate objectives (31 text passages) with only 13 passages referring to co-benefits of adaptation for mitigation, 11 of which are included in the PNA. In terms of mentions of sectoral focus, references to co-benefits to non-climate objective cover predominantly the environment and biodiversity (15 mentions), agriculture (13) and the water sectors (11), followed by forestry (7) (Figure 7).

Instead most references to adaptation co-benefits to mitigation refer to forest (7) agriculture (6) and environment & biodiversity (6). The text passages in the PNA refer to measures to combat forest fires, followed by the development of new agricultural practices to overcome impacts of extreme weather, which can might also promote GHG emission reductions. Measures that promote adaptation capacity and resilience for food security are indicated as potentially contributing also to mitigation efforts. The 2nd Communication to the UNFCCC has 2 references to adaptation co-benefits to mitigation: one suggests that the prevention of forest fragmentation and integrated crop-forest systems serve not just adaptation, but also mitigation efforts.

References to adaptation with co-benefits for non-climate objectives are most extensively discussed in 2 documents, the PNA (14) and the PNMC (12). Some mentions are also found in the Second Communication to the UNFCCC (2), the ABC plan (2) and PPA 2012-2015 (1).

Figure 7: Co-benefits of adaptation by sector*.



*: Count by sector might not match count of text mentions as one text mention can refer for more than one or no specific sector.

The PNA underlines that adaptation measures can contribute to multiple objectives and sectors, as food security and other environmental services like biodiversity, the protection of water sources and forest conservation. The policy is quite explicit about the need to support climate change adaptation measures in the land use sector that provide additional co-benefits for broader sustainability goals and recognize the linkages between agriculture and forests in this area.

The PNMC describes the benefits of adaptation actions under the National Action Plan to Combat Desertification and the Mitigation of the Effects of Drought (PAN), a pre-existing policy from 2004, which focuses on semi-arid and dry sub-humid regions and their surroundings comprising mainly the North-East of Brazil and North of Minas Gerais state. Co-benefits relate to four target areas of the anti-desertification programme, namely the reduction of poverty and inequality, the improvement of sustainable productive capacity, the conservation, preservation and sustainable management of natural resources, and the strengthening of institutions and democratic management. The plan highlights the gains in terms of governance and sustainable development from an integrated management of the Prata Basin, shared among Argentina, Bolivia, Brazil, Paraguay and Uruguay. The plan also includes instruments for climate change adaptation as the coastal flood risk mapping to inform decision makers on where to focus adaptation and coping strategies to avoid human and material losses. As for most references to adaptation, the need to strengthen networks for research and development on climate change adaptation is underlined, in particular, in relation to vulnerability scenarios and impacts on biodiversity.

The ABC Plan refers only twice to adaptation benefits to other sectors. Like the PNA it indicates that adaptation strategy seeks to generate the resilience of agricultural systems and the sustainable use of

biodiversity and water resources, while ensuring economic benefits from increased agricultural productivity through intensification and investment in research, development and innovation. It pursues an adaptive form of agriculture, based on methods aimed at enhancing productivity (May and Da Vinha 2012). Yet, the ABC Programme – the credit policy associated with the ABC Plan - only indicates emission reductions in agriculture and reducing deforestation as the goal of the programme, which could reduce the ability to finance adaptation measures. In addition, the limited uptake of credit lines to the ABC Plan reduces the current effectiveness of the policy, in particular for smallholders.

The need for more research on adaptation is stated in the 2nd Communication to the UNFCCC, which describes plans to foster science, technology and innovation as a way to generate more precise information and improve the capacity to forecast impacts and copying strategies. The analysis of impacts focuses on adaptation measures related to water resources in semi-arid regions that may affect the electric energy supply, agricultural production, ecosystems as well as human consumption.

D. Integrated approaches

Almost half of the policy documents coded mention at least once pursing both adaptation and mitigation, yet explicit reference to integrated approaches, highlighting the linkages or the advantages of pursuing them together appear in only one third of the documents and with less frequency (Table 2).

Table 2: Policies with most references to integrated approaches

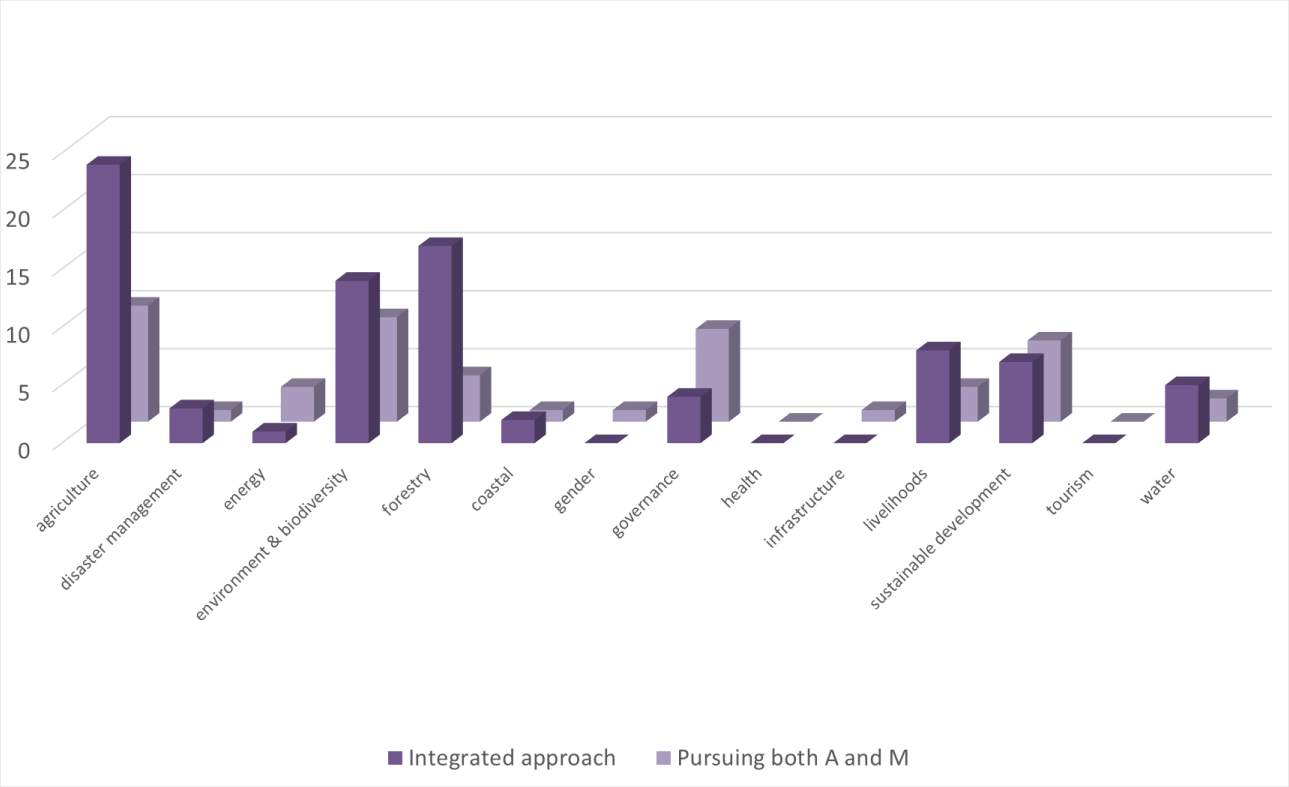
Policy	**No. of text passages on integrated approaches (% of total)**
ABC Plan (2011)	12 (24%)
PNA draft (2015)	11 (22%)
Pluri-Annual Plan 2016-2019	8 (16%)
Pluri-Annual Plan 2012-2015	7 (14%)
National Plan on Climate Change (2008)	6 (12%)
Total no text passage on integrated approaches	**51 (100%)**

In terms of sectoral focus (85 mentions), integrated approaches are discussed with reference to agriculture and livestock systems (24), followed by forestry (17), environmental and biodiversity (14), and sustainable development (7).

Integrated approaches start to be discussed in policy documents from 2008 in the National Plan and later in the National Policy on Climate Change. The National Policy on Climate Change includes achieving mitigation and adaptation as two central aims (Art.4) and explicitly indicates among the guidelines, the direction to pursue 'integrated strategies of climate change mitigation and adaptation at local, regional and national levels' (Government of Brazil 2010). The National Plan on Climate Change goes into further details, with 12 text passages on integrated approaches, indicating under the priorities for the first phase to 'identify and create new opportunities to enable the exchange of experiences and the integration of actions' in order 'to maximize the positive results of all national efforts in favor of global climate and strengthen the adaptive process of the country to the climate system.' (Government of Brazil 2008c, p.14-15). Most references to integrated approaches refer to

new research, projects and actions on carbon monitoring, vulnerability to and economic assessment of climate change and discuss the need to identify joint measures and opportunities that contribute to both mitigation and adaptation.

Figure 8: Integrated approaches and pursuing both adaptation and mitigation by sector*



*: Count by sector might not match count of text mentions as one text mention can refer for more than one or no specific sector

Yet, the policy that discusses more extensively integrated approaches is the ABC Plan itself (12 text passages), the only sectoral plan on both mitigation and adaptation in the land use sector. The plan has the overall objective to promote greenhouse gas emission reductions, increase resilience of agricultural production and livelihoods and facilitating adaptation to climate change in the agricultural and livestock sectors (Government of Brazil 2012, p.38) and expressly seeks to promote actions and the development and dissemination of technologies that have been proven to contribute to both emission reductions and adaptation to climate change impacts. Particular attention is given to technical assistance and role of extension services to strengthen the capacity of farmers to address both objectives in an integrated way within the Integrated Crop-Livestock-Forest Systems iLPF and Agroforestry Strategy (AFL).[5] Yet, the finance mechanism of the ABC Plan, the ABC Program, only mentions mitigation and financial source for adaptation in the ABC Plan are indicated to be funds such as the Amazon Fund and the Climate Fund.

The PNA has the second highest number of text passages (11) on integrated approaches. Most of these refer to linkages between agriculture and forestry sectors and underline how agricultural adaptation measures should achieve mitigation objectives at the same time. The nexus of food

[5] The iLPF Strategy and Agroforestry Systems include four different types of systems: integrated crop-livestock systems, crop-livestock-forest systems, livestock-forest systems and agroforestry systems.

security, adaptation and mitigation through actions that increase both agricultural productivity, create more resilient agricultural systems and contribute to reducing deforestation and rehabilitation of degraded land are at the center of these discussions.

Such a strong focus on integrated approaches in both the PNA and in the ABC is in stark contrast with the complete absence of mention in the National REDD+ Strategy and the Summary on REDD+ safeguards. This clearly indicates that attention to integrated approaches is underlined in the adaptation and agricultural policies, but is completely neglected in the forest mitigation policies, despite the fact that one of the Cancun REDD+ safeguards refers explicitly to adaptation. Yet, the Brazil Summary on safeguards does not discuss adaptation at all.

There are also clear indications of the inclusion of integrated approaches to climate change in the two Pluri-Annual Plans (2012-2015 and 2016-2019). The first PPA refer to integrated approach and the ABC Plan and in particular to the Recovery of Degraded Pastures and Integrated Crop-Livestock-Forest Systems (Recuperação de Pastagens Degradadas e Integração Lavoura-Pecuária-Floresta - iLPF), programs to combat deforestation and forest fires and the financing of climate change actions. The second PPA highlights integrated approaches in the National Plan on Climate Change with particular emphasis on linkages to combat deforestation and between disaster management, adaptation and the simultaneous promotion of mitigation.

The 2nd Communication to the UNFCCC reports evidence from studies about the importance of interactions between mitigation and adaptation (Marengo 2008) and indicates as a priority the need to 'increase the knowledge on the synergies between adaptation and mitigation practices' (CMGC 2010, p.465).

Apart from references to integrated approaches, many documents refer to the importance to pursue both mitigation and adaptation, yet without specifying that they should be pursued as part of an integrated approach (Figure 6 'pursuing both M and A'). These text passages are as numerous as those referring to integrated approaches (51), and they appear most often in the same documents that refer to integrated approaches. Sectors most mentioned in the text passages are: agriculture (10 times), environmental and biodiversity (9), governance (8) and sustainable development (7), followed by forestry (4) (labelled as pursuing both M and A in Figure 8).

E. Benefits of non-climate activities and plans to adaptation and/or mitigation

A number of actions in non-climate specific domains were mentioned to deliver mitigation or adaptation benefits. Adaptation benefits from non-climate activities are discussed in 28 text passages with 51 references to specific sectors, while benefits to mitigation are found in 31 text passages with 70 sectoral references.

The vast majority of text passages (16) on non-climate actions contributing to climate change adaptation are found in the PNA and refer to biodiversity conservation, which contribute to maintaining access to genetic resources, search for new species, races and productive varieties and water resources, food security, policies combating deforestation and disaster management. Agroecology is also mentioned as contributing to resilience of local communities.

The other mentions are sub-divided between MacroZEE (4), PNMC (3), the New Forest Code (2) and Zarc (1) and PPA 2016-19 (1). The PNMC indicates sustainable development as the most

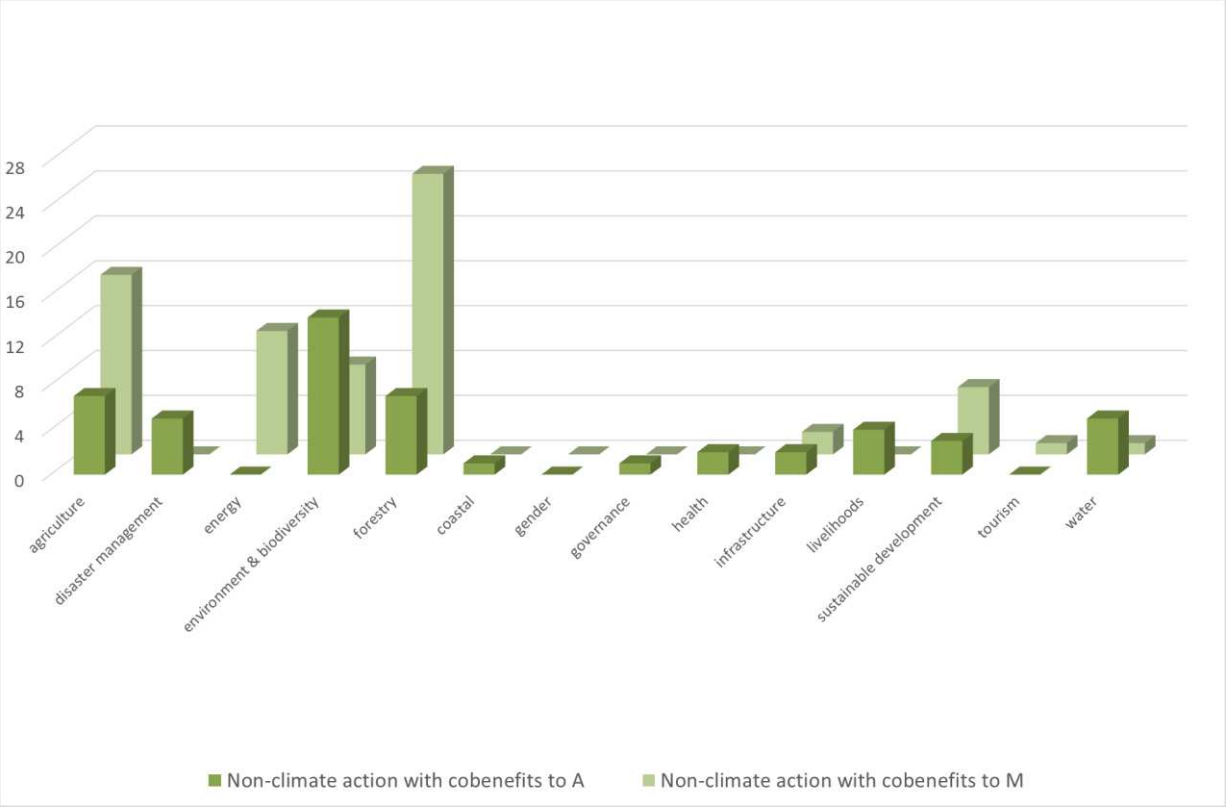
effective way to contribute to climate change adaptation, to be promoted through investments in people's well-being such as housing conditions, food security, health, education and employment. It also mention that the mapping of genetic resources from wild relative of domesticated cultivars will not only contributing to biodiversity conservation but also provide important adaptation benefits such as resistance to drought, pest and diseases. The Forest code mentions the contribution to water conservation, but without referring explicitly to climate change adaptation.

Most mentions of non-climate activities with co-benefits to mitigation benefits refer to forestry sector (25) and most are found in text passages in the PPCDAm, followed by the Macro-ZEE of the Legal Amazon and the 2nd Communication to the UNFCCC, the PNMC, the Forest Code and PAS. There are clear differences by sector between the references to non-climate actions co-benefits to adaptation and mitigation, with benefits to mitigation focusing primarily on forestry, followed by agriculture and bioenergy while benefits to adaptation focus primarily on environment and biodiversity, with lower mentions to agriculture, forestry and disaster management and water (Figure 9).

In terms of co-benefits to mitigation from other (pre-existing) policies, the PPCDAm is considered a key policy instrument for mitigation and for the implementation of REDD+. In addition, the Macro-ZEE references discuss how this policy aims to contribute to climate change mitigation targets, in particular through its focus on agro-ecological zoning activities for agro-energy crops and on reduction of deforestation rates linked to agricultural and livestock developments.

The Forest Code promotes payments for ecosystem services to compensate for ecosystem conservation activities and includes under those services the sequestration, maintenance and enhancement of stock of carbon as well as the decrease in carbon fluxes. Yet, these measures are far from being implemented to date, with the PES bill has yet to be approved, while the Amazon Fund has been moving ahead funding REDD+ projects.

Figure 9: Non-climate aims and actions with co-benefits to adaptation or to mitigation by sector*



*: Count by sector might not match count of text mentions as one text mention can refer for more than one or no specific sector

The PNMC describes a number of plans and activities with co-benefits to mitigation. For example, the soya moratorium, which prevents commercialization of soya from deforested areas in the Amazon, is mentioned as a mechanism that contributes to climate change mitigation, as is the agreement of the Federation of Industries of São Paulo to promote the production, consumption and sustainable use of Amazon timber products.

The recovery of degraded pastures, while reintroducing areas into production also generates mitigation benefits. The PPCDAm is one major program to incorporate the mitigation objectives outlined in the PNMC and the REDD+ strategy. The main objectives of the programme are to promote sustainability of resources uses in forest and agriculture, increase compliance with regulations on maintenance of Permanent Preservation Areas (APP) and Legal Reserve (RL) and stop the use of fire as a rural practice.

In the Second Communication to the UNFCCC benefits related to forests include the expansion of forest plantations for charcoal production as a strategy to reduce the use of native forest, the creation of the Brazilian National System of Protected Areas (SNUC), the expansion of National Forests and the strengthening of legal basis for forest concessions and forest management practices. These policies aim to improve natural resource management and conserve forest structure, functions and areas. All these policies are described in the as non-climate policies with co-benefits to mitigation.We found only 1 reference (in the ARPA Programme) that mentions co-benefits from non-climate aims simultaneously to both adaptation and mitigation. It refers to the consolidation of protected areas in the ARPA Programme and has as primary objective the conservation of biodiversity, but also the protection of environmental services related to both mitigation and adaptation.

5.2 Negative Interactions between Mitigation and Adaptation

Negative interactions between mitigation, adaptation and or other non-climate specific domains are discussed only in 11 instances, 9 of which refer to negative impacts of climate change mitigation and other non-climate objectives, and 2 refer to negative impacts of non-climate specific policies on mitigation (1) and on adaptation (1). No negative impacts between mitigation and adaptation are discussed or of adaptation on non-climate objectives, indicating that adaptation is largely perceived as complementary as opposed to in conflict with both development and mitigation objectives.

The nine text passages on mitigation threats to other sectors are found in the PNMC (4), in the Summary of REDD+ Safeguard report to the UNFCCC (4) and in the 2nd Communication to the UNFCCC (1). The PNMC indicates potential trade-offs with poverty alleviation and energy provision. One passage indicates that poverty reduction measures such as bringing electricity in remote areas could increase emissions, while another suggests the use of renewable energy and improvements in energy efficiency in order to avoid trade-offs between emission reductions and economic development. The use of biogas combustion is mentioned as controversial, hinting to possible trade-offs with climate change mitigation goals, while the expansion of nuclear power contributes to mitigation, but is labelled as unsustainable in the long run, due to the dependence on non-renewable resources. In general, the PNMC suggests that the expansion of biofuels, aimed at emissions reductions, needs to be monitored in order to avoid negative environmental and social consequences.

The REDD+ safeguards summary discusses avoiding or minimizing risks of negative impacts on social, environmental and economic conditions of local populations from REDD+ mitigation actions, ensure conflict resolution mechanisms and the respect of indigenous and local community rights. No reference is made to the safeguard on climate change adaptation (Annex 1. Point 1.h of the Cancun Agreement).

The two PNA references to trade-offs are particularly interesting and are the main text passages discussing how existing non-climate policies and practices impact negatively mitigation and adaptation. They are discussed in the food security and nutrition strategy chapter of the PNA and argue that the dominant agricultural production system substantially contributes to both GHG emissions and reduced resilience in terms of food security and biodiversity in particular. Conventional agriculture is seen a threat to climate change objectives and the chapter advocates agroecological approaches as not just climate friendly alternatives, but as contributing to a number of other sustainability and social justice objectives. On the other hand, no trade-offs are discussed in the PNA chapter on agriculture, that discusses extensively the ABC and other major agricultural plans.

In the next two sections we move from assessing different types of interactions to exploring broader references to linkages between climate change and sustainable development and to ecosystems services more generally.

5.3 Climate Change and Sustainable Development

Climate change impacts and adaptation influence sustainable development outcomes, while sustainable development pathways influence the opportunities for both climate change mitigation

and adaptation. Here we want to illustrate how policy documents on climate change related to land use and land use changes recognize and treat these linkages.

Overall, we identified 64 instances where linkages between mitigation and/or adaptation and sustainable development were explicitly discussed, most within the National Plan on the Adaptation to Climate Change (22 mentions), the PNMC and the National Policy and Plan on Climate Change (10 and 5 mentions respectively), the 2nd Communication to the UNFCCC (9) and the ABC Plan (5), the MZEE and the PPA 2012-2015 (each 4), the REDD+ Strategy, Safeguard Summary, and the PPA 2016-2019 (each 1).

The National Policy on Climate Change is very explicit about the need for any climate change strategy to observe the principles of sustainable development and Art. 3 and 4 indicate sustainable development as a fundamental approach to be used to tackle climate change while addressing the needs of communities living in Brazil. The 2nd Communication to the UNFCCC also underlines how the PNMC aims 'to harmonize economic and social development with the protection of the climate system' as well as the importance to integrating mitigation strategies into the long term development plans (CMGC 2010).

Further, with regard to linkages between climate change mitigation and sustainable development the PNMC highlights the great potential of renewable resources to contribute to sustainable development and local incomes – including biofuels, biogas and reforestation – and how carbon credits from CDM projects are seen as an opportunity to boost sustainable development in the Amazon. Yet, the REDD+ strategy explicitly refers to sustainable development objectives only once. It does this by referring to the PPCDAm as contributing to sustainable development objectives in the Amazon region through reducing deforestation rates whilst increasing the agriculture and livestock production. In addition, the REDD+ Safeguards Summary indicates that the Amazon Fund prioritize projects aiming at improving sustainable production. Mitigation-sustainable development linkages are also discussed in the ABC plan, which mentions the PAN programme's aim to optimise policies and investments in semi-arid regions in order to achieve all three goals of combating desertification, mitigating emissions and promoting sustainable development.

Yet, the majority of the discussions linking climate change to sustainable development relates to climate change adaptation. In this regard, the PNA stresses the role of the federal government in leading the integration of adaptation and sustainable development goals, supporting knowledge, information and technological innovation. Most of the passages connecting adaptation to sustainable development relate to the agriculture sector and focus on: 1. increasing the productivity of agro-livestock systems and their resilience to climate change and 2. increasing the resilience of sensitive human populations with particular attention to food security. The first emphasize sustainable development goals in the agribusiness sector through intensification and the development and adoption of new technology. The second aim targets smallholders and traditional people and is grounded on agroecology principles, socio-biodiversity and agro-biodiversity. In general, innovation in agro-livestock as having a high potential to contribute to social inclusion of small-scale producers, emission reductions, adaptation and sustainable development through the implementation of diversified production systems, also seek to improve incomes, quality of life and environmental sustainability. The ABC programme goes further and 'recommends' sustainable development as the main strategy to address climate change adaptation in semi-arid regions and the Integrated Sustainable Watershed Management programme is indicated as providing important adaptation measures as well as identifying opportunities for sustainable development. A number of

internationally funded projects focusing on forest conservation and biodiversity are mentioned in the PNMC as having both direct and indirect implications for adaptation to climate change, reducing emissions, fostering sustainable practices and creating environmentally sustainable jobs. To summarize, linkages between adaptation and sustainable development are discussed quiet extensively and explored in relation to desertification and innovation in agriculture. Mitigation and sustainable development linkages are discussed less frequently and feature most prominently in the energy and forestry sectors.

5.4 Environmental Services

We also coded explicit references about environmental or ecosystem services (ES) in the policy documents in order to assess potential linkages between adaptation and mitigation, such as those related to ecosystem based adaptation (EbA) (Pramova et al. 2012b, Doswald et al. 2014). These were coded independently from being discussed in relation climate change and therefore represent a broader environmental protection context. We found 108 explicit passages discussing environmental services in 17 of the 36 coded policies documents. Of these, 20 refer to EbA , most of which are found in the PNA.

The majority of the general references to ES are in the Macro-ZEE policy and methods document (22), followed by the PNA (16), the PPA 2012-2015 (8) references, and the PNMC (7). The Macro-ZEE supports further development of environmental and ecosystems services in Brazil, and recognizes the need to consider multiple environmental services such as biodiversity, water and forests in the Amazon. The PNA further focuses on the maintenance and improvement of ES, acknowledges direct and indirect ecosystems services, including those related to climate regulation and attests the importance of those services to the resilience of the economy and policy agendas such disaster management. The plan highlights examples of ES from coastal zones and livelihoods of traditional communities and indicates how forest ecosystems and native vegetation provide ES that are relevant to a following sectors: energy, agriculture, industry, infrastructure e urban development, food security, disaster management and health. Similarly, the PNMC recognizes the role of native, but also planted forests, as generators of ES. It argues that the value of native forests in terms of ES is underestimated, that ES are of great significance for forest dependent livelihoods and that there is a high potential to exploit ES in national forests concessions. The PPA 2012-2015 also acknowledges the role of forests as providing services associated with economic development and social welfare in Brazil and proposes actions designed to promote technological innovation related to biodiversity and ES and revisions of conservation, sustainable use and biodiversity policies. The REDD+ strategy refers to ES only once and indicates that REDD+ should ensure conservation of biodiversity in the Amazon as well as maintaining ecosystem services in the regions, including those related to climate change mitigation and adaptation. The REDD+ Safeguard Summary mentions ES 6 times and highlights the importance of ES from natural forest and how they are at the heart of the Amazon Fund activities

Around a third of the coded passages refer to payments for ecosystem services (PES), whether through incentives, remuneration, compensation, creation of markets, or through concession of rights to ES. The PAS policy calls for the use of multiple instruments to value ES, including economic market based incentives, and socio-economic programs such as rules on minimum pricing. Some documents point to the need for a national policy on ES. A bill on ES has been under discussion

since 2007 (PL 792/2007), currently with the Committee on Finance and Taxation of the Chamber of Deputies (Tito and Ortiz 2013). There are mentions in the Macro-ZEE, the PPCDAm and the PPA 2012-2015 of linkages between payments for environmental services and development, mainly in terms of transition to a new development model based in sustainability, where ecosystem services would play a key role. Yet, the development of markets for ES require new institutional arrangements and specific PES instruments. The PNA draft of 2015 keeps the same tone of earlier documents, referring to implementation, strengthening and broadening of PES as well as to the revisions of legal incentives. The PNMC, argues that PES should be embedded within a national policy on the management of ES.

Within the discussion on ecosystem services we also coded whether and how policy documents discussed the concept of Ecosystem-based Adaptation EbA and related plans or actions. EbA suggests that the management and conservation of ecosystems services, are key elements in reducing vulnerability and enhance resilience of populations or societies (Vignola et al. 2009, Pramova et al. 2012a). Multiple benefits such as biodiversity conservation, improvement of social and economic conditions and climate change mitigation outcomes can all be achieved through EbA, which makes it an ideal strategy to pursue integrated approaches to adaptation and mitigation. It also provides opportunities to tap into local knowledge and overcome the constraints of high technology or infrastructure options. EbA projects and programs are implemented worldwide (CBD 2009, Chong 2014).

Among the 36 policies investigated, the PNA is the only that explores, and it does so in quite a bit of depth, the EbA concept (19 text passages). Overall, the PNA supports mainstreaming EbA into public policies, sectoral activities and decision-making as an alternative or a complement to other adaptation approaches. Its guidelines mention pilot projects development, support for scientific studies on EbA and on linkages to disaster management, expansion of funding and identification of incentive mechanisms that could deliver EbA. While the PNA states that decision makers should embrace EbA and that it should drive adaptation choices in all strategic plans[6], EbA is discussed in depth only in the 'biodiversity and ecosystem (adaptation) strategy' (11 text passage), with only two mentions in the disaster management and coastal regions strategies and one in the strategy on vulnerable people and populations. The latter strategy underlines the role of indigenous people in maintaining ecosystem services that regulate climate regulators and that support local adaptation. Most surprising there is no mention of EbA in the agricultural and the water resources adaptation strategies, while both discuss PES.

6. DISCUSSION

6.1 Climate Policy Integration

The climate change policy architecture presents both horizontal and vertical integration features. If we understand vertical policy integration as hierarchical linkages that tend to channel responsibility

[6] Sectors with strategic plans in the PNA are: agriculture, biodiversity and ecosystems, cities, disasters risk management, industry and mining, infrastructure, vulnerable people and populations, water resources, health, food security and nutrition, and coastal zones.

from government to single ministries (Lafferty and Hovden 2003) this have been evident in the Brazilian climate change architecture, especially in the first phases of policy development with the Chief of Staff to the Presidency of the Republic leading a number of climate change bodies such as the FBMC, the CIM, as well as having a coordination role in anti-deforestation policies such as PPCDAm[7]. In fact, at the time the Minister of the Environment, Marina Silva, insisted that the Chief of Staff take the lead on anti-deforestation policies, because she felt such a cross-cutting issue should include the whole of government and the leadership of the Presidency would be able to achieve more effective outcomes (Abranches 2014). Other non-sectoral ministries, such as the Ministry of Foreign Affairs and Ministry of Finance, play major roles in climate change policy progress (mitigation in particular), which also suggests government led vertical integration is a dominant feature of Brazilian climate change architecture at the federal level. Vertical integration is pursued largely through a mainstreaming approach to both mitigation and adaptation into sectoral policies, with the two climate change objectives being mainstreamed separately into sectoral policies, as opposed to jointly.

In addition, the regulation power of the Brazilian climate change architecture has also very strong horizontal integration characteristics. These are reflected in the cross-sectoral coordination role of the Ministry of Environment and the Ministry of Science, Technology and Innovation and in the extensive use of inter-ministerial committees and other multi-sectoral bodies (Seroa da Motta 2011b). All climate change and anti-deforestation policy efforts include key regulating roles of such committees, from the Inter-Ministerial Committee on Climate Change (CIM) and its Executive Group (Gex), to the Inter-Ministerial Commission for Global Climate Change (CIMGC), the Brazilian Forum on Climate Change (FBMC), and the Permanent Inter-ministerial Working Group (GPTI). As an example, in relation to mitigation actions, CIM, GEx, and GPTI, which are all inter-ministerial bodies, have the specific mandate to support the integration of REDD+ with PPCDAm, PPCerrado, and the ABC plan. Yet, there usually is a clear separation between bodies that work on mitigation and adaptation under these committees, as for example the various working groups (REDD+ Working Group, and the Inter-ministerial Adaptation Working Group). While it is useful to have this separation of tasks, it is also important that lower level adaptation and mitigation bodies interact to facilitate internal climate change policy coherence in both planning and implementation.

A complex of vertical and horizontal policy integration features seems to be necessary to address cross-cutting issues as climate change in the land use sector (Nunan et al. 2012). Brazil's formal policy architecture seems to satisfy this requirement. It is, however, not sufficient to ensure effective policy integration: both the alignment of political objectives and power relations among policy actors affect whether inter-ministerial committees and well-intentioned policies and plans deliver vertical and horizontal integration in practice. In the mitigation domain, which is more advanced in Brazil, there is evidence that coordination challenges are substantial (Gebara and Thuault 2013, Gebara et al. 2014). The political agendas of the different ministries and factions within the Brazilian Congress have not always been in line, both in relation to climate change as well as anti-deforestation policies and objectives (Carvalho 2013, Abranches 2014). In general, since 2011 there has been a slowing trend in climate change policy progress and political commitment in Brazil (Hochstetler and Viola

[7] Although since 2013 the PPCDAm is led by the Department for Policies to Combat Deforestation (Departamento de Políticas para o Combate ao Desmatamento - PDCD) in the MMA.

2012, Hochstetler and Viola 2015). The revisions of the Forest Code in 2012, which weakened anti-deforestation and conservation measures, showcases the high level of political resistance to command and control measure to halt deforestation (Tollefson 2012, Viola and Franchini 2013). Recent concerns regarding ministerial support for the climate change agenda in Brazil relate to the appointment of Aldo Rebelo as Minister of Science, Technology and Innovation - although in the role only for ten months - and Katia Abreu as Minister of Agriculture, the former a climate sceptic and key actor in the major recent revisions undercutting the Forest Code, and the latter having served as the President of the National Confederation of Agriculture, which represents the interests of large and middle-size landowners and ranchers that have a strong representation in Congress and effectively lobbied for weakening conservation requirements of the Forest Code (Tollefson 2015). At the same time, Brazil maintains very ambitious climate change mitigation targets (Federative Republic of Brazil 2015). In relation to adaptation, ministerial political agendas of the MMA versus MAPA and MDA – as well as different national and international non-state actors - seem to differ in terms of the best approach to integrate adaptation into agricultural policies. The tensions between approaches that favour forms of climate-smart agriculture that aim at intensification and enhanced productivity approaches (ABC plan) versus agroecology approaches that focus more on forms of empowerment of smallholders, food sovereignty and environmental justice (Holt-Giménez and Altieri 2013) are evident in the PNA draft released for public consultation. How these power relations will affect the achievement of mitigation targets and how they will shape adaptation policies remains to be seen.

6.2 Principled Priority between Climate Change and Development Objectives

Key climate change policy documents indicate that compatibility between sustainable development goals and climate change actions is a key requirement for the development and implementation of climate change action. The aim of climate change policies includes the need to contribute to economic development as well as to the reduction of poverty and inequality (Government of Brazil 2008c). Similarly, the objectives of REDD+ mainstreaming into anti-deforestation policies and sustainable development plans also suggest that Brazil puts development objectives at the core of any climate change strategy.

Such a position aligns with existing climate policy integration literature, which suggests that climate objectives usually do not take precedent over development goals, in other words they do not have principled priority (Kok et al. 2008, Adelle and Russel 2013). But is there any indication that development objectives should take precedent? The requirements for climate change objectives to align with development goals would suggest this to be the case. If indeed, development objectives are considered to take precedent, this can lead to policy documents sidestepping the question of how to address possible trade-offs (Kok and de Coninck 2007). The overwhelming focus in Brazil's climate change policy documents on co-benefits as opposed to possible trade-offs is consistent with this argument. Importantly, Brazil sees climate change mitigation as a part of the broader strategy to combat deforestation (Government of Brazil 2008c, Inoue 2012). Such an approach is deemed to be more successful than focusing exclusively on achieving climate change mitigation targets in the forestry sector. In practice, it translates into a set of anti-deforestation, sustainability and climate change policies and measures that contribute to achieving multiple targets (Nepstad et al. 2014), something that goes in the direction of achieving external policy coherence, discussed below. The

MMA has played a decisive role in framing mitigation within forests in this light. In theory a possible negative consequence of the principled priority of development goals is that in practice this can translate in diminished attention on climate change objectives in favour of other development goals, as has been the case for other 'mainstreaming' approaches such as gender mainstreaming (Subrahmanian 2007).

6.3 Internal and External Climate Change Policy Coherence

In Brazil, the main climate change policies and to a lesser degree development plans make clear reference to the general need to pursue integrated climate approaches within as well as across policy domains. Yet at present, apart from the ABC plan, sectoral plans do little to translate these guidelines into more detailed actions to pursue mutual benefits between the two climate change objectives. While the main aims of the ABC plan emphasizes GHG emission reductions over adaptation, both objectives are included, and synergies between mitigation and adaptation are discussed more extensively than in other land use sector policy document.

One of the reasons for the focus on synergies in the ABC plan, is that climate change adaptation has been a long term concern in agriculture due to the importance of the sector for food security both in relation to livelihoods as well as for strategic reasons (UNFCCC, 1998, Art. 2). In fact, since the mid 1990s agricultural policies in Brazil have addressed climate change risk in one way or another, but largely through dissemination of information as opposed to targeted policy instruments that reduce vulnerability to climate change impacts. This also means that there is more knowledge on both climate change impacts and adaptation needs in the agricultural compared to the forestry sector. Yet, whether such integration occurs in practice within the ABC plan is questionable, because the main credit mechanism, the ABC programme, does not mention climate change adaptation at all, which is likely to restrict opportunities to pursue integration in practice. We have seen earlier that the ABC plan primarily targets largescale producers, while small scale producers are the most vulnerable to climate change. Thus, more efforts are needed to develop integrated approaches that reach small scale agricultural producers.

Linkages between ecosystems services and climate change adaptation have been explored in relation to improving adaptive capacity of ecosystems and of local populations in both agriculture and forestry (Biringer et al. 2005, Reid and Huq 2005, Verchot et al. 2007, Locatelli et al. 2011, Pramova et al. 2012b, Locatelli et al. 2015b). In EbA, ecosystems are not just seen as the main asset in fighting climate change impacts (Turner et al. 2009), but as providers of mitigation co-benefits. EbA therefore is a strategy that should support pursuing synergies between adaptation and mitigation. In Brazil, the PNA draft document for public consultation provides the strongest support EbA approaches. This has, however, not (or not yet) substantially influenced the development of sectoral adaptation strategies, apart from the 'biodiversity and ecosystem strategy'. In addition, within the PNA draft, there are additional tensions in terms of climate change adaptation approaches to be pursued in agriculture. The agricultural strategy in the PNA adopts the dominant adaptation approach based on intensification and increased productivity of the ABC plan, while the strategy on vulnerable people and population advocates a more environmental justice focused approach of agroecology, putting smallholder empowerment and local resilience at the center. Such tensions are likely to impact on both policy integration and internal policy coherence of adaptation strategies.

That said, the PNA is still in draft form and the final document might overcome some of these challenges.

While there is some recognition of trade-offs between mitigation and non-climate objectives, negative interactions between mitigation and adaptation are hardly discussed in any of the policy documents. Although some research has been undertaken on trade-offs deriving from climate change impacts between food production, biofuels and forest conservation and restoration, this has so far not translated into coherent policy guidelines (Seroa da Motta et al. 2011a). Two major factors seem to contribute to the limited discussion of trade-offs between mitigation and adaptation.

First, priority areas for mitigation and adaptation in the land use sector differ in terms of sectoral focus and biomes in Brazil. Mitigation efforts are concentrated primarily on the Amazon and to a lesser extent on the Cerrado biome, while adaptation focuses on semi-arid regions of the Caatinga and of the Cerrado. However, there are concerns around consistency, because the most vulnerable populations to climate change are concentrated in the Amazon Biome (60.3%) as opposed to e.g. the Caatinga biome (19.9%). The North (Amazon) and North East (Caatinga) of the country are also the regions at higher exposure to natural disasters, which are likely to be exacerbated by climate change (GEx-CIM and MMA 2015bp. 235; 238). Thus, there seems to be the need to better reconcile adaptation needs of ecosystems and populations. In other words, there is scope to assess the direct and indirect linkages between climate change impacts on ecosystems and how these translate into impacts on vulnerable populations in specific regions or localities. Also, there seems to be very limited focus on the importance and the needs to better understand climate change impacts and adaptation in forests as opposed to agriculture. Yet, given the vulnerability of ecosystems and populations to climate change and the complex linkages between climate, deforestation, drought and provision of other ecosystem services in the Amazon biome (Marengo et al. 2013, PBMC 2014, Allen et al. 2015, Spracklen and Garcia-Carreras 2015, Levine et al. 2016), there is the need for policy action as well as further research on climate change adaptation as well as interactions with mitigation in the Amazon region (Brienen et al. 2015).

Second, the main climate change policy documents and the literature emphasize the limited – although growing - knowledge and the need for more research on climate change adaptation in the land use sector (Government of Brazil 2008c, Vale et al. 2010). This contributes to explain the lack of focus on actual or possible negative interactions between adaptation and mitigation. While research on vulnerability promoted by the Center for Strategic Studies and Management in Science, Technology and Innovation (CGEE) has been under way for some time (Assad and Pinto 2008, Marengo 2008, Marcovitch 2010, Secretariat of Strategic Studies of the Presidency 2015), the approach taken has been criticized for focusing excessively on the impacts of climate change, future scenarios and technical solutions, as opposed to investigating the root causes of vulnerability and identifying actions needed to address current impacts (Obermaier and Rosa 2013). More integration between future climate change scenarios and vulnerability assessments is therefore required to build up the knowledge needed to effectively address adaptation needs.

7. CONCLUSION

According to the PNMC, policy coordination across sectors and scales is to be achieved through an ‘integrated strategy on mitigation and adaptation in land use change and forestry’ (Government of Brazil 2008c, p.29). Yet at the same time, Brazil seems to have chosen a path that focuses more on

mainstreaming mitigation and adaptation separately in different sectors and biomes according to distinct priorities set out for the two climate change responses. As a more concrete climate change adaptation agenda develops and more knowledge about climate change impacts in tropical forests emerges, it will be worth exploring whether a more integrated approach can deliver mutually beneficial outcomes with adaptation and mitigation actions reinforcing each other and increased attention to potential trade-offs. But in order for this to happen there is the need to develop and implement a policy agenda that provides: 1) the resources, knowledge development and concrete policy plans on climate change adaptation not just in agriculture, but also in tropical forests; 2) better knowledge, awareness and tools for policy makers to assess possible trade-offs between mitigation and adaptation, and 3) the translation of general climate policy integration objectives into specific integrated policy actions under the various thematic and sectoral policies. An ecosystem-based adaptation approach, which is advocated in parts of the National Adaptation Plan, can contribute to some of these objectives. Yet, this is unlikely to happen unless more attention to such integration emerges from the more resourced and influential policy actors linked to the climate change mitigation policy domain.

ACKNOWLEDGMENTS:

This research was funded by Economic and Social Research Council (ESRC) (grant number ES/K00879X/1), the Australian Department of Foreign Affairs and Trade (AusAID Agreement No. 63560), the International Climate Initiative (IKI) of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), NORAD, the CGIAR Research Program on Forests, Trees and Agroforestry (CRP-FTA) with financial support from the CGIAR Fund, and Ciência sem Fronteiras (CsF). Support was also provided by CPDA/UFRRJ, the Brazilian collaborating institution, and INCT-PPED for the realization and documentation of a workshop on synergies between mitigation and adaptation help in Rio de Janeiro on 29th August 2014. We would like to thank Stavros Afionis and Fernanda Carvalho for comments on an earlier draft of the paper.

Annex 1: List of Policy Documents

Name of document	Date	Policy Number	Type of document	Lead institution	Main sector/focus
Pluri-Annual Plan (PPA 2016-2019) - general overview and programme description	2016	Following the Law 13249	Government plan/programme /strategy	Ministry of Planning, Budget and Management	Development. Multi-sectoral
National Strategy for REDD+ (ENREDD)	2015		Government plan/programme /strategy	Ministry of Environment	Mitigation, Deforestation
National Plan for the Adaptation to Climate Change (PNA)	2015	Public consultation draft	Draft	Ministry of Environment	Adaptation, Multi-sectoral
Summary of information on how the Cancun safeguards were addressed and respected by Brazil	2015		Communication to UNFCCC	Ministry of Environment	Mitigation, Deforestation
Preventive action to risks, response and recovery actions in areas affected by disasters and the National Fund for Public Disaster, Civil Protection and Defence	2014	Law 12983	Law	Presidency of the Republic	Disaster Management
National Policy and National Plan on Agroecology and Organic Production	2013	Decree 7794	Government plan/programme /strategy	Ministry of Agrarian Developmento	Agriculture
National Policy on Agriculture-Forest-Livestock Integration (P-iLPF)	2013	Law 12805	Law	Ministry of Agriculture, Livestock and Food supply and Ministry of Environment	Cross-sectoral: forest, livestock and agriculture
Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm) phase 3	2013	Follows Decree of 3rd July 2003 and Decree 7957	Government plan/programme /strategy	Ministry of Environment	Deforestation, Multi-sectoral
Forest Rehabilitation and Implementation of Agroforestry Systems in Rural Areas	2013	Law 12854	Law	Ministry of Environment	Forestry
Decree on Rural Environmental Registration System (SICAR), the Rural Environmental Registration (CAR) and the Program of Environmental Compliance (PRA)	2012	Decree 7830	Decree	Brazilian Central Bank	Land-use planning
National Policy on Land and Environmental Management in Indigenous Territories (PNGATI)	2012	Decree 774 7	Decree	Ministry of Justice	Land-use planning
New Forest Code	2012	Law 12651	Law	Chief of Staff to the Presidency of the	Forestry

				Republic	
Sectoral Plan for the Mitigation and Adaptation to Climate Change for the Consolidation of a Low Carbon Economy in Agriculture (ABC Plan)	2012	Following the Decree 7390	Government plan/programme /strategy	Ministry of Agriculture, Livestock and Food supply	Agriculture
National Policy on Civil Protection and Defence	2012	Law 12608	Law	Ministry of National Integration	Disaster Management
Programa Áreas Protegidas da Amazônia phase II (ARPA)	2011	Following the Decree 4326	Government plan/programme /strategy	Ministry of Environment	Environment & biodiversity
Pluri-Annual Plan (PPA 2012-2015) - general overview and programme description	2011	Following the Law 12593	Government plan/programme /strategy	Ministry of Planning, Budget and Management	Development. Multi-sectoral
Programme to Support Environmental Conservation and Programme to Incentivise Rural Sustainable Activities	2011	Law 12512	Law	Ministry of Environment	Agriculture
Resolution on the Programme for the Reduction of GHG emissions in Agriculture (ABC Programme)	2010	Resolution 3896	Government plan/programme	Brazilian Central Bank	Agriculture
Approval of the Ecological-Economic Macro-Zoning of the Legal Amazon (MZEE Legal Amazon)	2010	Decree 7378	Decree	National Coordination Commission of ZEE and Consortium ZEE-Brazil	Land Use Planning, development and environment
Ecological-Economic Macro-Zoning of the Legal Amazon (MZEE Legal Amazon)	2010	Based on Decree 4297/2002	Government plan/programme /strategy	National Coordination Commission of ZEE and Consortium ZEE-Brazil	Land Use Planning, development and environment
National Policy on Climate Change	2010	Decree 7390	Decree	Inter-ministerial Commission on Climate Change (CIM)	Climate Change
Second National Communication to the UNFCCC	2010		Communication to UNFCCC	Ministry of Science, Technology and Innovation	Climate change
National Policy on Climate Change	2009	Law 12187	Law	Chief of Staff to the Presidency of the Republic	Climate change
Amazon Fund	2008	Decree 6527	Decree	National Bank for Economic and Social Development	Environment & biodiversity
National Plan on Climate Change (PNMC)	2008		Government plan/programme	Chief of Staff to the Presidency of the	Climate change

			/strategy	Republic	
Sustainable Amazon Plan (PAS)	2008		Government plan/programme /strategy	Chief of Staff to the Presidency of the Republic	Development
Agricultural Climatic Risk Zoning (ZARC)	2008		Government plan/programme /strategy	MAPA, MDA and Embrapa	Agriculture
Regulation of the Public Forest Management to Sustainable Production Law	2007	Decree 6063	Decree	Brazilian forest service	Forestry
Public Forest Management to Sustainable Production, establishment of the Brazilian Forest Service and Creation of the Forest National Fund	2006	Law 11284	Law	Brazilian forest service	Forestry
ZEE Programme - Methodological guidance for Ecological-Economic Zoning in Brazil – 3rd Edition	2006	Based on Decree 429 7/2002	Methodological Guideline for government programme	MMA, National Coordination Commission of ZEE and Consortium ZEE-Brazil	Land Use Planning, development and environment
National Programme for the Fight against Desertification and the Effects of Drought (PAN-Brasil)	2005		Government plan, programme or strategy	Ministry of Environment	Adaptation general
Criteria for the Brazilian ecological-economic zoning (ZEE).	2002	Decree 4297/2002	Decree	National Coordination Commission of ZEE	Land Use Planning, development and environment
National Forest Programme (PNF)	2000	Decree 3420	Decree	Ministry of Environment	Forestry
National System of Protected Areas (SNUC)	2000	Law 9985	Law	Ministry of environment	Environment & biodiversity
National Environmental Policy	1981	Law 6938	Law	Chief of Staff to the Presidency of the Republic	Environment & biodiversity
Indigenous Statute	1973	Law 6001	Law		Indigenous Rights

Annex 2: Definitions and types of interactions

category	Sub-category	description	Positive relationship*	Negative relationship
Type of interactions	1. Co-benefits/trade-offs	Positive/negative effects that a policy or measure aimed at one objective (adaptation, mitigation, or non-climate objective) might have on another objective	+	-
	2. Integrated approach	Policies or measures where mitigation and adaptation are pursued together as joint objectives and seeking mutual benefits.	++	
1. Co-benefits / trade-offs		Text passages referring to co-benefits/trade-offs between adaptation, mitigation and/or non-climate change specific domains		
	a. Adaptation with mitigation co-benefits/trade-offs	Text passages on adaptation resulting in co-benefits/trade-offs for mitigation	a → +A+M	a → +A-M
	b. Adaptation with other co-benefits/trade-offs	Text passages on adaptation resulting in co-benefits/trade-offs to non-climate change specific domains	a → +A+X	a → +A-X
	c. Mitigation with adaptation co-benefits	Text passages on mitigation resulting in co-benefits to adaptation	m → +M+A	m → +M-A
	d. Mitigation with other co-benefits/trade-offs	Text passages on mitigation resulting in co-benefits other than adaptation	m → +M+X	m → +M-X
	e. Non-climate action with co-benefits/trade-offs for adaptation	Text passages referring to non-climate change strategies or actions resulting in co-benefits to adaptation	x → +X+A	not coded
	f. Non-climate action with co-benefits/trade-offs for mitigation	Text passages referring to non-climate change strategies or actions resulting in co-benefits/trade-offs for mitigation	x → +X+M	not coded
2. Integrated approach	g. Integrated approach	Text passages related to pursuing both adaptation and mitigation objectives together in an integrated manner aimed at realizing mutual benefits.	a ∩ m → +AA+MM	
3. Pursuing both mitigation and adaptation without specific mention of interactions	h. Pursuing mitigation and adaptation	Text passages that indicate pursuing both mitigation and adaptation activities, but it is not clear that interactions between the two are explicitly taken into account.	a | m → +A? | +M ?	

*= a: adaptation objective, m: mitigation objective, x: non-climate related objective, →: results in, +: positive outcome, -: negative outcome, A: adaptation outcome, M: mitigation outcome, +AA or +MM increased outcome as a result of an interaction between A and M, -AA or -MM decreased outcome as a result of an interaction between A and M; ∩ : joint objective; | : separate objective ; ? outcome unknown or not considered for A or M.

REFERENCES

Abranches, S.r., 2014. The political economy of deforestation in Brazil and payment-for-performance finance. CGD Climate and Forest Paper Series. Washington DC: Center for Global Development.

Adelle, C. & Russel, D., 2013. Climate Policy Integration: a Case of Deja Vu? Environmental Policy and Governance, 23 (1), 1-12.

Agencia Brasil, 2015. Governo quer acelerar adesão de produtores ao Cadastro Ambiental Rural [online]. Empresa Brasil de Comunicação S/A – EBC. Available from: http://agenciabrasil.ebc.com.br/geral/noticia/2015-02/governo-quer-acelerar-adesao-de-produtores-ao-cadastro-ambiental-rural

Allen, C.D., Breshears, D.D. & McDowell, N.G., 2015. On underestimation of global vulnerability to tree mortality and forest die-off from hotter drought in the Anthropocene. Ecosphere, 6 (8), 1-55.

Assad, E. & Pinto, H.S., 2008. Aquecimento global e a nova geografia da produção agrícola no Brasil São Paulo: EMBRAPA-CEPAGRI/UNICAMP.

Banco Central do Brasil, 2010. Resolução Nº 3.896: Programa para redução da emissão de gases de efeito estufa na agricultura (Programa ABC). Brasilia: Banco Central do Brasil.

Barker, T., Bashmakov, I., Alharthi, A., Amann, M., Cifuentes, L., Drexhage, J., Duan, M., Edenhofer, O., Flannery, B., Grubb, M., Hoogwijk, M., Ibitoye, F.I., Jepma, C.J., Pizer, W.A. & Yamaji, K., 2007. Mitigation from a cross-sectoral perspective. In Climate Change 2007: Mitigation. In Metz, B., Davidson, O.R., Bosch, P.R., Dave, R. & Meyer, L.A. eds. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press.

Biringer, J., Guariguata, M.R., Locatelli, B., Pfund, J.L., Spanger-Siegfried, E., Suarez, A.G., Yeaman, S. & Jarvis, A., 2005. Biodiversity in a changing climate: A framework for assessing vulnerability and evaluating practical responses. In Robledo, C., Kanninen, M. & Pedroni, L. eds. Tropical forests and adaptation to climate change: In search of synergies. Bogor, Indonesia: CIFOR, 154-183.

BNDES (Banco Nacional de Desenvolvimento Econômico e Social), 2014. The Amazon Fund: Activity report 2013. Brasilia: BNDES.

Brienen, R.J.W., Phillips, O.L., Feldpausch, T.R., Gloor, E., Baker, T.R., Lloyd, J., Lopez-Gonzalez, G., Monteagudo-Mendoza, A., Malhi, Y., Lewis, S.L., Vasquez Martinez, R., Alexiades, M., Alvarez Davila, E., Alvarez-Loayza, P., Andrade, A., Aragao, L.E.O.C., Araujo-Murakami, A., Arets, E.J.M.M., Arroyo, L., Aymard C, G.A., Banki, O.S., Baraloto, C., Barroso, J., Bonal, D., Boot, R.G.A., Camargo, J.L.C., Castilho, C.V., Chama, V., Chao, K.J., Chave, J., Comiskey, J.A., Cornejo Valverde, F., da Costa, L., de Oliveira, E.A., Di Fiore, A., Erwin, T.L., Fauset, S., Forsthofer, M., Galbraith, D.R., Grahame, E.S., Groot, N., Herault, B., Higuchi, N., Honorio Coronado, E.N., Keeling, H., Killeen, T.J., Laurance, W.F., Laurance, S., Licona, J., Magnussen, W.E., Marimon, B.S., Marimon-Junior, B.H., Mendoza, C., Neill, D.A., Nogueira, E.M., Nunez, P., Pallqui Camacho, N.C., Parada, A., Pardo-Molina, G., Peacock, J., Pena-Claros, M., Pickavance, G.C., Pitman, N.C.A., Poorter, L., Prieto, A., Quesada, C.A., Ramirez, F., Ramirez-Angulo, H., Restrepo, Z., Roopsind, A., Rudas, A., Salomao, R.P., Schwarz, M., Silva, N., Silva-Espejo, J.E., Silveira, M., Stropp, J., Talbot, J., ter Steege, H., Teran-Aguilar, J., Terborgh, J., Thomas-Caesar, R., Toledo, M., Torello-Raventos, M., Umetsu, R.K., van der Heijden, G.M.F., van der Hout, P., Guimaraes Vieira, I.C., Vieira, S.A., Vilanova, E., Vos, V.A. & Zagt, R.J., 2015. Long-term decline of the Amazon carbon sink. Nature, 519 (7543), 344-348.

Brouwer, S., Rayner, T. & Huitema, D., 2013. Mainstreaming climate policy: The case of climate adaptation and the implementation of EU water policy. Environment and Planning C: Government and Policy, 31, 134-153.

Câmara Interministerial de Agroecologia e Produção Orgânica, 2013. Plano nacional de agroecologia e produção orgânica (PLANAPO). Brasília: MDS, CIAPO.

Campbell, B.M., 2009a. Beyond Copenhagen: REDD plus , agriculture, adaptation strategies and poverty. Global Environmental Change-Human and Policy Dimensions, 19 (4), 397-399.

Campbell, B.M., 2009b. Beyond Copenhagen: REDD plus, agriculture, adaptation strategies and poverty. Global Environmental Change-Human and Policy Dimensions, 19 (4), 397-399.

Carvalho, F.V.d., 2013. The Brazilian position on forests and climate change from 1997 to 2012: from veto to proposition. Revista Brasileira De Politica Internacional, 55 (special edition), 144-169.

CBD, 2009. Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal.

Chong, J., 2014. Ecosystem-based approaches to climate change adaptation: progress and challenges. International Environmental Agreements: Politics, Law and Economics, 14 (4), 391-405.

CMGC (Coordenação-Geral de Mudanças Globais do Clima Ministério da Ciência e Tecnologia), 2010. Segunda comunicação nacional do Brasil à convenção-quadro das Nações Unidas sobre mudança do clima. Brasília: Coordenação-Geral de Mudanças Globais do Clima Ministério da Ciência e Tecnologia.

COEP (Rede Nacional de Mobilização Social), 2011a. Mudanças climáticas, pobreza e desigualdades. Rio de Janeiro: Rede Nacional de Mobilização Social.

COEP (Rede Nacional de Mobilização Social), 2011b. Mudanças climáticas, vulnerabilidades e adaptação. Rio de Janeiro: Rede Nacional de Mobilização Social.

den Hertog, L. & Stroß, S., 2013. Coherence in EU external relations: Concepts and legal rooting of an ambiguous term. European Foreign Affairs Review, 18 (3), 373-388.

Di Gregorio, M., Nurrochmat, D.R., Fatorelli, L., Pramova, E., Sari, I.M., Locatelli, B. & Brockhaus, M., 2015. Integrating mitigation and adaptation in climate and land use policies in Indonesia: A policy document analysis. Centre for Climate Change Economics and Policy Working Paper No. 245; Sustainability Research Institute Paper No. 90; CIFOR Working Paper No. 199. Leeds, UK and Bogor, Indonesia Center for Climate Change Economics and Policy; Sustainability Research Institute; Center for International Forestry Research.

Doswald, N., Munroe, R., Roe, D., Giuliani, A., Castelli, I., Stephens, J., Moller, I., Spencer, T., Vira, B. & Reid, H., 2014. Effectiveness of ecosystem-based approaches for adaptation: Review of the evidence-base. Climate and Development, 6 (2), 185–201.

Duguma, L.A., Minang, P.A. & van Noordwijk, M., 2014. Climate Change Mitigation and Adaptation in the Land Use Sector: From Complementarity to Synergy. Environmental Management, 54 (3), 420-432.

Federative Republic of Brazil, 2015. Intended Nationally Determined Contribution. Brasilia: Federative Republic of Brazil.

Garrett, R.D. & Rausch, L.L., 2015. Green for gold: Social and ecological tradeoffs influencing the sustainability of the Brazilian soy industry. The Journal of Peasant Studies, 1-33.

GCF (Governors' Climate and Forests Task Force), 2014. Contributions to the National REDD+ Strategy: A proposal for allocation between States and the Union. Manaus, Brazil: IDESAM.

Gebara, M.F., Fatorelli, L., May, P. & Zhang, S., 2014. REDD+ policy networks in Brazil: constraints and opportunities for successful policy making. Ecology and Society, 19 (3).

Gebara, M.F. & Thuault, A., 2013. GHG mitigation in Brazil's land use sector: An introduction to the current nationa policy landscape. Washington DC: WRI.

GEx-CIM, (Grupo Executivo do Comitê Interministerial de Mudança do Clima) & MMA, (Ministério do Meio Ambiente), 2015a. Plano Nacional de Adaptação à Mudança do Clima: Volume I : Estratégia Geral. Versão Consulta Pública. Brasilia: GEx-CIM and MMA.

GEx-CIM, (Grupo Executivo do Comitê Interministerial de Mudança do Clima) & MMA, (Ministério do Meio Ambiente), 2015b. Plano Nacional de Adaptação à Mudança do Clima: Volume II: Estratégias Setoriais e Temáticas : Estratégia Geral. Versão Consulta Pública. Brasilia: GEx-CIM and MMA.

Government of Brazil, 2008a. Executive Summary: National Plan on Climate Change. Brasilia: Governent of Brazil.

Government of Brazil, 2008b. Fundo Amazônia, Decreto nº 6.527 de 1 de agosto de 2008. Brasília: Comitê Interministerial Sobre Mudança do Clima.

Government of Brazil, 2008c. Plano nacional sobre mudança do clima (PNMC), Decreto nº 6.263 de 21 de novembro de 2007. Brasília: Comitê Interministerial Sobre Mudança do Clima.

Government of Brazil, 2009a. Lei No 12.114, de 09 de dezembro de 2009. Cria o Fundo Nacional sobre Mudança do Clima, altera os arts. 6o e 50 da Lei no 9.478, de 6 de agosto de 1997, e dá outras providências. Brasília: Government of Brazil.

Government of Brazil, 2009b. Lei no 12.187, de 29 de dezembro de 2009. Institui a Política Nacional sobre Mudança do Clima (PNMC) e dá outras providências. Brasília: Government of Brazil.

Government of Brazil, 2010. Decreto no 7.390, de 9 de dezembro de 2010. Regulamenta os Arts. 6o, 11 e 12 da Lei no 12.187, de 29 de dezembro de 2009, que institui a Política Nacional sobre Mudança do Clima (PNMC), e dá outras providências. Brasília: Government of Brazil.

Government of Brazil, 2012. Plano setorial de mitigação e de adaptação às mudanças climáticas para a consolidação de uma economia de baixa emissão de carbono na agricultura: Plano ABC (Agricultura de Baixa Emissão de Carbono). Brasília: MAPA/MDA.

Government of Brazil, 2015. Estratégia Nacional para Redução das Emissões de Gases de Efeito Estufa Provenientes do Desmatamento e da Degradação Florestal, Conservação dos Estoques de Carbono Florestal, Manejo Sustentável de Florestas e Aumento de Estoques de Carbono Florestal ENREDD+. Brasilia: Government of Brazil.

Hall, A., 2012. Forests and climate chnage: The social dimensions of REDD in Latin America Cheltenham, UK: Edward Elgar Publishing.

Hochstetler, K. & Viola, E., 2012. Brazil and the politics of climate change: Beyond the global commons. Environmental Politics, 21 (5), 753-771.

Hochstetler, K. & Viola, E., 2015. Brazil. In Bäckstrand, K. & Lövbrand, E. eds. Research handbook on climate governance. Cheltenham, UK: Edward Elgar.

Holt-Giménez, E. & Altieri, M.A., 2013. Agroecology, food sovereignty, and the new Green Revolution. Agroecology and Sustainable Food Systems, 37 (1), 90-102.

Hsieh, H.-F. & Shannon, S.E., 2005. Three approaches to qualitative content analysis. Qualitative Health Research, 15 (9), 1277-1288.

Inoue, C., 2012. Governance of global climate change in the Brazilian Amazon: the case of Amazonian municipalities of Brazil. Revista Brasileira De Politica Internacional, 55, 170-189.

Jordan, A. & Lenschow, A., 2010. Environmental Policy Integration: a State of the Art Review. Environmental Policy and Governance, 20 (3), 147-158.

Klein, R.J.T., Schipper, E.L.F. & Dessai, S., 2005. Integrating mitigation and adaptation into climate and development policy: three research questions. Environmental Science & Policy, 8 (6), 579-588.

Kok, M., Metz, B., Verhagen, J. & Van Rooijen, S., 2008. Integrating development and climate policies: National and international benefits. Climate Policy, 8 (2), 103-118.

Kok, M.T.J. & de Coninck, H.C., 2007. Widening the scope of policies to address climate change: directions for mainstreaming. Environmental Science & Policy, 10 (7–8), 587-599.

Lafferty, W.M. & Hovden, E., 2003. Environmental policy integration: Towards an analytical framework. Environmental Politics, 12 (3), 1-22.

Levine, N.M., Zhang, K., Longo, M., Baccini, A., Phillips, O.L., Lewis, S.L., Alvarez-Dávila, E., Segalin de Andrade, A.C., Brienen, R.J.W., Erwin, T.L., Feldpausch, T.R., Monteagudo Mendoza, A.L., Nuñez Vargas, P., Prieto, A., Silva-Espejo, J.E., Malhi, Y. & Moorcroft,

P.R., 2016. Ecosystem heterogeneity determines the ecological resilience of the Amazon to climate change. Proceedings of the National Academy of Sciences, 113 (3), 793-797.
Lobell, D.B., Baldos, U.L. & Hertel, T.W., 2013. Climate adaptation as mitigation: the case of agricultural investments. Environmental Research Letters, 8 (1), 015012.
Locatelli, B., Evans, V., Wardell, A., Andrade, A. & Vignola, R., 2011. Forests and Climate Change in Latin America: Linking Adaptation and Mitigation. Forests, 2 (1), 431-450.
Locatelli, B., Pavageau, C., Pramova, E. & Di Gregorio, M., 2015a. Integrating climate change mitigation and adaptation in agriculture and forestry: Opportunities and trade-offs. WIREs Climate Change, 6 (6), 585-598.
Locatelli, B., Pavageau, C., Pramova, E. & Di Gregorio, M., 2015b. Integrating climate change mitigation and adaptation in agriculture and forestry: Opportunities and trade-offs. WIREs Climate Change. DOI: 10.1002/wcc.357.
Maraseni, T.N., Mushtaq, S. & Reardon-Smith, K., 2012. Climate change, water security and the need for integrated policy development: the case of on-farm infrastructure investment in the Australian irrigation sector. Environmental Research Letters, 7 (3).
Marcovitch, J., (coord.) et al., , 2010. Economia da mudança do clima no Brasil: custos e oportunidades. IBEP Gráfica.
Marengo, J.A., 2008. Vulnerabilidade, impactos e adaptação à mudança do clima no semi-árido do Brasil. 27, 149-176.
Marengo, J.A., Borma, L., Rodriguez, D., Pinho, P., Soares, W. & Alves, L., 2013. Recent extremes of drought and flooding in Amazonia: Vulnerabilities and human adaptation. American Journal of Climate Change, 2 (2), 87-96.
May, P. & Da Vinha, V., 2012. Adaptation to climate change in Brazil: The role of private investment. Estudos Avançados, 26 (74).
May, P.J., Sapotichne, J. & Workman, S., 2006. Policy coherence and policy domains. Policy Studies Journal, 34 (3), 381-403.
Mickwitz, P., Aix, F., Beck, S., Carss, D., Ferrand, N., Görg, C., Jenzen, A., Kivimaa, P., Kuhlicke, C., Kuindersma, W., Máñez, M., Melanen, M., Monni, S., Pedersen, A.B., Reinert, H. & van Bommel, S., 2009. Climate policy integration, coherence and governance. Peer Report. Helsinki: Partnership for European Environmental Research.
Moser, S.C., 2012. Adaptation, mitigation, and their disharmonious discontents: An essay. Climatic Change, 111 (2), 165-175.
Nepstad, D., McGrath, D., Stickler, C., Alencar, A., Azevedo, A., Swette, B., Bezerra, T., DiGiano, M., Shimada, J., Seroa da Motta, R., Armijo, E., Castello, L., Brando, P., Hansen, M.C., McGrath-Horn, M., Carvalho, O. & Hess, L., 2014. Slowing Amazon deforestation through public policy and interventions in beef and soy supply chains. Science, 344 (6188), 1118-1123.
Nepstad, D.C., Stickler, C.M., Filho, B.S.-. & Merry, F., 2008. Interactions among Amazon land use, forests and climate: prospects for a near-term forest tipping point. Philosophical Transactions B, 363 (1498), 1737-1746.
Nilsson, M., Zamparutti, T., Petersen, J.E., Nykvist, B., Rudberg, P. & McGuinn, J., 2012. Understanding policy coherence: Analytical Ffamework and examples of sector-environment policy interactions in the EU. Environmental Policy and Governance, 22 (6), 395-423.
Nunan, F., Campbell, A. & Foster, E., 2012. Environmental Mainstreaming: The Organisational Challenges of Policy Integration. Public Administration and Development, 32 (3), 262-277.
Obermaier, M. & Rosa, L.P., 2013. Mudança climática e adaptação no Brasil: uma análise crítica. Estudos Avançados, 27, 155-176.
Observatório do Plano ABC, 2014. Proposta para revisão do Plano ABC. DOI.
PBMC ed. 2014. *Impactos, vulnerabilidades e adaptação às mudanças climáticas. Contribuição do Grupo de Trabalho 2 do Painel Brasileiro de Mudanças Climáticas ao Primeiro Relatório da Avaliação Nacional sobre Mudanças Climáticas,* Rio de Janeiro: COPPE, Universidade Federal do Rio de Janeiro.

Pinto, H.S., Assad, E.D., Zullo Jr., J., Evangelista, S.R.d.M., Otavian, A.F., Ávila, A.M.H., Evangelista, B.A., Marin, F., Jr, M., Pellegrino, G.Q., Coltri, P.P. & Coral, G., 2008. Global warming and the new geography of agricultural production in Brazil. São Paulo, Brazil: Centro de Pesquisas Meteorológicas e Climáticas Aplicadas à Agricultura (CEPAGRI) and Brazilian Agricultural Research Corporation (EMBRAPA).

Pramova, E., Di Gregorio, M. & Locatelli, B., 2015. Integrating adaptation and mitigation in climate change and land-use policies in Peru. CIFOR Working Paper, 184. Bogor, Indonesia: Center for International Forestry Research.

Pramova, E., Locatelli, B., Brockhaus, M. & Fohlmeister, S., 2012a. Ecosystem services in the National Adaptation Programmes of Action. Climate Policy, 12 (4), 393-409.

Pramova, E., Locatelli, B., Djoudi, H. & Somorin, O.A., 2012b. Forests and trees for social adaptation to climate variability and change. Wiley Interdisciplinary Reviews: Climate Change, 3 (6), 581–596.

Presidency of the Republic of Brazil, 2015. Decreto Nº 8.576: Comissão Nacional para REDD+. Brasilia: Presidency of the Republic of Brazil.

QSR International Pty Ltd, 2012. NVivo qualitative data analysis software; Version 10.

Ravindranath, N.H., 2007. Mitigation and adaptation synergy in forest sector. Mitigation and Adaptation Strategies for Global Change, 12 (5), 843-853.

Reid, H. & Huq, S., 2005. Climate change - biodiversity and livelihood impacts. In Robledo, C., Kanninen, M., Pedroni, L. & Eds. eds. Tropical forests and adaptation to climate change: In search of synergies. Bogor, Indonesia: CIFOR, 57-70.

Rosenzweig, C. & Tubiello, F., 2007. Adaptation and mitigation strategies in agriculture: an analysis of potential synergies. Mitigation and Adaptation Strategies for Global Change, 12 (5), 855-873.

Secretariat of Strategic Studies of the Presidency, 2015. Brasil 2040: Resumo executivo. Brasilia: Government of Brazil.

Seroa da Motta, R., 2011b. A Política Nacional sobre Mudança do Clima: aspectos regulatórios e de governança. In Seroa Da Motta, R., Hargrave, J., Luedemann, G. & Sarmiento Gutierrez, M., B. eds. Mudança do Clima no Brasil: Aspectos econômicos, sociais e regulatório. Brasília: IPEA.

Seroa da Motta, R., Hargrave, J., Luedemann, G. & Sarmiento Gutierrez, M., B. eds. 2011a. Mudança do Clima no Brasil: Aspectos econômicos, sociais e regulatório, Brasília: IPEA.

Smith, P. & Olesen, J.E., 2010. Synergies between the mitigation of, and adaptation to, climate change in agriculture. The Journal of Agricultural Science, 148 (05), 543-552.

Soares-Filho, B., Rajão, R., Macedo, M., Carneiro, A., Costa, W., Coe, M., Rodrigues, H. & Alencar, A., 2014. Cracking Brazil's Forest Code. Science, 344 (6182), 363-364.

Spracklen, D.V. & Garcia-Carreras, L., 2015. The impact of Amazonian deforestation on Amazon basin rainfall. Geophysical Research Letters, 42, 9546-9552.

Stabile, M.C.C., Azevedo, A. & Nepstad, D., 2012. *Brazil's low carbon agriculture program":* Barriers to Implementation. Amazon Environmental Research Institute (IPAM).

Subrahmanian, R., 2007. Making sense of gender in shiftin institutional context: Some reflections on gender mainstreaming. In Cornwall, A., Harrison, E. & Whitehead, A. eds. Feminisms in development: Contradictions, contestations and challenges. London: Zed Books.

Swart, R. & Raes, F., 2007. Making integration of adaptation and mitigation work: mainstreaming into sustainable development policies? Climate Policy, 7 (4), 288-303.

Thuy, P.T., Moeliono, M., Locatelli, B., Brockhaus, M., Di Gregorio, M. & Mardiah, S., 2017. Integration of adaptation and mitigation in climate change and forest policies in Indonesia and Vietnam. Forests. DOI: doi: 10.3390/f5082016.

Tito, M.R. & Ortiz, R.A., 2013. Project Support to EU-Brazil Sector Dialogues: PaymenPayment for environmental services: Challenges to stimulate private sector demand. MMA: Brasilia.

Tol, R.S.J., 2005. Adaptation and mitigation: trade-offs in substance and methods. Environmental Science & Policy, 8 (6), 572-578.

Tollefson, J., 2012. Brazil set to cut forest protection. Nature, 485, 19.
Tollefson, J., 2015. Political appointments spur concerns for Amazon. Nature, 517, 251–252.
Tomasella, J., Pinho, P., Borma, L., Marengo, J., Nobre, C., Bittencourt, O.F.O., Prado, M.R., Rodriguez, D. & Cuartas, L., 2013. The droughts of 1997 and 2005 in Amazonia: floodplain hydrology and its potential ecological and human impacts. Climatic Change, 116 (3-4), 723-746.
Turner, W.R., Oppenheimer, M. & Wilcove, D.S., 2009. A force to fight global warming. Nature, 462 (7271), 278-279.
Valdes, C., Arriola, C. & Somwary, A., 2010. Brazil's climate adaptation policies: Impacts on agriculture. IATRC Pblic Trade Policy Research and Analysis Symposium. Stuttgart, Germany: MAPA (Brasilia).
Vale, M.M., Alves, M.A.S. & Lorini, M.L., 2010. Mudanças climáticas: desafios e oportunidades para a conservação da biodiversidade brasileira. Oecologia Brasiliensis, 13 (3), 518-535.
Verchot, L.V., van Noordwijk, M., Kandji, S., Tomich, T.P., Ong, C.K., Albrecht, A., Mackensen, J., Bantilan, C., Anupama, J. & Palm, C.A., 2007. Opportunities for linking adaptation and mitigation in agroforestry systems. Mitigation and Adaptation Strategies for Global Change, 12 (5), 901–918.
Vignola, R., Locatelli, B., Martinez, C. & Imbach, P., 2009. Ecosystem-based adaptation to climate change: What role for policy-makers, society and scientists? Mitigation and adaptation strategies for global change, 14 (8), 691-696.
Viola, E. & Franchini, M., 2013. Brasil na governança global do clima, 2005-2012: A luta entre conservadores e reformistas. Contexto Internacional, 35 (1), 43-76.
Weber, R.P., 1990. Basic content analysis Thousand Oaks, CA: Sage.
WWF, 2011. Brazil's Low Carbon Development Plan. Climate Country Brief. Brasilia, Brazil.
Young, O.R., 2002. The institutional dimensions of environmental change: Fit, interplay, and scale Cambridge, Massachusetts, USA: MIT Press.
Zullo Jr, J., Jr., M., C. Evangelista, B.A., Pinto, H.S., Marin, F.R., Assad, E.D. & Koga-Vicente, A., 2013. Riscos climáticos da cultura da cana-de-açúcar. In Baeninger, R., Jr., Z., J. Aidar, T. & Peres, R.G. eds. Regiões Canavieiras. Campinas, Brazil: Unicamp.
Zullo Jr, J., Koga-Vicente, A. & Rosa Pereira, V., 2015. Impacts of climate change in surgarcane production in Center-South Brazilian Region based on AR5/IPCC Climate models. Paper presented at 19th ICABR *Conference, 'Impacts of the Bioeconomy on Agricutlural* Sustainability, The Environment and Human Health. Ravello, Italy.
Zullo Jr, J., Pinto, H.S. & Assad, E.D., 2006. Impact assessment study of climate change on agricultural zoning. Meteorol. Appl. (Supplement), 69-80.