CHALMERS
UNIVERSITY OF TECHNOLOGY

Land Use and Forest Strategies to Combat Climate Change - Examples from Five Nationally Determined Contributions (NDCs)

A Policy Analysis for Bolivia, Brazil, Burkina Faso, Guyana and India

Bachelor's Thesis

Miranda Bånnsgård, Erik Eurenius, Klara Holmgård
Erik Larsson, Amanda Lundberg

Institution of Space, Earth and Environment
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2018

Land Use and Forest Strategies to Combat Climate Change - Examples from Five Nationally Determined Contributions (NDCs)
A Policy Analysis for Bolivia, Brazil, Burkina Faso, Guyana and India
MIRANDA BÅNNSGÅRD, ERIK EURENIUS, KLARA HOLMGÅRD,
ERIK LARSSON, AMANDA LUNDBERG

Supervisor: Madelene Ostwald, Department of Space, Earth and Environment, Physical Resource Theory
Examiner: Göran Berndes, Department of Space, Earth and Environment, Physical Resource Theory

Bachelor's Thesis
Department of Space, Earth and Environment
Physical Resource Theory
Chalmers University of Technology
SE-412 96 Gothenburg
Telephone +46 31 772 1000

Cover: Andrew Malone, "Forest," Available: `https://www.flickr.com/`, [Electronic image].
CC BY 2.0. Accessed on: May 13, 2018.

Typeset in LaTeX
Gothenburg, Sweden 2018

Abstract

This thesis aims to investigate how Bolivia, Brazil, Burkina Faso, Guyana and India are planning to fulfill the commitments related to Agriculture, Forestry and Other Land Use (AFOLU) in their Nationally Determined Contributions (NDCs), which they submitted to the UNFCCC prior to the Great Climate Summit in Paris 2015, with the topic of limiting global warming to 2°C. This investigation was done by analyzing the content of the NDC documents, and pinpointing AFOLU-related strategies in these.

Further, the feasibility of the NDCs is analyzed by evaluating existing national programmes and policies, how they are intertwined with the NDCs, and how they could affect the practical implementation of the NDC. Trends in historical GHG emissions and land covered by agriculture and forests is used as background to understand how future development might evolve.

The result given is that the AFOLU sector is the largest contributor to GHG emissions, for all investigated parties except India. For the South American parties the main issues are curbing deforestation and illegal logging, for Burkina Faso focus lies primarily on improvement of cooking stoves to decrease the usage of firewood, something India also concerns, although India's main focus lies on enhanced carbon sequestration through afforestation and reforestation, and quality improvement of existing forest.

It is identified that the greatest obstacle for implementing the mitigation and adaptation strategies described in the parties NDCs, is that they are heavily dependent on funding from developed countries. However, even if sufficient amounts of funding needed to finance the strategies in all parties NDCs are provided, the goal to limit the global average temperature rise to below 2°C is unlikely to be reached.

An identified driving force for the implementation of the NDC strategies for some developing countries, is that large parts of the poor populations are severely exposed to the effects of extreme climatic events, and therefore actions to limit global warming are pressing.

In summary, climate change is a global problem and the conclusion is that only joint international cooperation will be a viable way forward if global warming is to be limited, and the consequences of climate change is to be mitigated.

Keywords: NDC, feasibility, AFOLU, climate change, GHG emissions, Bolivia, Brazil, Burkina Faso, Guyana, India

Contents

List of Figures

List of Tables

Abbreviations

ABC	Low Carbon Emission Agriculture (Portugese abbreviation for: Agricultura de Baixa emissão de Carbono)
ABT	Forest and Land Monitoring and Control Authority
AFOLU	Agriculture, Forest and Other Land Use
APP	Areas of Permanent Preservation
BaU	Business as Usual
CAR	Rural Environmental Registry (Portugese abbreviation for: Cadastro Ambiental Rural)
CAT	Climate Action Tracker
CBA	Community-Based Adaptation
CDM	Clean Development Mechanism
CO_2 eq.	Carbon dioxide equivalent
CRSAP	Climate Resilience Strategy and Action Plan
EU-FLEGT	European Union Forest Law Enforcement, Governance and Trade
FAO	Food and Agriculture Organization of the United Nations
FC	Forest Code
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GIM	Green India Mission
ICLFS	Integrated Cropland-Livestock-Foresty Systems
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
JFM	Joint Forest Management
LCDS	Low Carbon Development Strategy
LR	Legal Reserve
LUCF	Land Use Change and Forestry
LULUCF	Land Use, Land Use Change and Forestry
MCMA	Joint Mitigation and Adaptation Mechanism for the Comprehensive and Sustainable Management of Forest and the Mother Earth
Mha	Mega hectare
MMA	Ministry of the Environment (Portugese abbreviation for: Ministério do Meio Ambiente)
MRVS	Monitoring, Reporting and Verification Systems
Mt	Mega tonne
NAMA	Nationally Appropriate Mitigation Actions
NAP	National Adaptation Plan
NAPA	National Adaptation Programmes of Action
NAPCC	National Action Plan on Climate Change
NDC	Nationally Determined Contribution
NGO	Non-Governmental Organization
NEP	National Environmental Policy
NP	National Program

OECD	Organisation for Economic Co-operation and Development
REDD	Reducing Emissions from Deforestation and forest Degradation
SFI-SLM	Strategic Framework for Investment in Sustainable Land Management
SGP	Small Grants Program
SICAR	System for Rural Environmental Registry (Portugese abbreviation for Sistema de Cadastro Ambiental Rural)
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
VPA	Voluntary Partnership Agreement
WRI	World Resource Institute

1 Introduction

Human-induced greenhouse gas (GHG) emissions related to Agriculture, Forestry and Other Land Use (AFOLU) correspond to 20-24 % of total GHG emissions to the Earth's atmosphere [1]. This makes it the second largest emitting sector globally, surpassed only by the energy supply sector [1]. In order for GHGs in the atmosphere to not increase further, it is paramount to preserve and utilize land and forests in a sustainable way.

Prior to the United Nations Great Climate Change Summit in Paris in December 2015, all participating countries, also called parties, were able to propose commitments to reduce their GHG emissions, with starting deadline 2020. The purpose of the agreement is that the countries of the world jointly shall reduce their emissions to such a degree that the overall increase in the Earth's average temperature by the year 2100 is less than 2 °C, and that the net carbon dioxide emissions should be zero during the second half of this century [2].

1.1 Background

In the parties' climate commitments, known as the Nationally Determined Contributions (NDC), there are actions related to AFOLU. Examples of these actions include afforestation, improved forest and soil management, and conservation of areas with high environmental functions.

This thesis will investigate in depth five countries whose climate measures are particularly interesting for land and forestry in various ways; Bolivia, Brazil, Burkina Faso, Guyana and India. The reasons why these countries are particularly interesting in terms of climate actions in AFOLU are because: Bolivia proposes an approach where mitigation (constraints) and adaptation are closely intertwined, especially in the agricultural and forestry sectors; Brazil relies heavily on existing programmes for sustainable land use; Burkina Faso focuses on measures aimed at reducing their dependency on firewood by increasing the proportion of climate-friendly agriculture; Guyana connects the NDC with a previously established development plan; and India's NDC focuses strongly on the forest sector and the national plans regarding that sector.

In addition to international commitments through the United Nations Framework Convention on Climate Change (UNFCCC), the parties have different national ambitions and plans. One factor that might be relevant for a successful implementation of the actions in the NDCs may be how well the parties have weaved them together with other plans at a national level.

1.2 Aim

This thesis is part of a research project at the Department of Space, Earth and Environment at Chalmers University of Technology, funded by the Swedish Energy Agency (Energimyndigheten). The thesis will describe how Bolivia, Brazil, Burkina Faso, Guyana and India - depending on their economic and social conditions - are planning to fulfill the commitments in their NDCs, focusing on the AFOLU-sector.

The thesis will also investigate how the countries' targets for reducing their GHG emissions are linked to national policies related to AFOLU, and how NDCs can be supported by these policies. The side effects which can occur by implementing the commitments in the parties' NDCs and national strategies can act as impeding or driving forces for the actual implementation, therefore, some of these side effects will also be evaluated.

Overall, the aim of this thesis is to increase the understanding of which of the commitments that will be effective, socially beneficial, and practically feasible, to ultimately increase the knowledge of how we should act in the world to alleviate the human acceleration of global warming.

1.3 Delimitation

This thesis will cover the parts of the NDCs and national policies that concern AFOLU. There are several different types of environmental impact in these areas, but this report will focus primarily on changes of GHG in the atmosphere.

1.4 Problem formulation

In order to reach the aim of the thesis, the following issues will be treated:

- Based on the NDCs - what measures in the AFOLU sector are proposed and planned by the parties to fulfill their climate commitments?
- Are there any other national decisions or policies that link together with the proposed measures in the NDCs?
- How much of the party's total GHG emissions is caused in the AFOLU sector?
- How would the implementation of the proposed measures affect the parties' GHG in the AFOLU sector?
- What are the significant driving forces or obstacles for the parties in order for them to fulfill their NDC commitments?

- How feasible is it that the parties actually will fulfill their commitments?

1.5 Method

This project is based on literature reviews of reports, articles and other relevant literature linked to the parties' AFOLU-related climate work. A seminar, AgroFoSe2030, and seminars and lectures associated with the structural construction of the report was attended. Sources are critically scrutinized to confirm that they are objective and scientifically rooted.

1.6 Outline

The report will begin to explain some terms connected to AFOLU, which are important for the understanding of measures planned by the parties to reduce GHG emissions. This is followed by one chapter for each country - Bolivia, Brazil, Burkina Faso, Guyana and India - including descriptions of their NDCs, other policy documents and analyses of how feasible the fulfillment of their commitments are. A joint conclusion of the five parties' feasibility of reaching their targets will wrap up the thesis.

2 Background to land use and actions to prevent climate change

In 2015, the members of the UNFCCC drafted the Paris Agreement to deal with GHG emissions, mitigation, adaptation and financing related to climate change. The agreement was adopted by 195 parties with the goal that with joint effort limit the global warming to below 2 °C, and avoid dangerous consequences caused by the climate change [3]. According to the agreement, each party shall create an NDC which describes the contributions the parties intends to achieve [4]. In this section concepts related to the NDC and climate change in general is described, all important for the full understanding of this report. The nations that will be investigated in this report are marked in Figure 1.

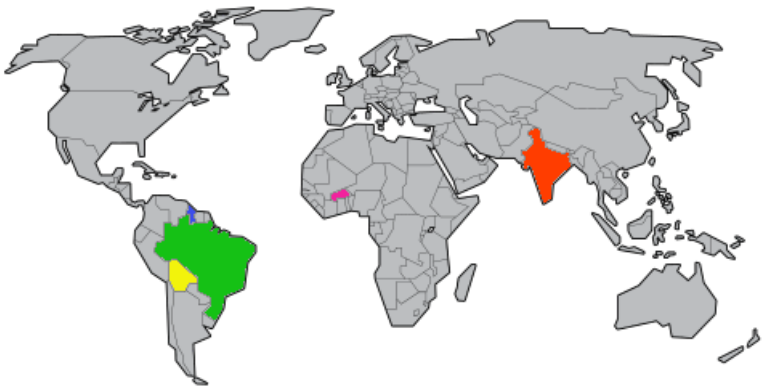

Figure 1: World map with the nations in focus for this report. Bolivia in yellow, Brazil in green, Burkina Faso in pink, Guyana in blue, and India in red. From [5]. CC0.

2.1 Nationally Determined Contribution

Intended Nationally Determined Contributions (INDCs) were submitted by parties as a result of the Great Climate Summit in Paris 2015, and consisted of actions the parties intended to take in order to combat climate change, post 2020. After the summit, when these propositions are accepted and ratified in respective country, it loose its 'Intended' from the name, making it a Nationally Determined Contribution - an NDC [2]. The Paris Agreement is ratified by all countries investigated in this report [6], therefore they are all called 'NDCs'. Each party is obligated to submit an updated NDC every five years [2].

The INDCs were supposed to include climate actions substantial enough to keep the global mean temperature well below a rise of 2 °C [2], but according to PBL Netherlands Environmental Assessment Agency, the contributions are far from from what they need to be in order to reach that goal [7].

Some parties submit a conditional and an unconditional pledge. The unconditional pledge includes actions that will be taken regardless of any financial help. The conditional pledge is actions that potentially can be taken if sufficient amounts of financial aid is provided.

2.2 Carbon cycle

All living matter are built upon carbon, and plants are fixating carbon in the form of CO_2-molecules from the atmosphere by the photosynthesis process [8]. When fixed in plants, it could be eaten and digested, and in that way sent travelling up the food chain [8]. Animals and humans produce CO_2 as a waste product while respiring, and biologically bound CO_2 reach the atmosphere again when bodies, plants or other biomass decay [8]. Some of the organic carbon is stored in the ground as fossil fuels, limestone and coral and is released to the atmosphere as CO_2 through anthropocentric activities [8]. The circulation of carbon in the nature is called the carbon cycle and is illustrated in Figure 2.

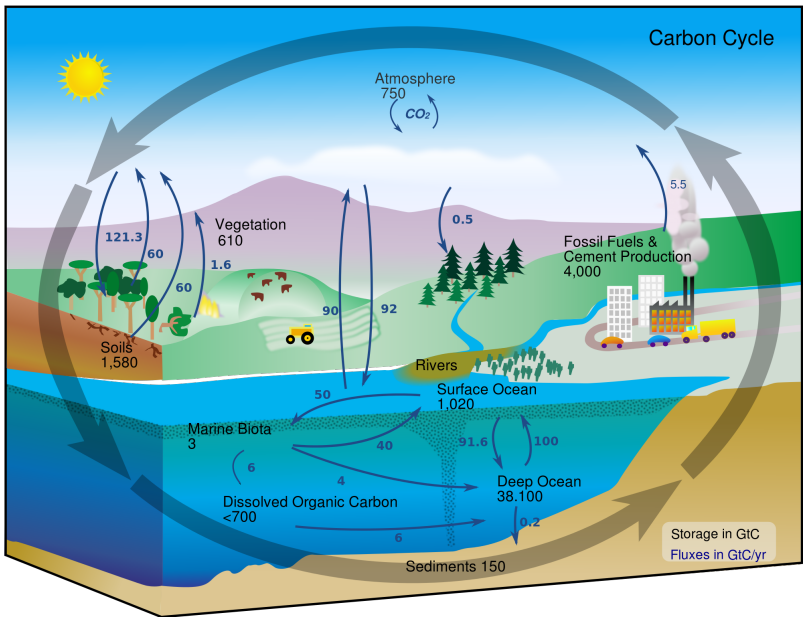

Figure 2: A schematic illustration of the carbon cycle. From [9]. CC0.

The different parts of the cycle have different time aspects of the recycling of carbon, for example the carbon stored as fossil fuels have the longest "recycle" rate while the exchange of carbon between air and sea is relatively very short [10]. In the photosynthesis, plants convert CO_2 in the atmosphere to compounds based on carbon [10]. Some elements, like forests, of the carbon cycle accumulate carbon in large amounts and make up reservoirs of carbon [10]. For example, the Amazon holds about 25 % of the forest carbon of the Earth and in the earthly communities, about 80 % of aboveground and 33 % of belowground carbon are stored in forests [10]. To avoid

additional GHG emissions, it is therefore of interest to keep the existing forests in the world intact and to use afforestation to create additional carbon reservoirs.

2.3 Mitigation and Adaptation

Mitigation and adaptation are two categories of strategies linked to climate work that are used in this report to categorize strategies linked to climate actions.

Mitigation strategies are means that reduces the effects on the climate caused by humans, which includes reduce GHG emissions or enhance a GHG sink [11]. The actions can be everything from extremely complex and broad, for example renewable energy and changing consumer behaviour, to much more simple and specific, like improvements to a cooking stove [12].

Mitigation An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

An adaptation strategy means to forecast effects caused by climate change and take action prevent or minimize them, or to reduce effects as a response when they are happening [13]. The purpose of such strategies is to strengthen the resilience of society against climate change [14].

2.4 AFOLU

The term Agriculture, Forestry and Other Land Use (AFOLU) was established by the Intergovernmental Panel on Climate Change (IPCC) in 2006, and describes the category of above named activities [15]. The sector is responsible for a quarter of all anthropocentric GHG emissions - mainly through deforestation, and agricultural activities such as livestock-, soil- and nutrient management - but it also creates CO_2 sinks through, for example, afforestation and management of soil carbon sequestration [16]. GHG mitigation options in the AFOLU sector include:

- Conserving existing carbon pools in soils or vegetation, and thereby reduce or prevent emission to the atmosphere [16].
- Enhancing the carbon sequestration in terrestrial reservoirs and thereby remove CO_2 from the atmosphere [16].
- Substitute fossil fuels and energy-intensive products to more climate sensitive alternatives [16].

Two important acronyms related to the AFOLU sector is LUCF and LULUCF. LUCF stands for Land-use Change and Forestry, and LULUCF stands for Land Use, Land-use Change and Forestry. The difference between the two is the inclusion

of present land uses in LULUCF, where land use can be agricultural practises, livestock farming, or other management of the land [17].

2.5 Multifunctional land use

'Multifunctional' land use is a term that is sprung from the Organisation for Economic Co-operation and Development (OECD) and the European Union (EU) in the thought experiment of theoretical reforms in the agriculture sector in Europe [18]. The idea is to get multiple utilities from a piece of land - economic, social, cultural and environmental functions [18]. Most, or all, of the goals stated in the NDCs are multifunctional since they have at least two outcomes; GHG savings, and something else, like conservation of forest or consolidation of agroforestry systems.

2.6 Market mechanisms to support environmental actions in AFOLU

An important part of climate work is often the financial aspect. The most environmentally beneficial option is not always the the cheapest available alternative. External financing may help parties with a lack of funds to still be available to carry through certain projects. There exist a number of market mechanisms whose goal is to facilitate sustainable development, and examples of these will be presented briefly in the upcoming sections.

2.6.1 REDD and REDD+

REDD is an abbreviation for "Reducing Emissions from Deforestation and forest Degradation", which is a financial incentive within the UN-REDD Programme, developed by parties in UNFCCC in order to reduce the anthropocentric stress on forests. The intention is that developed countries will provide financial help to developing countries for them to preserve their forests and thereby reduce forest carbon emissions [19].

In the beginning, REDD was focused on reducing emissions mainly from deforestation and forest degradation, but in 2007, the need for the inclusion of conservation, sustainable management of forests, and enhancement of forest carbon stocks, was raised. In 2010, these matters were included, and REDD became REDD+ with the following components [20]:

1. Reducing emissions from deforestation,

2. Reducing emissions from forest degradation,

3. Conservation of forest carbon stocks,

4. Sustainable management of forests, and

5. Enhancement of forest carbon stocks

The UN-REDD Programme supports 64 developing countries, which Bolivia, Burkina Faso, Guyana and India are parts of [21]. It is entirely reliant on voluntarily donations from governments in developed countries, and official and private organizations [22].

2.6.2 CDM

Clean Development Mechanisms (CDM) allows funding of GHG emission reduction projects in countries that have no commitments under the Kyoto Protocol, but have signed the protocol [13]. This includes all parties under investigation in this report. The CDM allows emission reducing programmes in developing countries to earn emission reduction credits equivalent to an amount of CO_2, which can be traded or sold and used by industrialized nations to meet a part of their emission reduction targets under the Kyoto Protocol, while at the same time stimulate sustainable development [23].

The second commitment period of the Kyoto Protocol continues to 2020 [24] and right now (May 2018), there are 66 projects registered under afforestation and reforestation and 131 under agriculture [25]. This is a remarkably low figure, only 2.5 % of all registered projects, which counts to 7 804 in total [25].

3 Bolivia

Bolivia, officially known as the Plurinational State of Bolivia (Spanish: Estado Plurinacional de Bolivia), is a landlocked, highland country divided into nine states. One-third of its territory lies in the Andes Mountains, where livestock farming and agricultural practises are the most common professions [26]. East of the Andes, the landscape is broken up by the Valles, a fertile valley and mountain system which merges in to a land composed of swamps, flooded bottomlands, savannas, and tropical forests in the north and east, covering two-thirds of Bolivia and supporting a great variety of wildlife and the country's largest population centre, Santa Cruz [27].

Bolivia is one of the poorest countries in Latin America, but between 2004 and 2014 the moderate poverty rates were reduced from 59 % to 39 %, and has since remained around 39 % [28].

Bolivia's NDC is interesting for this thesis since the suggested commitments for mitigation and adaptation are closely intertwined, without mitigation there can be no adaptation, and vice versa. This connection is particularly distinct in commitments regarding the AFOLU sector [29]. This sector is also the greatest contributor to GHG emissions in the country.

3.1 Land use in Bolivia

The north and east of the Andes, and the Valles contains the forest and agricultural areas, making up 84 % of the whole country [30]. The division between the uses of land, and sectors within the agriculture sector is shown in Table 1 and Table 2.

Table 1: Type of land use in Bolivia. From [30].

	Area [Mha]	**Area [%]**
Land area	108.3	100
Forest	54.7	50.5
Agriculture	37.7	34.8
Other land	15.9	14.7

Table 2: Type of land use in Bolivia within the agricultural sector. From [30].

	Area [Mha]	**Area [%]**
Total agricultural land	37.7	100
Permanent meadows and pasture	33.0	87.5
Arable land	4.5	11.9
Permanent crops	0.2	0.6

About two-fifths of Bolivia's working population is engaged in agriculture, including small numbers in forestry and also fishing and hunting [27]. The government withholds a policy that limits the export of agrocultural industrial goods, and provides fixed prices for small farmers with emphasis on social inclusion rather than supporting expansive ambitions, and such regarding exportation, which has resulted in the country consisting of mostly small scaled agricultural businesses [31].

The most commonly produced crops are soybean, sugar cane, wheat, maize, sorghum and sunflower, where soybean is the leading commercial crop dominating both the agricultural production and the export. But, the agricultural practises are mostly underdeveloped, the lack of irrigation is a big problem and there is an excessive use of agrochemicals. Soybean also has low crop rotation, and sugar cane has none [31], which make them more vulnerable for diseases and pests and in need of more agrochemicals. It also results in lower yields and a depletion of nutrients from the soil [32].

Most of the forest area, about 80 %, consists of natural tropical forests, although the type of forests varies depending on the altitude. These are particularly threatened by deforestation. In 2016, the Forest and Land Monitoring and Control Authority (ABT) reported that 0.32 Mha was deforested in the country, and in 2015 more than 0.24 Mha was deforested, which means an increase by 33 % between 2015 and 2016 [33]. The cause for this is partially the increase of cattle ranching, which between 1992 and 2004 contributed to deforestation by 27 % [34], but mostly the rising demand on soybean.

In 1996, the forestry laws were revised and the concept of sustainable forest management was announced, making annual inventory obligatory. In 2016, ABT reported that out of all deforestation in Bolivia, 84 % was generated in the state of Santa Cruz which of 80 % was deforested illegally [35].

3.2 GHG data and land use emissions

According to CAIT Climate Data Explorer, provided by the World Resource Institute (WRI), the total GHG net emission in 2014 was 134 Mt CO_2 eq., with the LUCF sector as the largest source of emission. The LUCF sector was more than three times bigger than the second and third following sectors, agriculture and energy [36]. An overview of the contributing sectors and their emissions is shown in Table 3.

Table 3: Bolivia's GHG emissions in Mt CO_2 eq. in 2014. From [36].

Sector	**Emissions [Mt CO_2 eq.]**	**Emissions [%]**
Energy	21.46	16
Industrial Processes	1.79	1
Agriculture	23.18	17
Land-Use Change and Forestry	85.71	64
Waste	2.03	2
Bunker Fuels	0.19	<1
Total	134.18	100

From the first recorded data in 1990 up till 2014, emissions has been stable, as well

as the distribution between the sectors, with the LUCF sector dominating. The historical emissions divided by sector are shown in Figure 3.

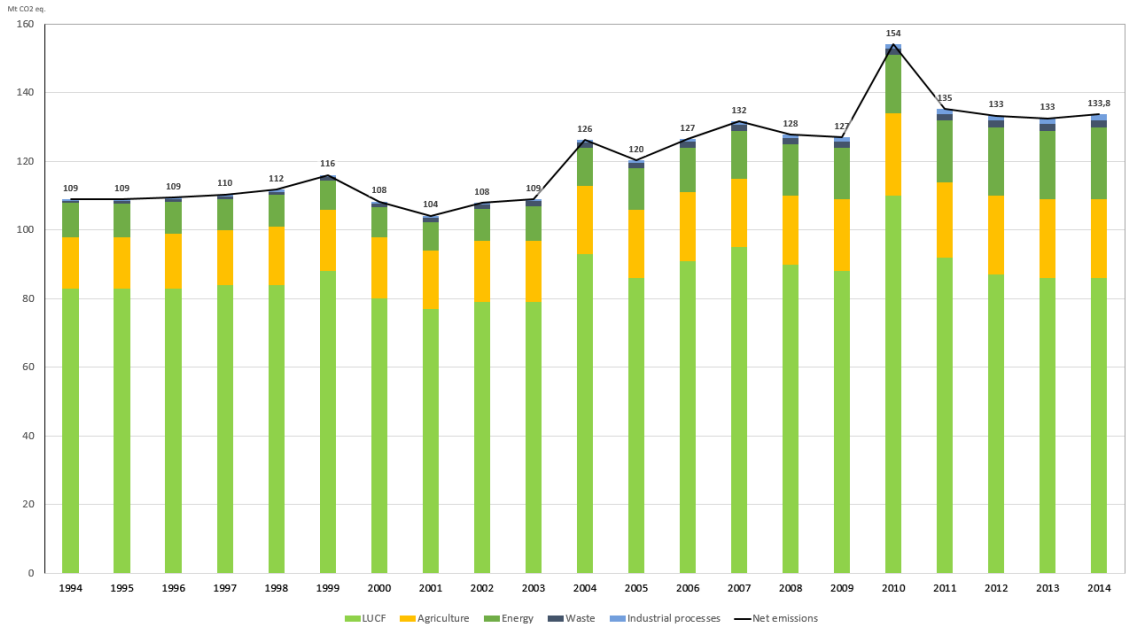

Figure 3: Bolivias' GHG emissions in Mt CO2 eq. from different sectors between 1990 and 2014. From [36].

3.3 Summary of national policies and documents

Bolivia has been a party of the UNFCCC since its beginning in 1992, and has a long history of projects targeting the AFOLU sector and climate related work. This section focuses on the national policies, projects and other documents related to climate work within the AFOLU sector. This is why Bolivia's NDC, its alternative to REDD+, and their projects within United Nations Development Program's (UNDP's) Community-Based Adaptation Project, which are implementing the building blocks of the REDD+ alternative and supports the goals stated in the NDC, are presented here.

3.4 The NDC of Bolivia

Bolivia submitted their NDC in October 2016, and the focus lies on three sectors: water, energy, and forest and agriculture [29]. Their climate plans are two dimensional: one part is focused on national actions and results to be met in the context of holistic development, and one part is focused on structural solutions to the climate crisis. The overall goal is improved living standard for Bolivia's population, where the most vulnerable part of the population is affected most by climate change. It is estimated in the NDC that between 1982 and 2014, 4 million Bolivian people

have been directly affected by the climate crisis, and with the goal to also eradicate extreme poverty within the country to by 2025, it describes a more sustainable way of life and improved climate as an important part of reaching that goal [29].

Overall, 27 national goals is established in regards to the national holistic development, which are to be met using 42 corresponding contributions of national effort. Of these, 11 goals and 22 contributions are connected to the sector forest and agriculture [29], see the contributions in Section 3.5, Strategies. The NDC states that the contributions are voluntary to each of the nine states in Bolivia. In addition to the contributions and goals made and met with national efforts, 10 results are presented that are estimated to be met with international cooperation and with the support from the UNFCCC's financial mechanism, the UN-REDD Supports National Program (NP) [29], the results are presented in Appendix A.

The NDC also proclaims 10 structural solutions to the climate crisis to complement the 37 national goals, where the structural solutions targets the very fabrication of all the societies contributing to the climate crisis. It considers that the joint approach between mitigation and adaptation, with regards to the holistic development plans, is the only way to systematically address climate change. By these 10 structural solutions it raises the need to establish international cooperation to strengthen the synergies between mitigation and adaptation in the field of forestry. The proposal for this is to adopt a new world civilization model focused on the rights of Mother Earth, and every person's equal right and responsibilities towards it [29], see further description of the structural solutions in Section 3.5, Strategies.

It is emphasized in the NDC that since the forest area in Bolivia is large, about 50 % of the country, and it provides a livelihood for communities and small scale producers as well as facilitates the provision of environmental functions, it is important to protect the forest areas for the population to thrive. Regarding agricultural production, the goal is to to expand the area of food production. In 2015, the agricultural areas represented 34.3 % of the country, thus, agricultural production plays an important role in the contribution to the climate change [29].

Bolivia is planning to fulfill the commitments in the NDC by implementation of provisions of the State Constitution (Law No.071 of The Rights of Mother Earth and Law No.300 of Mother Earth and Integral Development to Live Well) [37][38], and implementation of the 2025 Patriotic Bicentennial Agenda and its 13 pillars, as well as medium and long-term national plans. Bolivia will promote community and small farmers production, and programs that have been launched in line with the NDC goals are for example "My Water" and "My Irrigation", which are multipurpose hydro projects to enable coverage of irrigation to support e.g. AFOLU [29].

3.5 Strategies

In the following section, the strategies in the NDC concerning the AFOLU sector are described in further detail. The NDC describes the joint impacts of mitigation and adaptation to climate change, which is why both mitigation and adaptation strategies related to AFOLU are described in the same section; Section 3.5.1, Mitigation and Adaptation.

3.5.1 Mitigation and Adaptation strategies

In this section the strategies from the two dimensional plans related to AFOLU are presented.

Structural solutions to the climate crisis

Of the ten structural solutions proclaimed in the NDC, one is directly related to AFOLU:

10. Decolonize natural resources environmental colonial biased views that see the peoples of the South as forest rangers of Northern countries and communities as enemies of nature. [29]

National efforts and contributions in the forest and agriculture sector

The overall goal made with national efforts in the AFOLU sector, within time period 2015-2030, is to increase the capacity of joint adaptation and mitigation through the comprehensive and sustainable management of forests.

The 22 contributions related to the AFOLU sector, to be made with national efforts, covers: conservation, restoration and recovery of areas with high environmental functions and degraded soils and forests; implementation of sustainable management by control, monitoring, and tracking systems of forests; control of illegal deforestation via these systems; transition towards agricultural systems and forestry systems with sustainable practises, as the usage of better adapted varieties of species and reduction of agrochemicals; and through this, strengthen local AFOLU practices and achieve resilience against climate change threats[29]. The 22 contributions is fully presented in Appendix B.

3.5.2 REDD and The Joint Mitigation and Adaptation Mechanism for the Comprehensive and Sustainable Management of Forest and the Mother Earth

Bolivia is an UN-REDD partner country and a recipient of support within the NP, which by three steps supports developing countries' efforts to implement the REDD+ strategies [39]. Since Bolivia's situation is ideal for REDD+, a high proportion of forest coverage but with rife deforestation and low opportunity costs for the displacement of deforestation, there was an early and considerable interest from foreign countries in Bolivia's participation in REDD+. In 2005, the Coalition of Rainforest Nations, which Bolivia was a part of, submitted a market-based mechanism for forest conservation. In 2008, Bolivia applied for UN-REDD quick-start financing through the Forest Carbon Partership Facility for which they received funding of 1.2 million US$ [39][40].

However, with the market-based mechanism being proposed in 2005, Bolivia started to change its position on REDD, and since 2010, Bolivia has directly opposed REDD+ based on two main reasons: (i) because of its market mechanism and commodofication of nature; and (ii) because of its non-consistency with recognition of historical responsibility and because it is seen as a way for developed countries to evade their historic responsibility for the climate crisis [29]. In 2012, Bolivia instead presented the Joint Mitigation and Adaptation Mechanism for the Comprehensive and Sustainable Management of Forest and the Mother Earth (MCMA) as an alternative to REDD+. The MCMA implements the three steps of the NP and is based on the equal importance of forest within mitigation and adaptation to the climate crisis, and the non-commodification of nature [40].

The processes being put forward in the MCMA are multifunctional and includes the development of institutional conditions to ensure the rights of the owners of the forest; approaches to land management dealing with zoning and regulations; articulation of forest with agriculture to promote optimal use of the land; as well as other processes. The MCMA also gives four examples of projects in Bolivia based on multifunctional land use that implements this kind of forest management [41]. The processes mentioned in the MCMA also supports the goals in the NDC since they reach for the common goal - an improved climate.

3.5.3 UNDP's Community-Based Adaption Project

In 2004, the Global Environment Facility (GEF) council proposed that 10 % of the resources from the Strategic Priority on Adaptation should be channeled to small communities through the GEF Small Grants Program (SGP). The catalyst for this was based on that small communities often are most severely affected by climate change, but least equipped to deal with them [42].

UNDP in collaboration with SGP, along with other donors, thereby created the

Community-Based Adaptation (CBA) project to reduce the vulnerability and increase adaptive capacity to the effects of climate change. Bolivia was one of the 10 participating countries in the project, which of each country developed, planned and implemented a portfolio of projects. Bolivia created six projects, all of which were AFOLU related and running between 2009 and 2012. The projects focused on implementation of multifunctional land use in local communities, where both environmental and communital improvements were strived for. They also implemented the MCMA agenda, and by these two factors supported the work towards the goals stated in the NDC. The projects are described further down [43]:

1. Water Source Protection and Soil Conservation through Reforestation in Batallas

The CBA projects aimed to reduce the community's vulnerability to diminishing water levels by protecting water resources through reforestation, conservation practises and through soil management. An important tree nursery was to be restored and residents from tree communities to be informed, involved and trained [44]. Examples of results from the project are reforestation and construction of filtrating ditches and live barriers in an area of 8 ha, and 7000 vs 5000 linear meters, a municipal forest nursery rehabilitated and improved in productive capacity from 10 % to 60 %, and a source of water providing the nursery, independent of dry periods or decrease in flow [45].

2. Participatory Adaptation Learning to Reduce Food Insecurity in Ancoraimes

The project aimed to teach tree communities how to diversify their agricultural practises, develop new technologies, and which social and environmental factors that threaten their productive systems and how they are linked to climate change, which leads to reduced food insecurity [46]. Some results from the project, among others, were awareness and knowledge about climate change and its causes, effects, etc., introduction to the usage of fruit trees in the plot boundaries, and implementation in the local school plans to teach children about climate change through workshops and educational games [45].

3. Sustainable Management of the Cherimoya Crop for Climate Change Adaptation in Saipina

The project aimed to by environmental observations, improved water management, and food security, reduce the vulnerability of local agricultural practises due to climate change. Focus laid on improvement of the cultivation of cherimoya through different agroforestry techniques [47]. The project gave results such as 25 families

being trained in forest management, 6 new agricultural practises for production of cherimoya in agroforestry systems, and 2 hectares of improved cherimoya plantations [45].

4. Knowledge and Tools for Sustainable Management of Water and Soils in Moro Moro

The CBA project aimed to teach about sustainable forestry and resource management to protect native species, soils and ecosystems services from climate change risks [48]. The project resulted in two workshops to register local knowledge about climate change, the establishment of a meteorological and hydrological monitoring system and how to use it, and the establishment of a soil recovery plan e.g. [45].

5. Rural Water and Climate Risk Management in the Alto Seco Area

The project aimed to introduce climate resilient irrigation systems to enable more intensive agricultural practises, and thereby reduce land degradation [49]. Examples of results from the project were Natural Heritage Water Reserves being implemented in more than 8 communities, 7 storage tanks for irrigation meant for the production of agro-ecological food, and residents of 5 communities having understood the importance of adaptation to climate change and being prepared to share their knowledge with local government [45].

6. Recovery of Tarwi Seeds for Adaptation in the Carabuco Municipality near Lake Titicaca

The CBA project aimed to support the recovery of the tarwi seed in four communities, where the seed has a high ability to adapt to adverse conditions more commonly occurring because of the climate change, has a high nutritional value and is a cheap source of protein [50]. Some results from the project, among others, were experimental plots being implemented in four communities to evaluate planting time, density, varieties, etc., 40 producers being trained in positive seed selections, and 18 environmental promoters from different communities being trained and certified in climate change, agroecological practices, environmental issues and project preparation [45].

3.6 Evaluation of feasibility

The AFOLU contributions stated in the NDC seems to all be feasible, but more or less realistic:

Implementation of contributions

The contributions depending first hand on the government, such as conservation of areas with high environmental functions or forestation and reforestation, forest plantations, parks and urban forests, should be implementable both fast and rather easy. Bolivia has implemented many AFOLU related projects throughout the years, and with the support from the UNFCCC via the NP the actions should be even more feasible.

The contributions that are co-depending on the people, on the other hand, can be harder to implement. For the goals in the NDCs to be reached, and the contributions to be fulfilled, the implementation relies on the full cooperation by the local communities. Since these communities most of the time are part of the poorest class in Bolivia, they may lack the knowledge and technology to implement the commitments, or simply can't afford it.

Side effects of implementation

One of the plans to fulfill the commitments is to promote these communities' and small farmers' productions, and by this the government has set semi-fixed prices on common crops regulations on exportation [51]. This creates the side effect of making it hard for new farmers to ban their way in to the market when starting from zero; for the farming to be profitable they need to reach a certain level of crops being produced.

Since these farmers probably are at the bottom of the economic chain in Bolivia, they may not afford a slow but steady growth that could be both good for the environment and profitable in the long run, but could jeopardize their income the first years. A shortcut to this, as a result of forced short term thinking, is illegal deforestation and mono cropping.

Burning forests quickly provides land to grow soybean which is in season all year around, which means multi-cropping or polyculture doesn't come natural. Zero deforestation and improved AFOLU practises is maybe two of the most important goals for Bolivia to reach, since the LUCF sector is the biggest sector both by area and by GHG emissions. A solution to this could be further actions from the government to implement better agricultural practises, where incentives is given to farmers who practise polyculture, a non excessive usage of agrochemicals, and before all doesn't clear land by burning it down illegally. Subsidy on farming technology could also be given, such as tractors for managing or drones for supervision, which would develop the agricultural practise.

Implementation of the MCMA

The problem with illegal deforestation is also present in the MCMA. The proposals are technically feasible, but it's hard to see if it actually will reduce deforestation. Laws and guidelines against deforestation has been in practise for many years, but the deforestation keep on rising. The government should prioritize to enforce these laws, and also try to reduce the expansion of soybean farming and cattle ranching, by making the already existing practises more profitable and the illegal establishing of new practises harder. The results should be even better if joined efforts were made by the adjacent countries such as Brazil, Argentina and also Venezuela which compete in, and dominate on the same market as Bolivia. The global market also plays an important role in the deforestation rates and the forces poor practices. The demand on soybean internationally is rising, but there are no international regulations on producing and supplying it. Solutions such as "Fair trade" or "Rainforest Alliance" certification could play a role, as well as subsidies or incentives from maybe the UN when these are implemented. By these measures, zero illegal deforestation by 2020 could be possible, but the time frame 2020 may be too close by. A new time frame should be set, and all possible measures should be take to ensure the goal is reached.

As for the other goals, as well as the goals by international cooperation, with the MCMA, NP and other projects there are means to reach the goals, but it's hard to say if they will be reached because of the lack of resent data linked to the goals.

Implementation of the structural solutions

The structural solutions, on the other hand, may be a bit far fetched. Even though they are describing an, to Bolivia, utopia, since they are meant to be implemented by as many of the UNFCCC members as possible, they mean for the rest of the parties to ditch their civilization models irrespective of existing political believes, and transfer to a more socialistic society. Even though a world without consumerism. patents linked to climate connected technology, and other stated treats would be ideal from a socialistic, and also climate perspective, it is probably next to impossible.

Emission reduction and the overall goal of the NDC

Concerning emissions, reduced emissions can be seen as a result when reading through the lines, but no goals regarding it are stated in the NDC. But zero deforestation would indeed have a great impact on the emissions being emitted from the AFOLU sector, and reforestation would create CO_2 sinks.

The overall goal being mentioned, improved living standard for Bolivia's population, is also likely to be achieved, but a total eradication of extreme poverty may be implausible since there hasn't been a development on that front in the last couple of years. Although, the GDP is rising, which gives positive inclinations for the

continued reduction of poverty rates. The contributions in the NDC will definitely contribute to a reduction since the contributions will provide livelihood and food, and hopefully in the long run eliminate climate change threats such as droughts, floods or landslides, if implemented fully. This is also a driving force towards a more sustainable Bolivia; the fulfillment of the commitments of the NDC to save the most exposed social group from climate related threats.

4 Brazil

Brazil, officially the Federative Republic of Brazil, is the largest country in South America. At 850 Mha and with over 207 million people, Brazil is the world's fifth-largest country by area and the sixth most populous [52]. It covers 47.3 % of the South American continent's land area, and contains most of the Amazon River basin - which accommodates the world's largest river system and the world's most extensive virgin rainforest [52]. This rainforest houses a diverse wildlife, a variety of eco-systems, and considerable natural resources, like timber and oil [52]. This unique environmental heritage makes Brazil a focal point of global debate regarding deforestation and environmental protection.

In this section for Brazil, the summary of national policies and documents will be presented before the NDC of Brazil. This is due to the strategies in Brazil's NDC mainly being strengthening, enforcing or implementation of named policies. Therefore, it will simplify the reader's understanding of Brazil's NDC if the relevant policies are presented first.

4.1 Land use in Brazil

The total land area of Brazil, excluding waters, is 835.8 Mha, of which roughly two thirds are occupied by native vegetation - consisting of forests, cerrado (Brazilian savanna) and other types of land, see Table 4. Of the land not occupied by native vegetation, about 86 % are under agricultural use [53], most of which is occupied by pastureland for livestock, see Table 5.

Table 4: Type of land use in Brazil. From [54].

	Area [Mha]	**Area [%]**
Total land	835.8	100
Forest	493.5	59.0
Agriculture	282.6	33.8
Other land	59.7	7.2

Table 5: Type of land use in Brazil within the agricultural sector. From [54].

	Area [Mha]	**Area [%]**
Total agricultural land	282.6	100
Permanent pasture	196.0	69.4
Arable land	80.0	28.3
Permanent crops	6.6	2.3

The agricultural sector is one of the main sectors of the Brazilian economy. The country is one of the world's largest producers and exporters of various agricultural products, for example: beef, poultry, coffee, sugar, ethanol, orange juice and soy products [53]. Agribusiness' contribution to the Brazilian GDP totaled 310 billion US$ in 2015, accounting for 21.5% - with cattle raising accounting for 6.8 % and other agriculture 15.7 % [53]. The forestry sector represented 1.2 % of the country's total GDP in 2015 [53].

4.2 GHG data and land use emissions

In 2010, which the latest data point available for Brazil at the UNFCCC GHG inventory database [55], the total GHG emissions from Brazil were 1 268 Mt CO_2 eq. with agricultural activity being the largest source of emissions, followed by the energy sector and LUCF. Industrial processes and waste combined only contributed with 11 % of total emissions, while AFOLU (agriculture and LUCF combined) contributed to a whole 60 % [55]. Within the agricultural sector - enteric fermentation was the largest source of emissions, followed by emissions from agricultural soils. Emissions from waste management, burning of agricultural residues, and rice cultivation contributed in smaller proportions to the total emissions of the sector. An overview of the emission data follows in Table 6 and 7 below.

Table 6: UNFCCC data of Brazil's total emissions in Mt CO_2 eq. in 2010. From [55].

Sector	Emissions [Mt CO_2 eq.]	Emissions [%]
Total	1268	100
Agriculture	407	32
Energy	371	29
LUCF	349	28
Industrial processes	87	7
Waste	54	4

Table 7: UNFCCC data of Brazil's emissions within the agriculture sector in Mt CO_2 eq. in 2010. From [55].

Agricultural sector	Emissions [Mt CO_2 eq.]	Emissions [%]
Total	407	100
Enteric fermentation	234	58
Agricultural soils	140	35
Manure management	17	4
Rice cultivation	10	2
Field burning of agricultural residues	5	1

By industry, the main cause of Brazil's GHG emissions is the cattle industry. The emissions caused by cattle production can be seen both in LUCF, due to forest being burned in order to make way for new pastureland (i.e slash-and-burn), which releases the bound CO_2 in the atmosphere [56] as well as in enteric fermentation from the cattle itself. A glance at Table 7 above hints that LUCF and enteric fermentation combined causes about 54 % of total emissions. A study by Bustamente et al. [56] concluded that approximately 50 % of Brazil's GHG emissions between 2003 to 2008 were due to cattle production.

4.3 Summary of national policies and documents

Brazil has a long history of environmental efforts, and has a multitude of policies in place in order to combat climate change. The following section will present the main policies or programmes that builds the fundament which the NDC relies upon. These are especially and specifically the Low Carbon Emission Agriculture Programme (ABC), the National Adaptation Plan (NAP) and the Forest Code (FC) [57].

4.3.1 Low Carbon Emission Agriculture Programme

The Low Carbon Emission Agriculture Programme, or the ABC Programme, was established after the 15th Conference of the Parties in 2009, in line with a earlier commitment from the Brazilian government to reduce GHG emissions by 2020 [58].

The following extract from Brazil's NAP summarizes the main components of the ABC Programme: *"The ABC Programme features instruments, such as an exclusive line of credit for fostering activities targeted at increasing the area under sustainable agricultural production and thereby mitigating the GHG emissions by the agriculture sector. In addition to its commitment toward mitigating GHGs the Plan aims to encourage, motivate and support the farm sector in deploying actions to foster adaptation, where necessary, by mapping sensitive areas, increasing the resilience of the agro-ecosystems, development and transfer of technologies (especially those with proven potential for reducing GHGs) and adaptation to the impacts of climate change."* [59]

As the extract above implies, the ABC Programme features instruments for both mitigation and adaptation.

The ABC Programme is structured in six different main strategies: Recovery of Degraded Pastures; Integrated cropland-livestock-forestry systems (ICLFS) and Agroforestry Systems; Direct Planting System; Biological Fixation of Nitrogen; Expansion of planted Forests; and Treatment of Animal Waste [58]. Two of these, recovery of degraded Pastures and ICLFS, are cited as strategies in the NDC and will be further presented in Section 4.4.1.

4.3.2 National Adaptation Plan

Brazil is currently working on the design of a new set of public policies related to adaptation to climate change, through a National Adaptation Plan, a NAP, which currently is in its final elaboration phase [57].

The NAP proposes *"actions, strategies and guidelines for management and reduction of climate risk in Brazil, with a view to facing up to the adverse effects of the social, economic and environmental dimensions of climate change. It also proposes institutional mechanisms for concerted deployment among states and municipalities, economic sectors and the general public, and for scheduled implementation of structural measures to overcome gaps observed in the national context."* [59]

The NAP is divided into strategies for adaptation in 11 different sectors. Among the 11 sectors, two are of relevance for AFOLU. These are: agriculture, and biodiversity & ecosystems. Regarding adaptation strategies for agriculture, the NAP mentions the ABC Programme as 'one of the highlights' [59], meaning that the ABC Programme, the NAP and the NDC are all closely tied to each other.

4.3.3 The Forest Code

The Forest Code, FC, is a law first created in 1965 that has gone through many transformations up to this date. Since 2001, the FC requires landowners to set aside some portions of their land in native habitat. This land, set aside in native habitat, is called Legal Reserve (LR). The proportion of the LR varies from 20 % to 80 %, depending on the region in Brazil. The law also designates environmentally sensitive areas as Areas of Permanent Preservation (APPs). Examples of APPs are riparian areas, springs, hilltops, mountain slopes, and mangroves [60].

The FC severely restricts deforestation on private property, but has proved challenging to enforce, particularly in the vast Amazon [60]. As deforestation rates rose in the early 2000s, efforts to strengthen enforcement increased pressure on the agriculture sector, which triggered a backlash against the FC [60]. The agribusiness lobby took advantage of a favorable political moment, related to a substantial drop in deforestation rates in the Brazilian Amazon between 2005 and 2010 to propose the creation of a new FC, which was approved in late 2012 [60]. The legislation has been criticized for being too lenient on landowners; others maintain that it is a barrier for agricultural development [60].

One of the main instruments to enforce the FC is the Rural Environmental Registry (CAR). The goal of the CAR is to provide a database of information on each property and its environmental situation that allows municipalities, states, and the federal government to control, monitor and identify environmental deficits, conduct environmental and economic planning, and combat deforestation [61]. The CAR System (SICAR) is a national electronic system operated by the Ministry of Environment (MMA) that provides satellite images for monitoring and registration purposes [61]. The CAR should contain geo-referenced information, such as the location of the property, its boundaries, as well as the identification of APPs, LRs and other areas of restricted use [61].

4.4 The NDC of Brazil

Brazil commits to an absolute target in the NDC, to reduce GHG emissions by 37 % by 2025, and by 43 % by 2030 (in relation to 2005 levels) [57]. In order to achieve this, the NDC also commits to an overarching goal for the land use sector, of zero net emissions from LUCF by 2030.

The GHG emission reduction target in the NDC is based on estimated emission levels of
2 100 Mt CO_2 eq. in 2005 [57]. Meaning that targets of emissions 37 % and 42 % below the 2005 level corresponds to emissions below 1 400 Mt CO_2 eq. in 2025 and 1 300 Mt CO_2 eq. in 2030.

As means to achieve these mitigation targets, a number of commitments, or strate-

gies, are cited in the NDC. These strategies have been divided upon six different sectors: biofuels, LUCF, the agriculture sector, the energy sector, the industry sector and the transport sector.

All the strategies presented directly in the NDC relate mainly to mitigation, and for mitigation measures regarding agriculture, the NDC refers to the ABC Programme. Also, the FC acts as the main legal base for most of the strategies concerning the LUFC sector. In regard to undertakings related to adaptation, the NDC refers to Brazil's NAP.

All of the commitments presented in the NDC are unconditional, meaning that Brazil claims not to be contingent upon international support for the implementation of the NDC [57].

In a report from La Rovere et al. [53], the costs for some of the strategies presented in the NDC were estimated. To translate these estimated costs from Brazilian reais of 2015 to US dollars of 2015, the historical exchange rate of 1 US$ = 3.962 BRL has been used [62].

4.4.1 Mitigation strategies

In line with the scope of this thesis, which is AFOLU, - the strategies presented for the energy, industry and transport sector will be disregarded. The strategies for biofuels, LUCF and agriculture will be presented in the form of a direct extract from the NDC.

i. Biofuels

- *"Increasing the share of sustainable biofuels in the Brazilian energy mix to approximately 18% by 2030, by expanding biofuel consumption, increasing ethanol supply, including by increasing the share of advanced biofuels (second generation), and increasing the share of biodiesel in the diesel mix;"* [57]

The share of biofuels in the energy mix was about 9 % in 2016 [63], meaning that the share would have to be doubled by 2030 to reach the goal of 18 %.

Sugar cane is the raw material used for the production of ethanol - so an increased production and demand for ethanol will be entailed by an increase in the demand of sugar cane. La Rovere et al. [53] have estimated the cost for expanding sugar cane production for the purpose of producing ethanol to 1 616 US$/ha. In 2014, the total area occupied for sugar cane production in Brazil was 9 Mha. If yields continue to increase following the historical trajectory of the past two decades, an expansion of 45 % of sugarcane area would be needed to satisfy a high-demand scenario by 2024 [64].

So, given that doubling the share of biofuels would represent a high-demand scenario, the cost of expanding sugar cane supply for achieving this goal could be approximated to 6.55 billion US$.

ii. Land Use Change and Forestry

- *Strengthening and enforcing the implementation of the Forest Code, at federal, state and municipal levels* [57];
- *Strengthening policies and measures with a view to achieve, in the Brazilian Amazonia, zero illegal deforestation by 2030 and compensating for GHG emissions from legal suppression of vegetation by 2030* [57];
- *Enhancing sustainable native forest management systems, through georeferencing and tracking systems applicable to native forest management, with a view to curbing illegal and unsustainable practices* [57];
- *Restoring and reforesting 12 Mha of forests by 2030, for multiple purposes* [57];

The FC itself implies a significant limitation of deforestation, at the same time as the means for enforcing it (the CAR) provides instruments for forest monitoring and management. Thus, the first three sub-target cited are tightly tied to each other. In achieving a high enforcement of the FC, especially by applying the CAR, illegal and unsustainable practises (especially illegal deforestation) could also be curbed.

The last cited sub-target for LUCF is the restoration (return of ecosystem as close as possible to the original "reference" ecosystem) and reforestation (any process that returns complete or partial tree cover on forest land through planting or through natural or assisted regeneration processes) of 12 Mha of forest. However, the NDC does not specify the relative contributions of these two activities [65].

La Rovere et. al [53] have estimated the cost for restoring natural forest to 2 374 US$/ha .

This would thus mean that the total cost for achieving the target of restoring 12 Mha of natural forest by 2030 would sum up to 28.48 billion US$. However, the World Bank [65] estimates the total cost of achieving this target to 13.74 billion US$. The big difference between the approximations is probably due to different assumptions regarding reforestation and restoration.

The World Bank [65] cites that the estimates of the costs range from 400 US$ (natural regeneration) to 2 857 US$ (complete planting) per ha.

iii. The agriculture sector

- *Strengthen the Low Carbon Emission Agriculture Programme (ABC) as the main strategy for sustainable agriculture development, including by restoring an additional 15 Mha of degraded pasturelands by 2030 and enhancing 5 Mha of integrated cropland-livestock-forestry systems (ICLFS) by 2030 [57];“*

As indicated in the extract above, strengthening the ABC Programme is the main instrument for the strategies within the agriculture sector. Specifically, the restoration of degraded pastureland and ICLFS are suggested. These strategies are presented below.

Recovery of degraded pastures

Recovering pasture by increasing primary pasture productivity raises carbon inputs to the soil and, consequently, is an important way to remove atmospheric CO_2 [53]. In addition, increasing performance of animals in recovered pastures results in reduced emissions per unit of output [53].

The goal of the NDC is to recover 15 Mha of degraded pasture, extending from the year 2020 to 2030, in line with a commitment in the ABC Programme [58]. Rovere et al. have estimated the costs for this recovery to 290 US$/ha [53]. This would thus mean that the cost for implementing this strategy would total 4.35 billion US$ by 2030.

Integrated cropland-livestock-forestry systems

Integrated cropland-livestock-forestry systems, ICLFS, is a prime example of a multifunctional land use system that seeks synergistic effects by integrating agricultural, livestock and/or forestry activities in the same area [53].

The target for the techniques is set to integrating 2 Mha by 2020 and an additional 3 Mha in the period 2020-2030, totaling 5 Mha in 2030 [53]. La Rovere et al. [53] estimates the cost for integrating these techniques to 508 US$/ha. This would thus mean that the cost for achieving this target would total 2.54 billion US$ by 2030.

All the above mention strategies, or commitments, are summarized with their corresponding costs in Table 8 below.

Table 8: Strategies cited in the NDC of Brazil, corresponding sector and approximated cost for each strategy. From [53][57][65].

NDC strategy	Sector	Cost [billion US$]
Increase the participation of bioenergy by 18% in the Brazilian energy matrix	Biofuels	6.55
Strengthening and enforcing the FC	LUCF	N/A
Zero illegal deforestation until 2030 in the Amazon biome	LUCF	N/A
Compensate GHG emissions from deforestation	LUCF	N/A
Restoration of 12 Mha of forest	LUCF	13.74-28.48
Expand sustainable forest management	LUCF	N/A
Strengthening the ABC Programme	Agriculture	N/A
Recovery of 15 Mha of pastures	Agriculture	4.35
5 Mha of ICLFS	Agriculture	2.54
Total	N/A	27.18-41.92

4.4.2 Adaptation strategies

The NDC cites the NAP as it's main instrument for its adaptation strategies. Regarding the agriculture sector, the NAP contains a list of 11 adaptation measures proposed for drafting of the Adaptation Programme for Agriculture. Examples of these measures are, among others, pest and disease management, rural development and, genetic resources and improvement [59].

However, the NAP cites that the measures proposed are quite general and should be discussed, detailed and prioritized and their responsibilities defined [59]. Since the main focus of this thesis is the NDC, and not the NAP, and since the NAP is as of now just available in this drafting stage, and no implementation plan has been found - this thesis will be delimited to not evaluate the NAP or any other adaptation strategies further.

4.5 Evaluation of feasibility

First, in order to evaluate the feasibility of the commitments in Brazil's NDC, the overall ambition of the NDC will be evaluated. Following the evaluation of ambition, the proposed strategies' estimated effect on GHG emissions will be presented, which will lead to the highlighting of strategies within LUCF as the key for achieving said commitments. Finally a conclusion will be presented where the main obstacles for the fulfillment of the NDC will be presented.

Overall ambition of Brazil's NDC

As noted in Section 4.4, The NDC of Brazil, the reference year for the NDC was 2005. The year of 2005 was a year of exceptionally high emissions, which can be seen clearly in Figure 4 below. This implicates that the NDC target of GHG emissions 37 % below 2005 levels, is in fact not a target that substantially reduce emissions below current levels, but one of not letting current emissions increase much further. The reader should also note from Figure 4 that the overall unconditional NDC target lies only slightly below the projected Business as Usual (BaU) scenario. This makes Brazil's overarching commitment much less ambitious than it might seem at first, which have some positive implications for the feasibility of Brazil's fulfillment of said commitment.

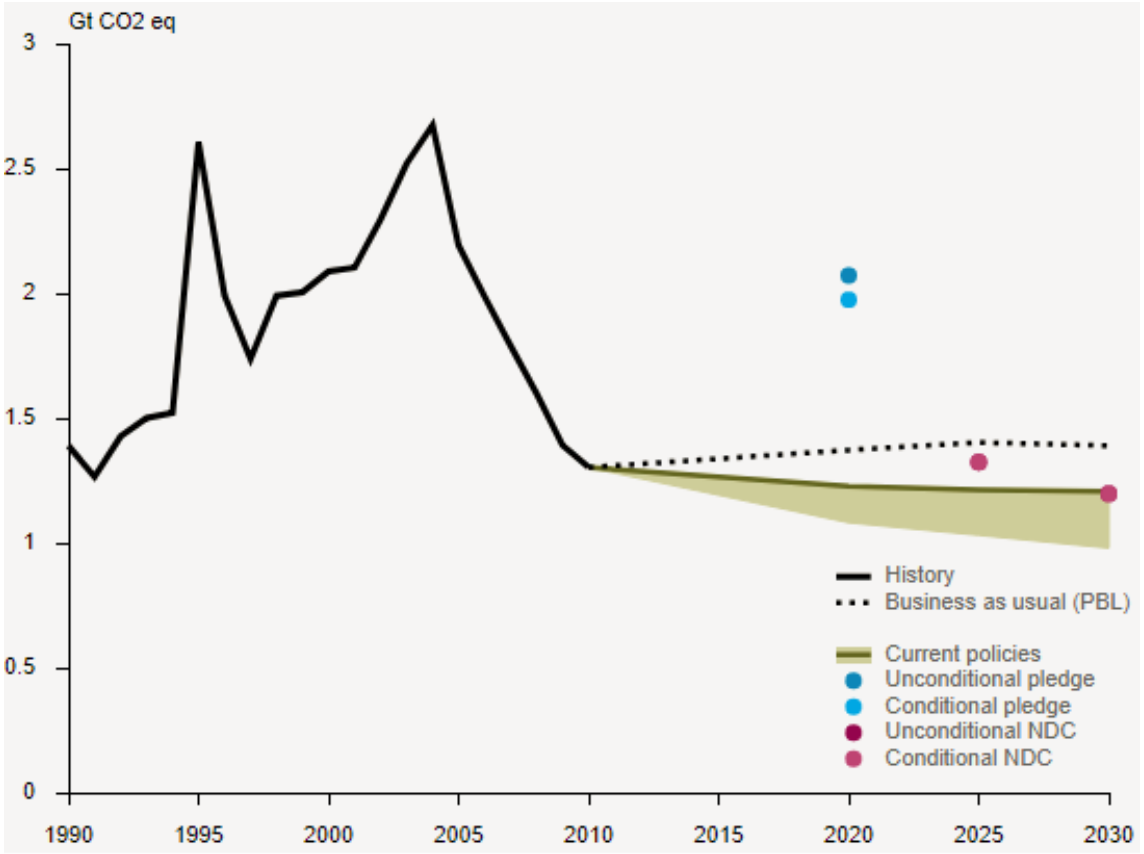

Figure 4: Forecast of Brazil's GHG emissions. The red dots represents Brazil's unconditional pledges by 2025 and 2030. From [66]. Used with permission.

Future predictions

Figure 5 below shows the predicted future GHG emissions, given that all strategies and commitments stated in the NDC are fully implemented.

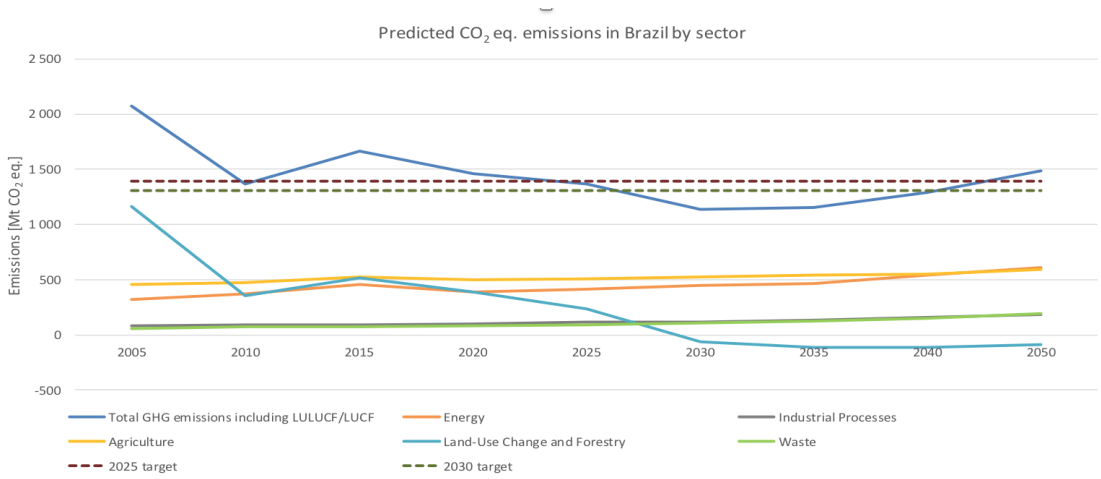

Figure 5: Forecast of GHG emissions in Brazil by sector after full implementation of the NDC. From [67].

The reader should note that according to these predictions, if all strategies would be adequately implemented, Brazil's emission target would be reached by 2030, with LUCF also turning from an emitting sector into a sink of CO_2 by 2030, also achieving the overarching LUCF target in the NDC.

So, given that all strategies are financed and adequately implemented, Brazil would likely reach the overarching targets of its NDC, which leads to the main issues - if the Federative Republic of Brazil will be able to muster the political and financial efforts required to fulfill their commitments and implement the proposed strategies.

The central role of LUCF

Emissions in all sectors, except LUCF, are expected to rise by 2030, see Figure 5. Figure 5 also illustrates the importance of the LUCF sector in Brazil as a regulator of total emissions, the reader should note that the changes in LUCF is the main indicator for changes in total emissions up until 2030 according to these predictions.

So, for Brazil to reach the overall target of keeping emissions below to 1 300 Mt CO_2 eq. (37% below 2005 levels) in 2030, it is crucial that Brazil arrive at the target of zero net emissions from LUCF. The LUCF strategies of 12 Mha of reforestation and zero illegal deforestation by 2030 will be crucial in order to achieve this central target for the sector.

According to the cost estimations done by The World Bank [65] or La Rovere et al. [53], the total cost of restoring 12 Mha of forest would be somewhere in between 13.7 and 28.5 billion US$ by 2030, see Table 8. This equals to approximately 1.1-2.4 billion US$ per year up until 2030. To put this figure in context, the total annual public credit for agriculture is about 56.25 billion US$ [65] - meaning that the implementation would require 2.0-4.3 % of the available funds annually. Even

though the investments would be likely to have a low financial return, this seems like an affordable sum, if the Brazilian government is inclined to fulfill its commitments.

However, for Brazil to reach zero emissions from LUCF, reforestation won't be enough - the deforestation would also have to be curbed. In the last years, the MMA and deforestation monitoring authorities experienced budget cuts, which has raised issues of concern around the Brazilian government's ability to adequately monitor deforestation [68]. Not only has the enforcing capacity of authorities been reduced, but the Government has also started to reverse some land use policies already in place, regularizing former illegal land-grabbing practices and removing protection from national forests [68]. This has halted Brazil's recent progress in mitigation of LUCF emissions, with deforestation and resulting emissions actually increasing again in the last years. Total deforestation increased almost 30 % in 2016 compared to 2015, adding around 130 Mt CO_2 to total net emissions in 2016 [68]. This increase in emissions goes in the opposite direction of the commitments in the NDC. It is therefore deemed unlikely that Brazil will achieve the target of turning its second biggest emitting sector, LUCF, to a CO_2 sink by 2030, and therefore the overall target of reducing emissions below 1 300 Mt CO_2 eq. by 2030 also becomes unfeasible.

Conclusion

In conclusion, the main obstacles for the full implementation of Brazil's NDC seems to be social, as well as macro-economical. For Brazil to achieve the NDC targets and fulfill the commitments, deforestation will have to be drastically curbed. With budget cuts for deforestation monitoring authorities and recent increased rates of deforestation, it seems unlikely that Brazil will be able to reach its targets by 2030.

One related issue is the Brazilian economy's dependence on agriculture, in conjunction with the agricultural sector's continued demand for new land, which is likely to lead to further deforestation within the foreseeable future.

One more particular issue, which seems to be a low hanging fruit, are the emissions from Brazil's cattle industry. The cattle industry represents only 6.8 % of Brazil's GDP, while still being the source of roughly half of the country's GHG emissions. Brazil's need of curbing deforestation runs counter to the cattle industry's common modus operandi of slash-and-burn in order to make way for new pastureland. The agricultural lobby is also strong in Brazil, and it is difficult to persuade cattle farmers to freely give up competitive advantages in changing to more costly alternative methods of generating new pastureland. Also, the enforcement of laws and regulations, like the FC, in the vast Amazon has shown to be extremely challenging. However, governmental efforts with new technological systems, such as the SICAR, grant positive implications for the enforcement of said laws and regulations, which could lead to a better regulated and more sustainable rate of deforestation in the future. Also, if global demand for beef would decline, it could increase the incentives for cattle producers to readjust to more sustainable forms of agriculture.

5 Burkina Faso

Burkina Faso is a landlocked country in Western Africa. It is one of the poorest countries in the world with a population of almost 20 million people. The country has had a yearly population growth about 3 % the recent decades [69]. The majority of the population's livelihood depends on agriculture and livestock raising [69], but there has been an increase in migration from rural to urban areas in recent years [70]. To the north in the Sahelian zone the climate is hot and dry with mostly savanna and steppe land. To the south, in the Sudanic zone, the climate is more humid [69].

Burkina Faso is not a large emitter when looking to CO_2 emissions per capita, compared to the average CO_2 emissions per capita in the world [71], but the country is nevertheless vulnerable to climate change caused by GHG emissions, especially reoccurring droughts and floods [72]. Burkina Faso has produced a NDC with several different strategies, programmes and projects regarding the AFOLU sector.

5.1 Land use in Burkina Faso

Burkina Faso's economy is heavily reliant on agriculture and livestock raising, and this sector provides the livelihood of around 80 % of the population [69] and 32 % of Burkina Faso's GDP [73]. Table 9 below shows the different kind of land use in Burkina Faso.

Table 9: Land cover and land use in Burkina Faso, 2014. From [74].

	Area [Mha]	**Area [%]**
Land area	27.4	100
Forest	5.4	19.8
Agriculture	12.1	44.2
Other	9.9	36.0

The landscape has changed in the last decades in order to feed a growing population. Between 1975 and 2013 the savanna shrank with 39 % while land covered by agriculture increased from 15 % to 39 % [73].

5.2 GHG data and land use emissions

Data from the UNFCCC GHG inventory [55], shows the GHG emissions in Burkina Faso from 1994 and 2007, see Table 10. The total GHG emissions including LULUCF/LUCF were 4.58 Mt CO_2 eq. in 1994, which since then have increased to

20.43 Mt CO_2 eq. in 2007. The reason for the total GHG emissions excluding LULUCF/LUCF in 1994 is bigger than when the LULUCF/LUCF sector is included, is because of the sink that the sector did provide. By 2007, the sink had disappeared, and the sector now contributes to the total GHG emission.

Table 10: GHG emissions in Burkina Faso 1994 and 2007. All numbers in Mt CO_2 eq. From [55].

Category	**1994**	**2007**
Total GHG emissions excluding LULUCF/LUCF	5.97	20.41
Total GHG emissions including LULUCF/LUCF	4.58	20.43
GHG emissions from Agriculture	4.71	17.96

The UNFCCC GHG inventory database [55] only provides data of Burkina Faso's GHG emissions from two years, 1994 and 2007 [55]. That existing data shows an increase of GHG emissions with more than 300 % between 1994 and 2007, while the population increased by 45 % between the same years [70]. Table 10 also shows that the majority of the country's GHG emissions comes from the agriculture sector.

Data from CAIT Climate Data Explorer shows the GHG emissions from 1990 to 2014 [75], see Figure 6.

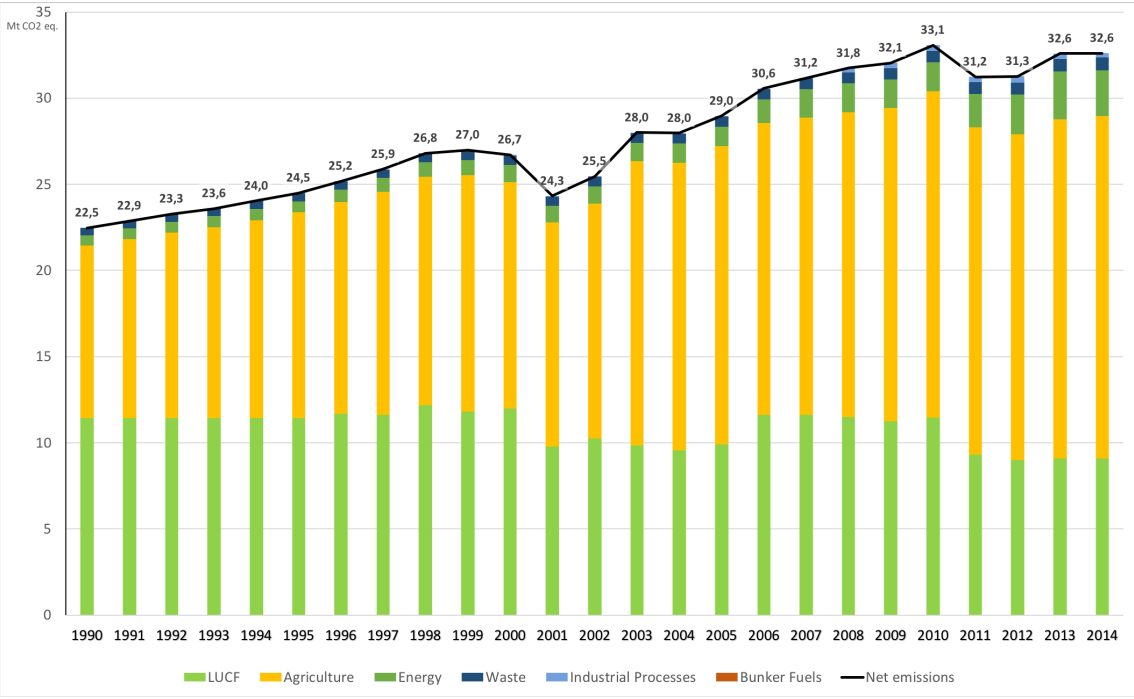

Figure 6: Burkina Faso's GHG emissions in Mt CO_2 eq. from different sectors between 1990 and 2014. From [75].

There is a difference in the GHG emission data between UNFCCC and CAIT Climate Data Explorer, due to different methods in estimating the GHG emissions.

What can be observed from Figure 6 is the increase of GHG emissions from the agricultural sector. It can also be seen that the AFOLU sector (LUCF and agriculture combined) contributed to 89 % of the total GHG emissions in Burkina Faso in 2014, see Figure 7.

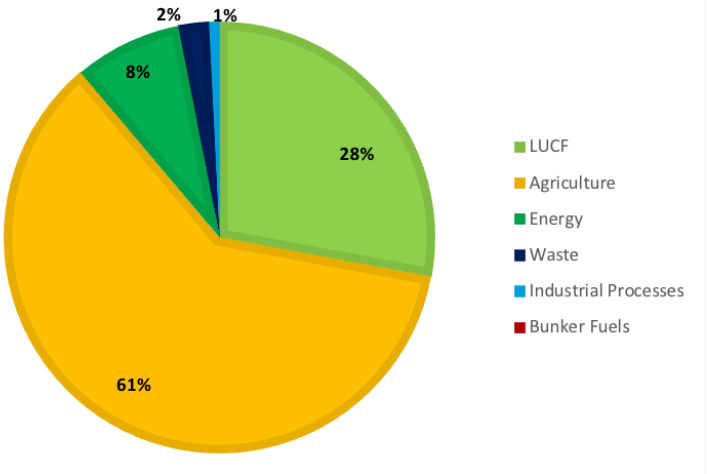

Figure 7: The distributions of GHG emissions from different sectors in Burkina Faso, 2014. From [75].

5.3 Summary of national policies and documents

Burkina Faso ratified the UNFCCC in 1993 and the Kyoto Protocol in 2005 and there have been a number of documents produced since then:

- 2001: The National Strategy for implementing the Climate Change Convention [76]
- 2007: A National Adaptation Program of Action (NAPA) were submitted to the UNFCCC [76]. Three projects were developed with technical and financial support from the United Nations Development Programme (UNDP), the Global Environment Facility (GEF) Denmark and Japan [77]
- 2008: Development of a framework, Nationally Appropriate Mitigation Actions (NAMA) [76]
- 2014: National Adaptation Plan (NAP) [76] - This was developed because the NAPA had not been able to convince financial aid, so a new programming framework needed to be adopted in order to to be able to perform urgent adaptation actions [77]

5.4 The NDC of Burkina Faso

Burkina Faso's NDC has both a mitigation and an adaptation component. The aim of the mitigation component is to reduce GHG emissions, for example by modifying production techniques that is being used and the adaptation component aims to adjust to the impact of climate change.

There are three scenarios described in the NDC: an unconditional, a hybrid conditional (hybrid meaning that the scenario also includes some adaptation projects) and an adaptation scenario. The three scenarios aim to reduce GHG emissions with 6.6 %, 11.6 % and 37 %, respectively, when compared to a BaU projection, which is a forecasted projection for the future based on past trend. The unconditional scenario is already ongoing with financing that has already been, or is currently being acquired. The hybrid conditional scenario represents those projects in need of external financing. The NDC of Burkina Faso states that the cost of the unconditional scenario is 1.13 billion US$. The hybrid conditional scenario, which includes the projects without acquired financing, could be carried out with additional funding of 756 million US$. Reducing the GHG emission by 37 %, which is the adaption scenario, would require 5.8 billion US$ according to estimates in the NDC [76].

5.4.1 Mitigation strategies

For the mitigation component of the NDC, a baseline scenario target is used, which means emission reduction targets are described relative to BaU. In this case, the projections are based on data from the 2007 GHG inventory, and 2030 is the target year [76].

The mitigation part of the NDC is divided into a BaU scenario, unconditional and a conditional scenario. The unconditional scenario takes into account the policies, studies and developments after 2007, with finance that has or is being acquired. The conditional scenario consists of mitigation projects that have been developed but without funding [76].

The GHG emission projection calculated for the BaU scenario is 118 Mt CO_2 eq. in the year 2030. The reduction of emissions at the 2030 horizon, compared to BaU, in the unconditional scenario is 7.8 Mt CO_2 eq. (corresponding to 6,6 % reduction of GHG emission when compared to BaU) and in the conditional scenario the reduction compared to BaU is projected to be 13.7 Mt CO_2 eq. (corresponding to 11.6 % reduction of GHG emission when compared to BaU). This makes the total reduction of GHG emission of the mitigation targets to 21 Mt CO_2 eq., which is a reduction of 18.2 % compared to BaU [76].

The projected GHG emission reductions are separated into sectors; agriculture, waste and energy. In the unconditional scenario, almost all suggested GHG emission reductions, 92 %, comes from mitigation in projects and programmes in the sector of

agriculture, forestry and land use (AFOLU). The majority of Burkina Faso's GHG emissions come from the AFOLU sector [76], see Section 5.2.

The projects within the AFOLU sector, listed in the NDC from the unconditional scenario with a mitigation component follows [76]:

- Forest Investment Programme (FIP) [76] - A programme under Climate Investment Fund (CIF) that helps developing countries to decrease deforestation (which also leads to emission reductions) and work for a more sustainable forest management [78], is where Burkina Faso is implementing its 30 million US$ FIP investment plan [79].

- National Biodigester Project [76] - The National Biodigester Programme in Burkina Faso is a collaboration with SNV, a the Dutch development organization and Hivos, a Dutch Non-Governmental Organization, that helps farmers fund and install biodigesters. There are several benefits from the initiative. It reduces the use of firewood, which slows down deforestation, but it also reduces polluted air from cooking with wood or charcoal. The digesters also produces organic compost which can be used by the farmers as fertilizer [80]. The project is registered under the UNFCCC Clean Development Mechanism (CDM) [81].

- NAMA's SNV [76] - Burkina Faso Biomass Energy NAMA Support, a project aiming for a more sustainable use of biomass by the use of more efficient cookstoves. One of the main causes of deforestation is the need of wood for fuel [82].

- Improved cook stoves SNV [76] - The SNV promote the building and use of improved cookstoves for the production of dolo, (locally produced beer). The new stoves reduce the consumption of firewood by 60 % [83].

- Improved cook stoves Tipaalga [76] - Livelihoods Fund provides households with efficient cook stoves that reduces wood consumption and thus deforestation [84].

5.4.2 Adaptation strategies

The adaptation scenario, the other part of the NDC, state the aims to restore and develop 5 Mha of degraded lands (before 2030) which corresponds to 50 % of the country's current area of degraded lands. According to the NDC of Burkina Faso, this would also help in feeding an additional 6 million people [76].

The adaptation scenario is conditional and dependent on financial support. According to the NDC, the adaptation projects will contribute to a GHG emission reduction of 43.7 Mt CO_2 eq., which corresponds to a reduction of 37 % when compared to BaU, for an investment cost of 5.8 billion US$.

In 2014, a NAP was developed, a process which lets a country plan adaptation actions and implementations. For many developing countries, the adaptation is the priority since they are already experiencing the impacts of climate change. In Burkina Faso's NAP, the sectors identified as particularly vulnerable, and thus prioritized, were: agriculture, livestock breeding, water, forests and natural ecosystems, energy, health, infrastructure and housing

The objectives of the adaptation measures foreseen in the country's NAP:

- *"(i) reduce the vulnerability to the impacts of climate change on the development of adaptation and resilience capabilities* [76]
- *(ii) facilitate the coherent integration of adaptations to climate change in policies, programmes or activities, new or already existing, in the specific processes of development planning and in the strategies of the relevant sectors at different levels."* [76]

In 2014, Burkina Faso developed and validated, within the National Partnership Program for Sustainable Land Management, a Strategic Framework for Investment in Sustainable Land Management (SFI-SLM). The vision in regard to Sustainable Land Management (SLM), which takes the year 2025 as its projection horizon, is:

"Sustainable rural production systems which, by taking into consideration local knowledge and know-how,

- *(i) preserve the fertility of the soil,*
- *(ii) increase plant and animal productivity per unit of area in use and/or by volume of water consumed,*
- *(iii) improve the well-being of the people living on the land and*
- *(iv) restore preserve the integrity and functioning of ecosystems."*

Based on the adaptation actions identified in the National Adaptation Plan in the sectors vulnerable to climate change, national experts from different areas classified those actions that they considered high priority in a environmental and socioeconomic context. These mostly matched with those objectives and actions developed and proposed in the SFI-SLM.

The NDC contains proposed adaptation actions for the sectors of agriculture, water management, animal husbandry, biomass energy, forests and land use changes in general (AFOLU). There are also adaptation actions in the sectors housing and urban development, health and management of extreme climatic events.

Many actions in the adaptation component consists of projects whose objective is not mainly GHG emission reduction, but the improvement of environmental services such as food security, water and soil conservation, sustainable agriculture, etc. These

projects might result in reductions of GHGs as well, in the long term.

Examples of adaptation projects mentioned in the NDC are restoring and maintaining the fertility for 1.5 Mha of cropland, rehabilitating 1.1 Mha degraded land for forest and pastoral purposes and providing 75 000 households with biodigesters.

5.5 Evaluation of feasibility

Being one of the poorest countries in the world, Burkina Faso depends on international financial assistance for the implementation of their NDC. Because of the poverty, there is a chance that cheaper and less sustainable techniques will be used if no financial aid can be provided. Burkina Faso is also a country where climate change has shown its effect, where droughts and floods are not uncommon.

Improved cook stoves bring several positive benefits

In the unconditional mitigation part of the NDC, there were several projects mentioned about the improvement of cook stoves. Improved cook stoves provide several benefits; the reduction of firewood that also reduces deforestation. A co-benefit of is the reduction of health risk due to polluted air. Mitigation actions that provide more than one positive effect could give a priority for implementation and funding.

Prediction of emissions compared to outcome of emissions

One question that rises is the gap between the BaU scenario described in the NDC and the GHG emission data from other sources. Since BaU trend is based on 2007 and there exist newer data after 2007 illustrating the actual outcome of GHG emissions in Burkina Faso. An comparison between the projections in the NDC (the BaU scenario) and the actual GHG emission outcome from CAIT Climate Data Explorer (Figure 6) shows that the predicted BaU in the NDC are much higher than the actual emission outcome. In the NDC, the predicted GHG emission in 2015 is 71.4 Mt CO_2 eq., but according to data from CAIT the GHG emissions in 2014 was 32.6 Mt CO_2 eq. The actual increase in GHG emissions according to the CAIT data does not match the predictions in the NDC, and if the same trend continues there will be a substantial difference between the predicted BaU scenario in the NDC and actual GHG emissions in Burkina Faso. The stated GHG emission reductions in the NDC are based on a percentage of GHG emissions from the BaU scenario, which means that the amount of GHG emission reductions will decrease with the BaU.

The need of financial support

The combined cost of all actions and projects suggested in Burkina Faso's NDC is estimated to 7.8 billion US$, where 6.5 billion US$ is still lacking in order to perform the all the named actions and projects in the NDC. Since there is a lack of funding, many of the different plans and projects in the NDC might never be accomplished.

The NDC states the need for financial support, and is also quite specific in the details of financial requirement. However, it is hard to find any viable sources on the financial details, since the NDC document only references to the author of the NDC. An additional difficulty in analyzing the NDC was that the description of the projects were not always clear, making it difficult to find additional information about the projects.

6 Guyana

Guyana, officially the Co-operative republic of Guyana, is located by the northern coast of South America, north of Brazil. The majority of the population of 738 000 people resides along the narrow coastline, where most of the agriculture is concentrated. The interior is largely dominated by rainforest and populated by indigenous (Amerindian) people and other minor settlements [85].

Guyana provides an example of a nation with high forest cover, a low historical deforestation rate and a high share of climate work within the AFOLU sector. Other interesting aspects are that Guyana has built the NDC on a previously existing low carbon development strategy and is highly reliant on external support. Together, these circumstances make Guyana a relevant party to study within the scope of this report.

6.1 Land use in Guyana

The AFOLU sector covers a large share of the total land area, see Table 11. With 84 % of its total land area covered by rainforest, Guyana has one of the highest percentages of rainforest covers in the world [86]. Guyana has a history of low deforestation; during the period 1990-2000 the deforestation rate was approximately 0.01 % per year and during the period 2001-2013 it varied between a lower value at 0.02 % in 2006-2009 and a peak at 0.08 % in 2012, as reported by the Guyana Forestry Commission [87].

Table 11: Land cover and use in Guyana 2015. From [88]

	Area [Mha]	**Area [%]**
Land area	19.7	100
Forest	16.5	84.0
Agriculture	1.7	8.5
Other	1.5	7.5

Agricultural practices in Guyana covers approximately 8.5 % of the total land area (see Table 11) where most of the area consists of permanent meadows and pastures, followed by arable land and a small share of permanent crops [88]. The coastal location of large parts of the agricultural activities makes the sector vulnerable to extreme climate events such as floods and rising sea levels [89].

Forestry and agriculture are both important industrial sectors. Another important sector is mining of, for example, gold and bauxite; during 2017 more than half of Guyana's national income from exports came from raw gold [90]. However, this is also one of the major driving forces for deforestation, small scale gold mining was

the reason for 89 % of recorded deforestation during the three years prior to the publication of the NDC [89].

6.2 GHG data and land use emissions

The GHG inventory data for Guyana from the UNFCCC [55] show values for each year during the period 1990-2004 and are shown in Figure 8. The net total GHG emissions excluding LUCF increased from 2.7 Mt CO_2 eq. in 1990 to 3.1 Mt CO_2 eq. in 2004. The net total GHG emissions including LUCF was -57.9 Mt CO_2 eq. in 1990 and -51.6 Mt CO_2 eq. in 2004. From this data it is apparent that the AFOLU sector has a massive impact on Guyana's total net emissions, making Guyana a net carbon sink because of carbon sequestration by the high amount of rainforest in the nation. Although UNFCCC's data ends in 2004, it still visualizes the historical net emission trend in Guyana and how AFOLU influences the net emissions.

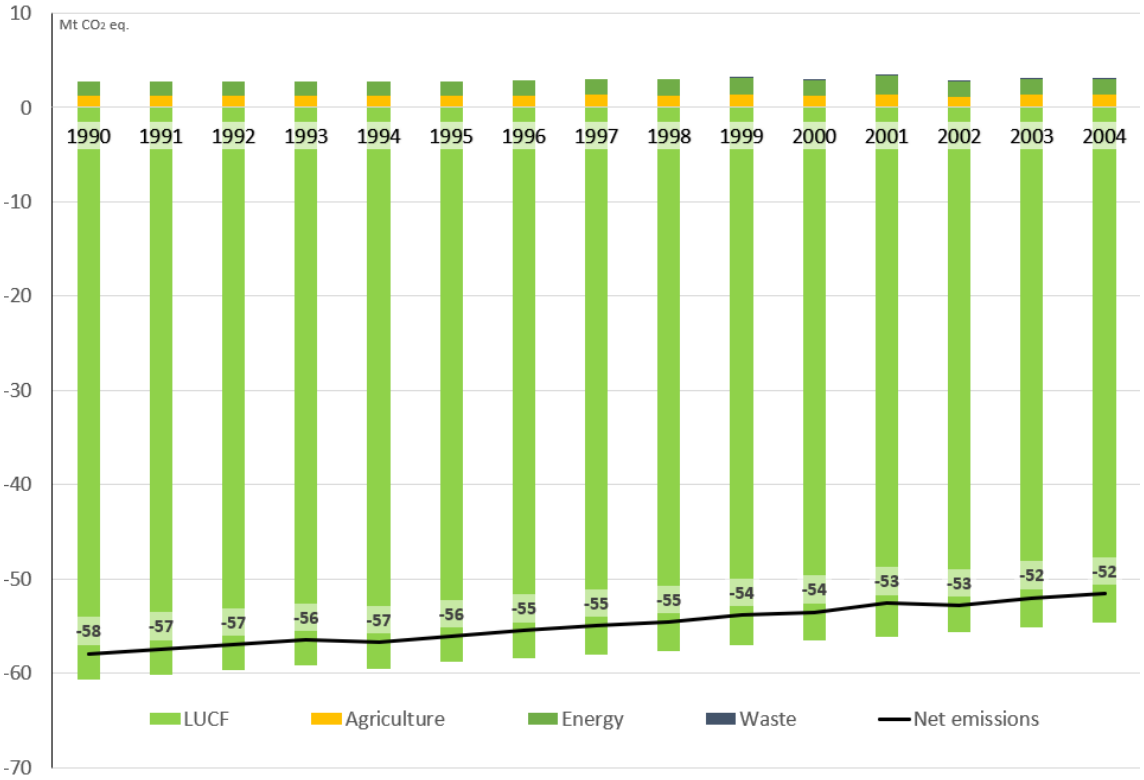

Figure 8: Net emissions in Mt CO_2 eq. by sector in Guyana during the period 1990-2004. From [55].

The GHG emissions during 1990-2014 based on data from the CAIT Climate Data Explorer, provided by the WRI [91] are presented in Figure 9. Note that the data differs significantly from the UNFCCC data, depending on the different methodologies used. The WRI states that the CAIT data is not meant to replace the UNFCCC data but rather to complement it and give a relative sense of trends over time [92].

The data is included here in order to show emission trends for more recent years.

Figure 9 illustrates that the AFOLU sector is responsible for the major share of the GHG emissions. It can also be seen that total emissions have been increasing during the later years, mainly driven by an increase in the LUCF sector which is responsible for the majority of emission. This also helps visualize the role of emissions from forests that is "concealed" by the different methodology when calculating sequestration in the UNFCCC data.

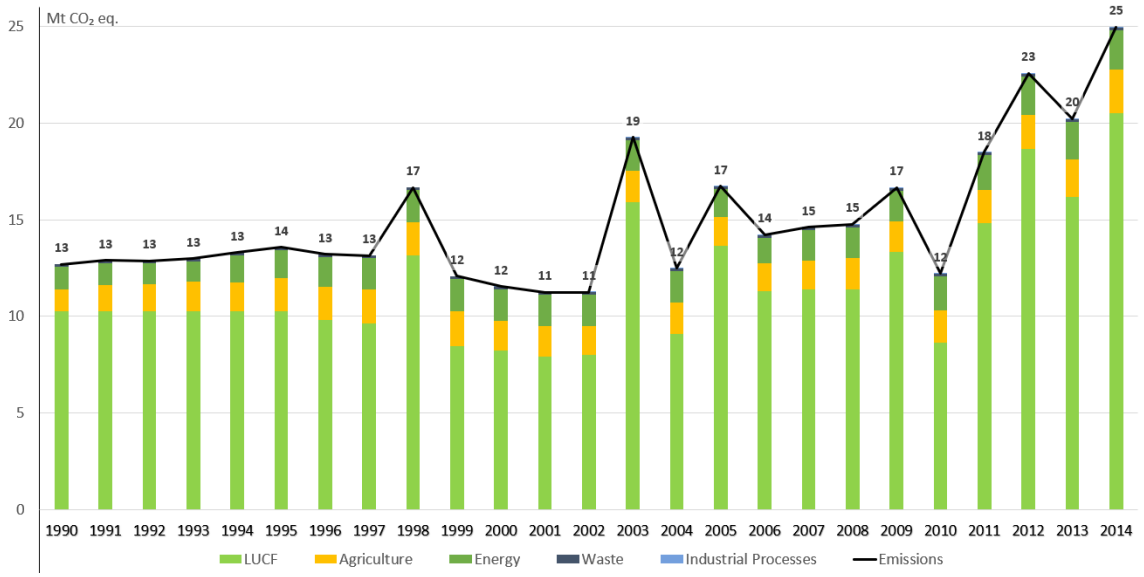

Figure 9: Emissions in $MtCO_2$ eq. by sector in Guyana during the period 1990-2014. From [91].

As can be seen in Table 12, the AFOLU sector, which is the LUCF and agriculture sectors combined, contribute to approximately 91.2 % of the total GHG emissions during the latest available year (2014) which shows the importance of AFOLU in Guyana's total emissions.

Table 12: Share of GHG emissions by sector in Guyana during 2014, the most recent year shown in Figure 9. From [91]

Sector	**Gross Emissions (2014) [Mt CO_2 eq.]**	[%]
LUCF	20.50	82.1
Agriculture	2.28	9.1
Energy	2.04	8.2
Waste	0.12	0.5
Industrial Processes	0.03	0.1
Total Gross GHG Emissions	24.97	100

6.3 The NDC of Guyana

This section will first give an overview of the NDC of Guyana and present included strategies connecting to AFOLU divided between mitigation and adaptation and classed as unconditional and conditional respectively. Relevant national policies that connect to the NDC will be described later in section 6.4.

Guyana's NDC focuses on mitigation in the forest and energy sectors and is divided into unconditional and conditional contributions, it also includes an appendix where adaptation measures are presented. Guyana states in the NDC that the agricultural sector is a considerable source of GHGs such as methane and nitrous oxide that should be included on a global scale, however agriculture is only treated as an adaptation measure in the NDC because of its small scale and its vulnerability to a rising sea level [89]. The only GHG considered is CO_2 and the time frame is up to 2025 [89].

One message that is put forward is that Guyana is willing to continue sustainable forest management but in turn requires financial support from the international community [89]. A payment-for-performance forest conservation agreement with Norway has helped finance the Low Carbon Development Strategy (LCDS), a REDD+ model that relies on Guyana's forest Measurement, Reporting and Verification Systems (MRVS). The goal of the MRVS is to make it possible to verifiably measure changes in forest cover and resulting emissions [93]. The NDC will build on these previous achievements to move towards an overall goal of a green economy [89].

The implementation of measures in the NDC rests on the assumption that Guyana will receive external financial support. It is assumed that Guyana and Norway will extend their bilateral agreement, that the Green Climate fund will be operational in 2016, that small islands and coastal low-lying developing states such as Guyana will receives special consideration regarding financing and that the REDD+ programme will be resourced in a sufficient manner [89].

6.3.1 Mitigation strategies

The mitigation efforts in the NDC of Guyana focuses on the forestry sector (including mining) and the energy sector.

Unconditional Contributions in Forestry

- Continue and improve ongoing work to implement sustainable forest management and keep illegal logging below 2 % of production by ensuring compliance with codes of practice in the timber industry and maintaining a high level of timber legality by monitoring [89].
- Finalize and implement the Voluntary Partnership Agreement (VPA) under the EU-FLEGT which is an initiative that aims to promote low deforestation

by sustainable governance and promoting trade in legally produced timber [94]. The VPA will provide independent accreditation of forest legality and management practices in the timber industry [89].

- Improve added-value activities locally to assist in creating higher potential for carbon storage in long-use wood products which could potentially reduce the pressure on forest resources as derivation of a higher value may result in reduced harvest levels [89].

- Increase support for indigenous communities, who traditionally use the land in a sustainable way [89].

Conditional Contributions in Forestry

The overall conditional emission goal is to continue to avoid emissions from deforestation in the amount of 48.7 Mt CO_2 eq. annually [89]. This value was chosen because it was the proposed reference level in the Guyana-Norway REDD+ agreement, it is calculated based on forest carbon stocks and corresponds to a rate of forest carbon stock loss of 0.25 % [95].

- **The Emission Reduction Programme for Forests**, which focuses on the mining and timber industries and includes:

  - Conservation of an additional 2 Mha through several area-based measures [89].

  - Timber Industry

    * Use of Reduced Impact Logging, this will reduce collateral damage from tree-felling and skid trails and could reduce annual emissions by 0.43 Mt CO_2 [89].

    * In the process of reviewing compliance of "significant timber concession agreements" to make sure that they meet agreed targets. A wider review to determine the most optimal use of these lands will be performed [89].

  - Mining Industry

    * Implement mineral mapping in mining districts in order to identify economically exploitable resources. This will reduce deforestation by avoiding clearing of forest on land that contain only marginal mineral deposits [89].

    * Implement awareness and incentive programmes to improve efficiency of technologies and practices in mining. For example improving of low recovery rates would make reprocessing of mining sites unnecessary and facilitate reforestation and recovery of sites [89].

    * Implement policies to institute mandatory, nationwide land reclamation and reforestation of mined areas [89].

- Forest governance, with enough resources Guyana can build capacity to meet other trade and supply conditions than the EU-FLEGT [89].
- An advanced MRVS has already been developed within the REDD+ agreement where it is an important tool in reporting forest carbon emissions. With enough resources, Guyana will maintain and complete this system [89].

Energy

The energy sector is not the main focus of this report but is in some aspects interlinked with the AFOLU sector, for that reason a short summary of relevant strategies in energy is included.

Unconditional contributions in energy include expansion of renewable energy supplies such as biomass, wind, solar and hydropower [89]. This could have an impact on the AFOLU sector, depending on how much land is needed for energy purposes. Another strategy is governmental encouragement of bio-digesters in agricultural areas which will reduce waste, produce biogas and provide household cooking means and thus provides an example of multifunctional land use in agricultural areas [89].

Under conditional contributions the overall goal is to develop a 100 % renewable power supply by 2025, assessments will be performed to determine the most effective way of doing this [89], but a further analysis of this is outside the scope of this report.

6.3.2 Adaptation strategies

In the NDC, Guyana lists the adaptation measures in an appendix. Some unconditional contributions will be made but a full implementation of the conditional contributions would require substantial financial assistance.

Unconditional Contributions in Adaptation

Climate change considerations will be mainstreamed in all sectors of national development. Work on integrated water management infrastructure will continue. New agricultural techniques will be introduced. At the time of the creation of the NDC, the government was in the process of creating a Climate Resilience Strategy and Action Plan (CRSAP) with the objective to provide a framework for adaptation and resilience building [89]. A draft of the CRSAP has since been published in 2015 [96].

Conditional Contributions in Adaptation

If enough support is provided, the measures in the CRSAP will be implemented. Environmental and sustainability awareness programs will be implemented at all

levels of society. Especially relevant for the AFOLU sector are mangrove restoration and development of new crops better suited for a changing climate by being flood, drought and disease resistant. Other strategies that may connect to land use are adaptation in the hinterland as well as upgrading infrastructure against flooding [89].

It is estimated that the total cost of implementation for the conditional contributions in adaptation will be 1.6 billion US$ during the period that is covered by the NDC, which is up to 2025 [89].

6.4 Summary of national policies and documents

The NDC of Guyana builds on the previously existing Low Carbon Development Strategy (LCDS). Both the LCDS and the NDC itself also relies on external financial support, like a bilateral agreement between Guyana and Norway. Both the Guyana-Norway agreement and the LCDS will be described in sections 6.4.1 and 6.4.2 respectively. The agricultural policy will be briefly described in section 6.4.3 to give an overview of its role in Guyanese development.

6.4.1 The Guyana–Norway Agreement

An important source of funding for Guyana's climate policies and strategies is a bilateral agreement with Norway. In 2009 the two parties signed a Memorandum of Understanding and a Joint Concept Note. The Guyana REDD+ Investment Fund was created with the World Bank as the trustee and a steering committee with representatives from both countries as well as external observers [97].

In an article by Angelsen [97], two major reasons behind Norway's decision to establish an agreement with Guyana are stated. One reason was that Norway looked to diversify its country support portfolio and Guyana represented one of several high-forest low-development countries, and measures had to be taken in order to prevent an increased deforestation rate in Guyana. A second reason was that Guyana expressed political willingness to become a model for a new mechanism for these types of countries [97].

As stated above, Guyana has historically had a low deforestation rate but this had the potential to change when the government launched the LCDS in 2009. As a part of this strategy, assessments done by McKinsey & Company showed a scenario involving a large expansion of the agricultural sector that would result in an increased deforestation rate, to 4.2 % per year [98].

Guyana expressed in a report [99] that much of the world's deforestation is driven by commercial activities such as producing timber or clearing land for other more profitable uses. On the other hand, the world economy does not make it as profitable

to conserve forests, even though that is more sustainable from an environmental point of view. They also highlighted that one problem with the REDD mechanism was that if the baseline for payments to a party were based on historical deforestation levels, countries with historically high deforestation levels would be favored over those with historically low levels such as Guyana [99].

Furthermore, Guyana stated that they faced a choice of national development. If the nation's rainforests were to be conserved, Guyana required external financial support that, at the minimum, had to correspond to the economic value of pursuing deforestation and related activities such as agriculture and mining [99].

6.4.2 Low Carbon Development Strategy

The Low Carbon Development Strategy (LCDS) is a national strategy that was launched in 2009 and followed by an updated version in 2013. The main purpose of the strategy is to achieve two major goals. The first goal is the transformation of the economy of Guyana to deliver greater economic and social development for its people by following a low carbon development path. The second goal is to provide a model for the world on how climate change can be addressed through low carbon development in developing countries, if the international community provides enough action, particularly regarding REDD+[100].

In the version from 2009 the strategy involved eight prioritized areas of low carbon development, and in 2013 five more were added [100]. They concern many different areas and not just the AFOLU sector. Some of the measures and priorities in the strategy are also included in the NDC while others are not.

Several priorities concern the indigenous Amerindian population and their land which is also included in the NDC. Another priority is to support low carbon organizations and sectors where examples include more sustainable forest and mining, sectors that play a significant role in the NDC [100]. The priority Renewable Energy in the LCDS is mirrored by the focus on energy in the NDC. Both the LCDS and the NDC includes adaptation measures such as protection against flooding. It is also stated in the LCDS that a Climate Resilience Strategy will be created which is also the case in the NDC, where creation of such a strategy is also mentioned [100].

Finally the LCDS include the priority "MRVS and other supporting tasks" which include, for example, the EU-FLEGT initiative and the REDD+ MRVS that will verify the viability of the LCDS [100]. These strategies are also important parts of the NDC.

In summary, some aspects of the LCDS are more highlighted and play a larger role in the NDC while others are not mentioned at all. However several priorities are common in both policy documents and at least some parts of the LCDS seems to be well integrated in the NDC. Furthermore it is stated in the NDC that it will build on the LCDS to achieve a green economy.

6.4.3 Agricultural Policy

The current agricultural policy in Guyana is presented in the report *Agriculture - Our Vehicle for Sustained Economic Social Prosperity: A National Strategy for Agriculture in Guyana 2013 - 2020*, issued by the Ministry of Agriculture [101]. This policy builds on several other policies and strategy documents, the LCDS for example, and has the overall goal to end hunger and eliminate poverty by 2025. More specifically, the policy aims to provide food security for Guyana's own population but also states that agriculture will play an important part in making Guyana a high middle-income country by 2025 [101].

In the policy document it is stated that agriculture is central to food security, economic growth and environmental sustainability. This vision include 25 prioritized areas where several aspects of development of the agriculture sector are presented. Examples include improved crop and livestock varieties, better and cheaper fertilizers, more effective financial arrangements, improved availability and access to land by road, enhanced weather-related disaster management [101].

As stated above, agriculture is only treated within the adaptation strategies in the NDC. The adaptation actions that do concern agriculture, such as more resistant crops, fit well into this policy. It is worth noting that if the agriculture would actually increase significantly it could be a driver for deforestation and have consequences for the forest land use in the NDC. Also, the fact that agriculture is not included in the NDC mitigation measures may allow the sector to expand more freely. Although one should note that sustainability still plays an important part in this agricultural policy and that it is stated that forestry is taken into account.

6.5 Evaluation of feasibility

The NDC of Guyana seems to be quite well-integrated with the course of national development, at least within the sectors that are included in the NDC. It also builds on the LCDS that aims to influence both society and economy. A significant share of the NDC strategies fall within the AFOLU sector because of the large focus on forests and forest management.

Included sectors

The focus of the NDC are the sectors forestry (including mining) and energy. The choice to focus on forests and mining seems relevant, considering that they produce a significant share of the total GHG emissions. Considering the minimal share of GHG emissions that sectors such as waste and industrial processes cause (see Figure 9), it seems fair to exclude them from the NDC. One could argue that agriculture, that causes about 9 % of total GHG emissions, should be included in mitigation and not just in adaptation. At the same time, the choice to not include agriculture is motivated by its small scale, vulnerability and importance to food security [89]. The

decision to not include agriculture may fit well into the agricultural plan that has the aim to achieve food security and make Guyana a middle-income country, since it allows the sector to grow freely without any environmental goal to consider, at least not within the NDC. Some parts of the adaptation, especially resistant crops, are important in both the NDC adaptation and the agricultural policy.

Forest monitoring supports other strategies

Regarding specific strategies it is sometimes difficult to assess what has presently been implemented and a full survey of this should perhaps be done in the final stage of the NDC time frame. Within forestry, the overall conditional GHG target 48.7 Mt CO_2 eq., corresponding to 0.25 % carbon loss is already completed due to Guyana's low deforestation, the goal is rather to continue the trend. Due to Guyana's presently low deforestation, it looks like this goal will continue to be fulfilled.

The MRVS continues to be developed and the Guyana Forestry Commission has regularly published MRVS interim measures reports [93] were the forest situation in Guyana is assessed relative to REDD+ indicators. In the latest report which describes the period up to December 2016, it is shown that the deforestation rates are gradually decreasing from the peak in 2012 [93]. The share of deforestation caused by mining is also reported to have decreased from 85 % in 2014 to 74 % in 2015-2016 [93]. Values for later years may be needed in order to verify if this is a continuing trend or depends on fluctuations. Full data is not yet available for all indicators, the legally harvested volume of timber are for example lacking "hard data" [93].

The MRVS and forest governance will allow increased quality and precision in monitoring of forests and a completion of these strategies would probably help control the status and implementation of several other strategies such as the Emission Reduction Programme for Forests. In summary, focus on these strategies could pay off by facilitate implementation of others and should therefore be a priority.

A Low Carbon Model?

Positive side-effects that may arise from the implementations of the NDC are mainly a continued economic growth while at the same time a transition towards a green economy would be taking place. Maintaining a low deforestation rate will mean continued funds through the REDD+ agreement. Another positive effect could be to serve as a model for a REDD+ mechanism for other High Forest Low Deforestation countries, something that is brought up in the LCDS, the Guyana-Norway agreement and the NDC.

The main hindrance for implementations of the strategies in the NDC seems to be financing. It is explicitly stated that the strategies rely on external financing. If external financing were to cease, Guyana might be forced to transition to an even more expansive agricultural policy that could lead to increased deforestation, something that they have stated that the present agricultural policy will not do.

7 India

India is a big country regarding many factors; population, emissions, size, languages, religions and social status, only to mention a few. With 17.8 % of the world's population (2016) [102] and 6.8 % of the world's total GHG emissions (2015) [103], it makes India the second most populated country and the fourth largest emitter - behind China, USA and the EU.

The size of the nation is cause of diversity in the matter of nature regions, which means that the climate and temperature differs across the country. In general, it is a monsoon climate with variability of rains between years, which affect the agricultural system and creates uncertainties of yields [104].

India consists of 29 states with a considerable amount of power over their own matters [104]. It is a federal republic with multiple parties governing, and with legislation determined by two houses - Council of States and House of the People [104]. It is one of the poorest countries in the world, but due to the technology boom, India has had a big annual growth since the late 20th century [104].

India's NDC [105] is interesting for this thesis since a large part of the nation's strategies to reduce GHG emissions depend on an afforestation and restoration program called Green India Mission (GIM). Other aspects to why it is interesting to investigate India is the size of the country, the population and the emissions.

7.1 Land use in India

The share of forest and agriculture area compared to the total land area of India is presented in Table 13.

Table 13: Land cover and use in India 2015. From [106].

	Area [Mha]	**Area [%]**
Total land	297.7	100
Forest	70.7	23.7
Agriculture	179.7	60.4
Other	46.9	15.9

A large share of the Indian population is dependent on agriculture for their income - somewhere between one half and two thirds [104][105] - so naturally a large proportion of the land is dedicated to farming and livestock. About one fifth of the GDP comes from the agriculture sector [104]. India hosts the largest bovine population in the world, even though most people do not eat meat because of religious reasons [104].

As introduced in the previous section, the agricultural sector is widely dependant on the monsoon rains [104]. The crop yields between years differ a lot since the rainfalls have variability both in intensity and occurrence in time [104]. In parts of the country where the annual rainfall exceeds 1 500 mm, two crops can be grown per year without irrigation which means that the areas can support high density of inhabitants [104]. The areas that are too dry to cultivate without irrigation are used as pastureland in many cases [104].

Amount of forest area over time is presented in Figure 10. It is clear that the total forest area increases from year to year, even though the last figures from The World Bank are from 2016. In a report from the Indian Government from 2017, the total area is 70.8 Mha [107] which is an increase with 0.2 % from 2016 [108]. It might be that the official numbers on forest area are deceptive since the forest accounted for mostly include scrub forest [104], but since the official numbers are the ones that the Indian government uses for their strategies and for reference, that is what is presented in the report.

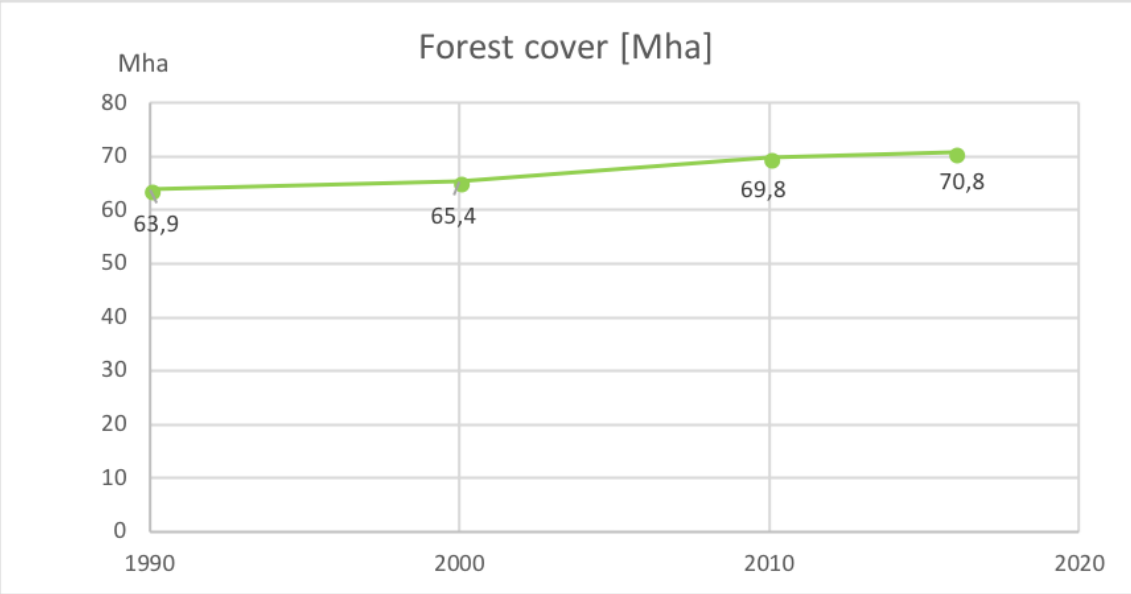

Figure 10: Forest area in India over time. From [108].

The type of forest in different areas, as well as the biodiversity, depend on the amount of rainfall [104]. Because of the isolation of species in various geographical areas, there are a lot of endemic species present in the Indian forests [104]. The forest areas are in many cases used for purposes such as grazing, hunting and gathering of firewood and forest products [104] which makes them multifunctional. The forest could also be used for commercial forestry and for shifting cultivation, which is illegal but still occurs [104].

7.2 GHG data and land use emissions

The nation's total emissions are growing but net emissions are lower because of the carbon sequestration in forests. The level of emissions from agriculture is almost the same over the measured years which is noteworthy since the population have grown with 30.6 % from 1994 to 2010 [102]. One reason for this is the increasing use of fertilizers and hybrids of seeds that both give higher yields [104]. The emissions from LUCF and agriculture, namely the emissions from AFOLU, contributed to 7.4 % of the total net emissions in 2010 according to the UNFCCC [55]. In Figure 11, the GHG emissions trends in different sectors over the time period 1990-2014 is shown, with data from CAIT Climate Data Explorer.

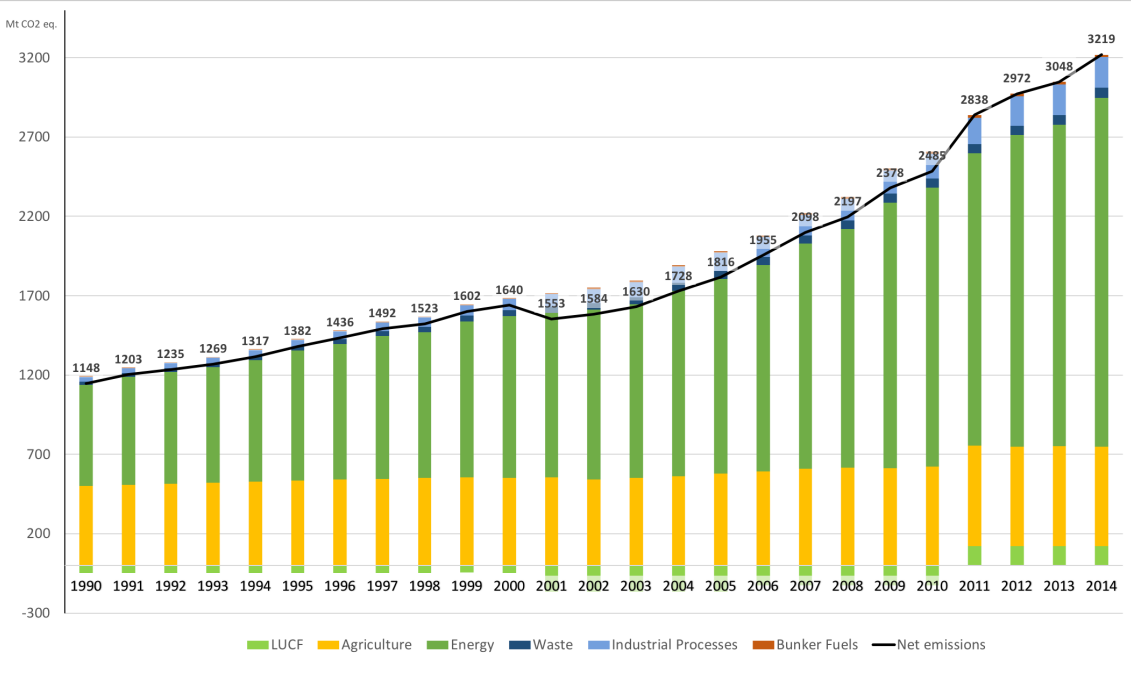

Figure 11: GHG emissions from different sectors over time in India. All data in Mt CO_2 eq. From [109].

Worth noting in Figure 11 is that the GHG emissions from the energy sector has increased approximately 3.5 times while the emissions from the agriculture sector remain at almost the same level (as previously discussed). The distribution of GHG emissions from different sectors in 2014 is shown in Figure 12.

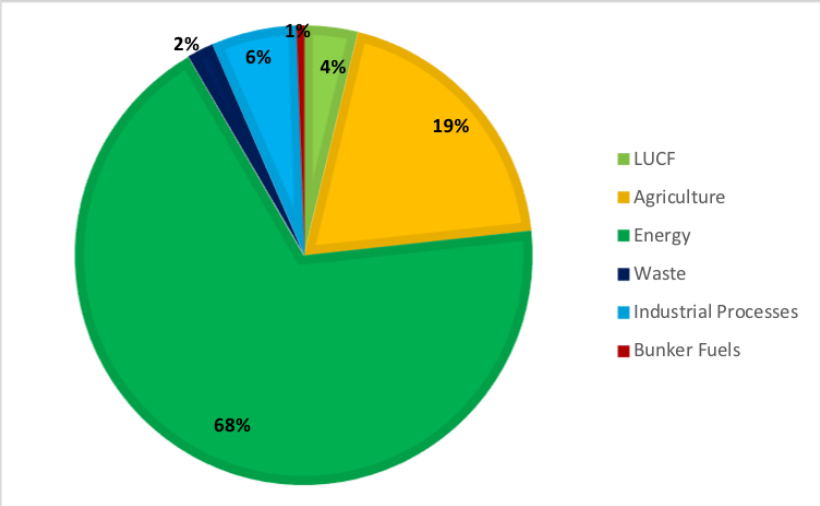

Figure 12: Distributions of GHG emissions from different sectors in India 2014. From [109].

The largest emitting sector is by far the energy sector, with 68 % of the total emissions in 2014 [109]. About 18 % of the energy use came from biomass in 2015 [105]. The AFOLU sector (LUCF and agriculture) contributed with 23 % in 2014 [109], which differs a lot from the UNFCCC figure (7.4 % in 2010 [55]). The numbers deviate so much because CAIT Climate Data Explorer and the UNFCCC estimate emissions in different ways. The important thing to keep in mind is that the AFOLU sector is a relatively small emitter in India, compared to the energy sector.

7.3 The NDC of India

The NDC communicates the desire for India to achieve better living standards for its population, and at the same time contribute to the world's joint actions against climate change [105]. The Indian Prime Minister, Narendra Modi, stresses that the world should talk about climate justice instead of climate change, since the latter gives the perception that the goal is to secure the comfortable lifestyles of the western world, but the term climate justice highlights the need to resolve security from future natural disasters for the poor [105].

India presents the Intended Nationally Determined Contribution as eight points, with the **overall goal to achieve an emission intensity reduction of 33-35 % of its GDP by 2030** [105]. The targets in the AFOLU sector are presented below.

- Around 40 % cumulative installed electric power from non-fossil fuel based resources by 2030 [105].
- Additional carbon sink of 2 500-3 000 Mt CO_2 eq. by 2030 [105].
- Invest in development programs in agriculture, Himalayan region and coastal

regions to better adapt to climate change [105].

India also has a **voluntary goal to achieve an emissions intensity reduction of 20-25 % of its GDP by 2020** [105]. The voluntary goal is unconditional and the overall goal and the bullet points are conditional. The NDC states that no mitigation actions in any specific sector are binding [105].

The NDC has goals for specific types of renewable energies that will help India to achieve 40 % electric power from non-fossil based resources by 2030. The only goal that is relevant for AFOLU is that India aims to increase the installed biomass capacity from 4.4 GW (2015) to 10 GW (2022) [105].

The additional carbon sink relies heavily on Green India Mission (GIM), but also efforts such as National Agroforestry Policy (NAP), National Afforestation Programme, REDD+ and Joint Forest Management (JFM) [105]. About 6 billion US$ will be transmitted from government to states through Compensatory Afforestation [105].

The actions proposed in the agriculture sector are mainly adaptation strategies, but there are no measurable targets linked to them. The upcoming sections will therefore not primarily focus on the agriculture sector.

Estimates in the NDC show that India needs approximately 206 billion US$ for adaptation actions and 834 billion US $ for mitigation actions [105]. They further estimate that the whole cost of India's climate change actions is at least 2.5 trillion US$ from 2005 to 2030 [105]. It is not specified how much funding is needed to finance any specific goal.

7.3.1 Mitigation strategies

The mitigation strategies in the AFOLU sector in India's NDC include the following points:

- Promote to use biomass energy more clean and efficient, and generate electricity based on biomass [105].
- Eventually put 33 % of the geographical area under forest cover [105].
- Increase forest cover with 5 Mha and improve quality of forest cover on additionally 5 Mha, and thereby enhance carbon sequestration with about 100 Mt CO_2 eq. per year, up to 2030 [105].
- Implement "Green Highways" by planting a 140 000 km long tree-line along national highways [105].

These strategies will be implemented conditionally, so India has need for funding from developed countries to carry through with the actions. It is unclear from the

NDC how much funding is needed for these measures alone. The Indian government will transfer about 174 US$ per ha and year to states for afforestation. The NDC communicates that India will achieve the goals with *"full implementation of Green India Mission another programmes of afforestation"* [105], which covers all but the first points in the list.

To put 33 % of the geographical area under forest cover will require India to expand the cover from 70.8 Mha (2017) [107] to 98.2 Mha, which is an expansion of 38.7 %. To increase the forest cover with 5 Mha until 2030 from the area in 2010 (69.8 Mha [108]), which is the starting year of the GIM [110], would be an increase of 7.2 %.

7.3.2 Adaptation strategies

The adaptation strategies regarding AFOLU in the NDC are mostly affecting the agriculture sector. Both strategies that are presented below contain typical multi-functional properties. It is unclear how to determine when the goals are satisfied, and to what extent.

One strategy that is mentioned is to use modified crops that have higher potential to fixate CO_2 while at the same time consume less water and are more climate resilient [105]. It is part of the National Mission on Sustainable Agriculture [105].

Another presented strategy originates from the National Agroforestry Policy. It means to integrate tree plantation with crops and livestock, with the aim to protect and stabilize ecosystems. While at the same time promote crops and farming systems with more resilient properties, this will minimize risk during extreme weather conditions that are amplified by climate change [105].

7.4 Summary of national policies and documents

India has a number of strategies in order to combat environmental change and the following sections will sum up relevant policy documents and programs for AFOLU. The legislated policies originate from the National Environment Policy (NEP) of India from 2006 which in turn originate from two articles in the Constitution, following below, which commits to create conditions for a clean environment [111]:

Article 48-A: *"The state shall endeavor to protect and improve the environment and to safeguard the forests and wild life of the country."* [112]

Article 51-A (g): *"It shall be duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wild life and to have compassion for living creatures."* [112]

7.4.1 Joint Forest Management

The Joint Forest Management (JFM) was first formulated in the National Forest Policy 1988 and the guidelines were latest reformulated in 2000 [113]. The idea of JFM is that local communities and the government will work together to protect forests from different kind of degradation, both induced by human and environmental factors, and as reward, they receive non-timber forest products [113]. Originally, the focus was to build up degraded forests by local development and afforestation but it has expanded to include resource planning and management for healthy forests [113].

7.4.2 National Action Plan on Climate Change

The National Action Plan on Climate Change (NAPCC), stretching between 2008 and 2017, consists of eight National Missions. The missions relevant specifically for AFOLU are National Mission for Sustaining the Himalayan Ecosystem, National Mission for a "Green India" and National Mission for Sustainable Agriculture [114]. One important factor to be able to complete the missions was to raise the public awareness and their support [114].

The most interesting mission for this report, is the National Mission for a Green India which also goes under the name Green India Mission and still is running even though the NAPCC has run out. It strives to enhance ecosystem services provided by forests, such as carbon sequestration [114]. This mission aims to afforest 6 Mha of degraded forest land, to put 33 % of the land area under forest or tree cover, and is managed by JFM Committees and the Departments of Forests in the governments in the states [114].

7.4.3 Green India Mission

The Greening India Mission (GIM) is a mission which aims to enhance ecosystem services of forests and other ecosystems, and at the same time enhance its provisioning services for local communities [110]. The GIM also strives towards enhanced hydrological services and biodiversity [110]. The ecosystem service that is most interesting for this report is carbon sequestration, since one of the goals in India's NDC is to create an additional carbon sink of 2 500-3 000 Mt CO_2 eq. until 2030 [105]. The outputs of a fully implemented GIM are described in Table 14.

Table 14: Descriptions of GIM targets and the area affected in Mha. From [110].

Area [Mha]	**Description of target**
2.0	Increase cover and density of moderately dense forest
4.0	Regenerate/afforest and further sustainable management of degraded forest
0.10	Restore/establish mangroves
0.10	Enhance conservation status of wetlands
0.20	Forest cover of urban/peri-urban forest lands and institutional lands
1.50	Bring degraded agricultural lands and fallows under agro-forestry
0.10	Secure corridor areas critical to wildlife migration

In addition to the targets in Table 14, 10 million households will begin to use devices for cooking that are more fuel-wood efficient, and communities dependant on biomass and non-timber forest products will be enhanced to reduce vulnerability [110].

There are some challenges with the implementation of the GIM. The mission aims to enhance carbon sequestration, while at the same time it is important to not affect food security and livestock grazing, to meet the population's needs for biomass, and to conserve biodiversity [110]. It also is a problem that there are specific details only for the carbon sequestration strategies and that there are no measures to know if the objectives are met [110].

The GIM that has been presented in this section will run until 2020 [110], but according to Prof. Ravindrath, who has been researching and working with forest related issues in India for many years, the mission will continue to run until 2030 [115].

7.4.4 National Agroforestry Policy

The National Agroforestry Policy that was launched in 2014 aims to help achieving the government goal to put 33 % of Indian lands under forest or tree cover, by expanding the use of agroforestry [116]. The objectives of the policy are shortly summarized in the list below:

- Improve life quality for people in rural households by integrating afforestation with crops and livestock [116].
- Reducing risks associated with climate change by promoting resilient crops and farming systems [116].
- Meet the needs of wood based industry and reduce import of wood products

[116].

- Decrease the pressure of forests by increasing the availability of products from agro-forests [116].

The National Agroforestry Policy is entirely built on the idea of multifunctional land use. The financing will consist of Rs 4000-5000 crores annually from programs running in agriculture and forest departments, corresponding to approximately US$ 615-769 million [116].

One problem with this policy is that there is no number of how much agro-forestry contributes to the GDP. This makes is hard to estimate how much will be needed for funding and how big the economical gains will be [116]. The uncertainties affect both the individual farmers intent to invest in trees and the states intents to plan and implement the policy [116]. There is ongoing research on the area [116].

7.4.5 REDD+ in India

Both GIM and the National Agroforestry policy have potential to receive funding through the REDD+ programme [117]. There are areas which India needs to consider in order to be successful in implementing REDD+ mostly including management of forests by the local communities [117].

7.5 Evaluation of feasibility

The goals and strategies in India's NDC are very well integrated with already existing documents and policies. In fact, all mitigation goals in the AFOLU sector are covered by the NAPCC, GIM and the National Agroforestry Policy and the adaptation strategies are covered by the NAPCC and the National Agroforestry Policy.

Achieving the dream scenario

How would India's GHG emissions be affected if the NDC targets are reached in 2030? It is assumed that a baseline for the GHG emissions 2030 is the Business as usual-line in Figure 13, which is 4 500 Gt CO_2 eq.

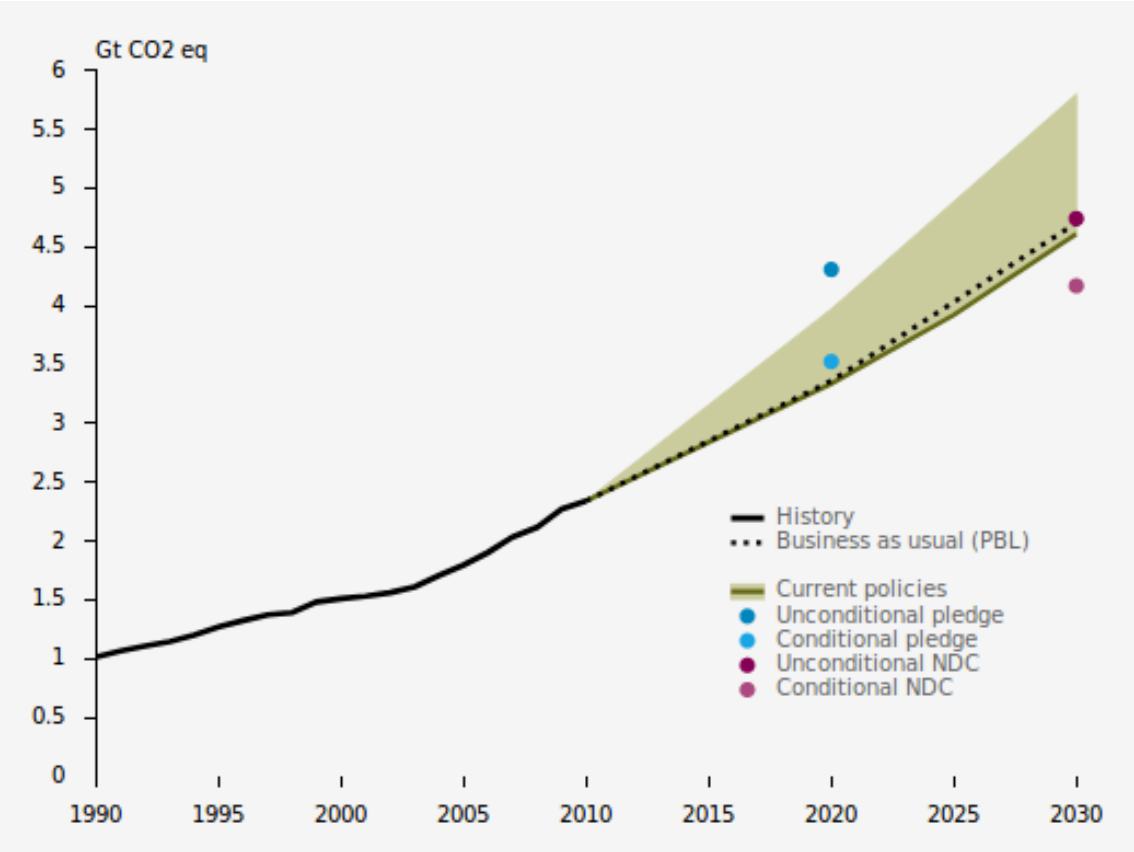

Figure 13: Forecast of India's GHG emissions The dots represents the conditional and unconditional pledges India made in the NDC. From [66]. Used with permission.

Increase in non-fossil based energy

If 40 % of India's energy comes from non-fossil based sources in 2030, it would mean that 1 224 Mt CO_2 eq. of the total 4 500 Mt CO_2 eq. come from greener alternatives than they do today. The assumption that the distribution of emissions from different sectors is the same as in 2014, see Figure 12, with 68 % from the energy sector, leads to the conclusion that 27.2 % of the emissions would have non-fossil based origins instead of fossil based ones 2030. Since this report does not focus on the energy sector, it is impossible to say if this is actually obtainable.

Additional carbon sink through forests

An additional carbon sink of 2 500-3 000 Mt CO_2 eq. by 2030 would decrease India's total net GHG emissions substantially. The emission level in 2030 would be somewhere between 2 000 and 1 500 Mt CO_2 eq., which is 56-67 % lower than the BaU emissions in Figure 13.

According to the NDC, the expectation of the increase and improved quality of

forest and tree cover is that approximately 100 Mt CO_2 eq. will be fixated in trees annually. From 2015 to 2030, it adds up to 1 500 Mt and it will be achieved through afforestation of 5 Mha and quality improvement of additionally 5 Mha. Between 2000 and 2016, the forest cover increased with 5.3 Mha, shown in Figure 10, so an increase of forest cover by 5 Mha between 2015 and 2030 could be possible to achieve. From the start of the mission 2010 up until 2016, the forest area had only grown with 0.9 Mha [108]. It is unclear if it is possible to enhance the quality of forest and tree cover to such an extent that the carbon sequestration target can be achieved, since there are no concrete ways to actually evaluate how successful the strategies are.

To achieve a total carbon sink of 2 500-3 000 Mt CO_2 eq. by 2030, would require an annual sink of 250-300 Mt between 2015 and 2030. India has only planned an annual sink of 100 Mt CO_2 eq., approximately one third of what is needed. That leads to the issue of how an additional amount of 150-200 Mt CO_2 eq. annually will be fixated through carbon sequestration.

GHG emissions target depending on GDP

It is hard to evaluate the GHG reduction targets in the NDC, since they are depending on the development of India's GDP. To make an analysis, a study which have been modelling future scenarios [118] have been used. In a modelled BaU scenario with 8 % growth rate, the GHG emissions in 2030 are expected to be 9 083 Mt CO_2 eq., and with a modelled NDC scenario, the expectation is 8 460 Mt CO_2 eq. [118]. This would mean that India easily will reach the overall goal to reduce the emission intensity with 33-35 % if the other goals in the NDC are achieved.

Distrust in authorities and lack of funding

The NEP 2006 lifts the importance of getting the local communities involved in the management of forests [111]. This is also one of the corner stones in JFM [113] and one item that needs to be considered when implementing REDD+ [117]. This is possibly an obstacle for implementation of the policies since the urban population generally is very skeptical because of historical events, where the involvement of the government in forest matters have been affecting people that are dependent on forests in negative ways [119].

A fully implemented GIM will give large environmental benefits, but one obstacle with the implementation of the mission could be that it is unclear how much the different strategies will cost. The estimated cost of the whole mission is
Rs 46 000 crore (approximately 8.4 billion US$ with the exchange rate in January 2013 [120]) over 10 years, starting from 2012-13 [121]. In the government budget for 2018-19, Rs 160 crore (approximately 24.9 million US$ with the exchange rate in February 2018 [122]) is earmarked for the GIM [123]. This indicates that GIM is

entirely dependent on external funding, since the budget only covers 0.3 % of the total estimated cost.

High afforestation ambitions

The mitigation strategy in the NDC to put 33 % of the land area under forest cover might be too much of a wish in a foreseeable future. The goal has been on the table for a long time, for example it was presented in the NEP 2006 where it was supposed to be reached in 2012 [111]. As mentioned in Section 7.3.1, Mitigation strategies, it is an increase of 38.7 % from the forest area 2017.

The GIM aim to increase the forest and tree cover with 5 Mha might also be tough to reach. In the first six years of the mission, the cover increased with 0.9 Mha [108], which is 17.8 % of the goal. If the afforestation continues in the same pace, the goal will not be reached until 2043, 13 years later than targeted.

Benefits with investments in the energy sector

Articles investigating India's NDC put forward the energy sector as the most important sector to invest resources in to achieve positive environmental paybacks [118] [124]. Since the energy sector contributes with 68 % of the total GHG emissions, and have grown almost 3.5 times in less than 20 years [109], it is reasonable to encourage mitigation actions related to energy matters.

It could possibly be easier to get revenues on energy related investments, and therefore it might be more attractive for private enterprises to finance projects in the energy sector compared to AFOLU, where investments could be compared with charity. An obstacle for implementing the AFOLU related strategies can therefore be that investments in the energy sector are more attractive and beneficial for GHG emission reductions than investments in AFOLU.

Positive effects of coupling between NDC and national programmes

As described in the beginning of Section 7.5, Evaluation of feasibility, all targets in the NDC are also targets in national programmes. This probably has positive implications for the feasibility of India's NDC, since the threshold to start working with the NDC is smaller for a country with already existing frameworks than for a country who put forward brand new strategies. According to Climate Action Tracker (CAT), the NDC of India is compatible with the 2 °C target in the Paris Agreement [125].

8 Conclusion

As have been shown, AFOLU plays an important role in all the NDCs of the examined parties. The strategies and proposals often differ significantly between countries depending on various national circumstances such as geography, financial situation or political ideology. However, several similarities are also evident between certain parties.

In this section, the overall conclusions of this report will be presented and discussed.

General strategies in AFOLU

In all countries but India investigated in this thesis, the AFOLU sector is the main contributor to GHG emissions. Especially for countries covered with rainforest, actions in the AFOLU sector are crucial if the world jointly shall reach the target to have zero net emissions during the second half of this century.

For the South American parties, one strategy stood out as particularly important in order to keep deforestation at a low rate and limit illegal logging, and that is is monitoring and sustainable management of forests. The South American parties all work with conservation and restoration to retain the rainforests. In India, the central mitigation strategies are enhanced carbon sequestration through: afforestation, reforestation and by increasing the quality of already existing forests, and similar strategies can be found in Brazil's NDC as well. The improvement of cooking stoves in Burkina Faso is one of the primary strategies to decrease the use of firewood and thereby deforestation. India also has a similar strategy as an integrated part of the GIM, even though it is not the main focus.

The general effectiveness of the NDCs

Generally, the proposed measures in the parties' NDCs would be effective in reducing their GHG emissions from AFOLU if fully implemented. Most parties aim to achieve zero net emissions from their LUCF/LULUCF sector, as well as no significant increase in agricultural emissions. This makes AFOLU the sector where most progress is expected to be accomplished for most parties. However, generally, emissions from other sectors are expected to increase in the coming years, making the IPCC 2°C target an unlikely achievement. It is unclear if the investigated strategies will impact other environmental issues, apart from GHG emissions from AFOLU, since the named emissions are the only environmental issue that have been investigated in this report.

Even though most parties press the fact that they consider their own respective NDC unequivocally very ambitious, the joint efforts, given that all parties of the UNFCCC

fully implement their contributions, have been deemed likely to be insufficient in order to achieve the named 2°C target, which can be seen in Figure 14 below.

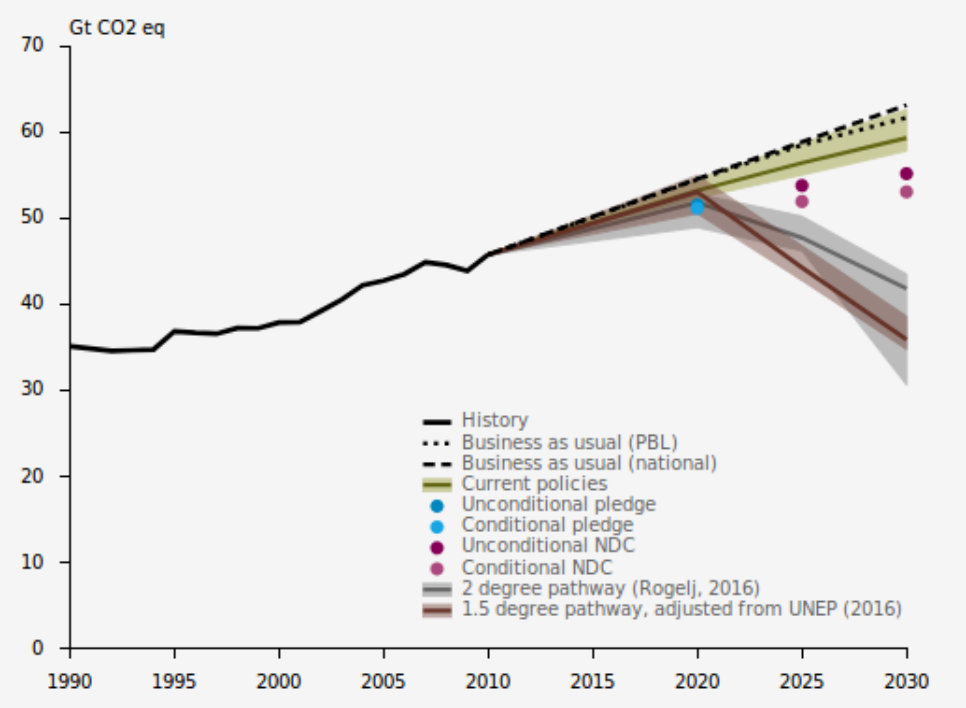

Figure 14: The world's joint historical emissions and a forecast of the years up to 2030, with conditional and unconditional pledges in parties' NDCs and how the emissions needs to develop in order for the targets in the Paris Agreement to be fulfilled. From [66]. Used with permission.

CAT [126] is an independent scientific analysis that quantifies and evaluates NDCs, it then aggregates the parties' action to a global level, determining likely temperature increase by the end of the century. Of the NDCs evaluated in this thesis, CAT [126] only considers India's NDC to be compatible with the 2°C target, while the ambition level of Brazil's NDC is deemed to correspond to a global warming of 2-3°C by 2100 [68][125]. However, neither Bolivia's, Burkina Faso's or Guyana's NDC have been evaluated by CAT. The conclusion made of this is that India, for example, might be a good role model for other countries when drafting their environmental policies.

The general feasibility of the NDCs

The parties' chance of fulfilling their commitments at a national level is moderately high for most of the parties, if the prerequisites of external funding are met. The commitments in the NDCs are mostly well integrated with other national decisions, policies, and programmes, which contributes to the feasibility. However, the feasibility for some of the parties are highly subservient on the existing cooperation

and support from other countries, but provided that this support is continued, the national level commitments will continue to be feasible.

The parties' motivation for fulfillment is also supported by the threats that climate change make on the poorer parts of the parties' populations. These are the most exposed groups when a drought, flood, or other climatic catastrophes occur, and most of parties state in their NDCs that this is a driving force for implementation of the commitments.

But, in order to fulfill all of the commitments and implement the proposed strategies in respective NDC, most of the parties evaluated in this report are heavily reliant on external funding. This implicates that the more developed countries must contribute when the developing countries falls short in funding, technology or other necessities.

Fairness, equity, and ambition - international cooperation as a way forward

All of the parties evaluated in this report are developing countries, with challenges regarding poverty eradication, infrastructure and energy access. Thus, it is evident in the NDC documents that the parties press the issue of the fairness, equity and ambition in regards to their respective commitments.

What seems to be a common thread among the parties evaluated in this thesis is the argument that it is unfair that developing countries have to commit to refrain from GHG intensive activities, that possibly could benefit their economic growth. Especially since the biggest share of the aggregated global GHG emissions have been caused by now developed parties, that have appropriated wealth as a result of such GHG intensive activities. If developed countries do not take responsibility for their historical actions, the lack of funding for the developing parties becomes the greatest obstacle for full implementation of the commitments stated in the NDCs.

Market mechanisms such as REDD+ provides one possible solution for how developed countries can support developing countries. There are, however, contrasting opinions regarding if REDD+ provides a solution or a problem. Bolivia opposes REDD+ because of the market mechanism's commodification of nature and because they regard the non-consistency with recognition of historical responsibility as a way for developed countries to avoid their historic responsibility. Guyana on the other hand, rely on support from the Guyana-Norway REDD+ agreement in order to be able to implement certain strategies and hopes that it can serve as a model for countries with high forest cover and low deforestation.

Several of the parties have similar challenges, the South American parties for example all have goals including a decrease in deforestation of the rainforest. Similar challenges may also have similar solutions and thus, information sharing, such as transferring of ideas and technology, could facilitate the implementation of the

NDCs. Although the NDCs are specific for each nation, climate change is a global problem and international cooperation could increase the feasibility of implementation of strategies and policies on a national level.

References

1 Introduction

[1] O. Edenhofer, et al., "Summary for Policymakers," Climate Change 2014: Mitigation of Climate Change, Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2014. Available: https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_summary-for-policymakers.pdf, Accessed on: May 08, 2018.

[2] World Resource Institute, Washington, D.C., "What is an INDC?," 2017. [Online]. Available: http://www.wri.org/indc-definition, Accessed on: May 08, 2018.

2 Background

[3] European commission, "Paris Agreement," N/A. [Online]. Available: https://ec.europa.eu/clima/policies/international/negotiations/paris_en, Accessed on: May 07, 2018.

[4] United Nations Framework Convention on Climate Change, "NDC Registry," N/A. [Online]. Available: https://unfccc.int/process/the-paris-agreement/nationally-determined-contributions/ndc-registry, Accessed on: May 07, 2018.

[5] Wikimedia Commons, "Simplified angular world map," 2011. [Electronic image]. Available: https://commons.wikimedia.org/wiki/Maps_of_the_world#/media/File:Simple_world_map.svg, Accessed on: May 11, 2018.

[6] United Nations Framework Convention on Climate Change, "Paris Agreement - Status of Ratification," N/A. [Online]. Available: http://unfccc.int/paris_agreement/items/9444.php, Accessed on: May 08, 2018.

[7] PBL Netherlands Environmental Assessment Agency, "PBL Climate Pledge NDC tool," 2017. [Online]. Available: http://themasites.pbl.nl/climate-ndc-policies-tool/, Accessed on: May 08, 2018.

[8] Encyclopædia Britannica, "Carbon cycle," 2018. [Online]. Available: https://academic.eb.com/levels/collegiate/article/carbon-cycle/20247, Accessed on: may 08, 2018.

[9] Wikimedia Commons, "File:Carbon cycle-cute diagram.jpeg", 2006. [Elec-

tronic image]. Available: https://commons.wikimedia.org/wiki/File:Carbon_cycle-cute_diagram.jpeg, Accessed on: May 12, 2018.

[10] Encyclopædia Britannica, "Biosphere," 2018. [Online]. Available: https://academic.eb.com/levels/collegiate/article/biosphere/117266#, Accessed on: May 08. 2018.

[11] Intergovernmental Panel on Climate Change, "IPCC Fourth Assessment Report: Climate Change 2007: Appendix 1. Glossary E-O.," 2007. [Online]. Available: https://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-e-o.html, Accessed on: May 08, 2018.

[12] UN Environment, "Mitigation," 2018. [Online]. Available: https://www.unenvironment.org/explore-topics/climate-change/what-we-do/mitigation, Accessed on: May 08, 2018.

[13] Intergovernmental Panel on Climate Change, "IPCC Fourth Assessment Report: Climate Change 2007: Appendix 1. Glossary A-D.," 2007. [Online]. Available: https://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessglossary-a-d.html, Accessed on: May 08, 2018.

[14] European Commission, "Adaptation to climate change," 2018. [Online]. Available: https://ec.europa.eu/clima/policies/adaptation_en#tab-0-2, Accessed on: may 08, 2018.

[15] Redd desk, "Agriculture, Forestry and Other lans Uses," N/A. [Online]. Available: https://theredddesk.org/encyclopaedia/agriculture-forestry-and-other-land-uses, Accessed on: May 07, 2018.

[16] P. Smith et al., "2014: Agriculture, Forestry and Other Land Use (AFOLU)". In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, et al.]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

[17] United Nations Framework Convention on Climate Change, "Land Use, Land-Use Change and Forestry (LULUCF)," N/A. [Online]. Available: https://unfccc.int/topics/land-use/workstreams/land-use--land-use-change-and-forestry-lulucf, Accessed on: May 08, 2018.

[18] H. Wiggering et al., "Indicators for multifunctional land use—Linking socio-economic requirements with landscape potentials," Ecological Indicators, vol. 6, no. 1, pp. 238-249, January 2006. doi: https://doi.org/10.1016/j.ecolind.2005.08.014, [Online]. Available: Science Direct, https://www.sciencedirect.com/science/article/pii/S1470160X05000786, Accessed on: May 08, 2018.

[19] United Nations REDD Programme, "What is REDD+?," 2016. [Online]. Available: http://www.unredd.net/about/what-is-redd-plus.html, Accessed on: May 08, 2018.

[20] Redd desk, "What is REDD/REDD+?," 2016. [Online]. Available: https://theredddesk.org/what-redd#toc-2, Accessed on: May 07, 2018.

[21] United Nations REDD Programme, "Partner Countries," N/A. [Online]. Available: http://www.un-redd.org/partner-countries, Accessed on: May 07, 2018.

[22] United Nations REDD Programme, "Our Donors," N/A. [Online]. Available: http://www.un-redd.org/donors, Accessed on: May 13, 2018.

[23] United Nations Framework Convention on Climate Change, 2018 [Online]. *What is the CDM*. Retreived from https://cdm.unfccc.int/about/index.html. Accessed on 2018-05-03.

[24] United Nations Framework Convention on Climate Change, "Kyoto Protocol," 2014. [Online]. Available: http://unfccc.int/kyoto_protocol/items/2830.php, Accessed on: May 08, 2018.

[25] United Nations Framework Convention on Climate Change, "CDM: Project search," 2018. [Online]. Available: http://cdm.unfccc.int/Projects/projsearch.html, Accessed on: May 08, 2018.

3 Bolivia

[26] Collaborative encyclopedia in the Cuban network, "Departamento de Potosí," N/A. [Online]. Available: https://www.ecured.cu/Departamento_de_Potos%C3%AD, Accessed on: May 07, 2018.

[27] P. J. McFarren, C. W. Arnande, "Bolivia," in Encyclopaedia Britannica. [Online]. Available: https://www.britannica.com/place/Bolivia, Accessed on: May 03, 2018.

[28] World Bank, "The World Bank in Bolivia," 2018. [Online]. Available: http://www.worldbank.org/en/country/bolivia/overview#1, Accessed on: May 03, 2018.

[29] The Government of Bolivia, "Contribustion Prevista Determinada Nacionalmente del Estado Plurinacional de Bolivia," 2016. [Online]. Available: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Bolivia%20(Plurinational%20State%20of)%20First/ESTADO%20PLURINACIONAL%20DE%20BOLIVIA1.pdf, Accessed on: May 08, 2018.

[30] Food and Agriculture Organization of the United Nations, "Bolivia (Plurina-

tional State of)," N/A. [Online]. Available: http://www.fao.org/faostat/en/#country/19, Accessed on: May 03, 2018.

[31] M. Peperkamp, "Fact-finding Agro-Food Bolivia - With a special focus on the Santa Cruz region," Netherlands Enterprise Agency, The Hague, Netherlands, RVO-051-1701/RP-INT, 2017.

[32] G. W. Roth, "Crop Rotations and Conservation Tillage," The Pennsylvania State University, Pennsylvania, PA, USA N/A, N/A. [Online]. Available: https://extension.psu.edu/crop-rotations-and-conservation-tillage, Accessed on: May 08, 2018.

[33] Cámara Forestal de Bolivia, "Santa Cruz es el departamento de Bolivia con mayor superficie deforestada," 2017. [Online]. Available: https://www.cfb.org.bo/noticias/medioambiente/santa-cruz-es-el-departamento-de-bolivia-con-mayor-superficie-deforestada, Accessed on: May 03, 2018.

[34] Forest Legality Initiative, "Bolivia," 2014. [Online]. Available: https://forestlegality.org/risk-tool/country/bolivia, Accessed on: May 03, 2018.

[35] A. Zegada, "Inundacioned y sequías son causadas por la deforestación," *El País*, Feb 21, 2016. [Online]. Available: https://cedib.org/post_type_titulares/inundaciones-y-sequias-son-causadas-por-la-deforestacion-el-pais-21-2-16/, Accessed on: May 03, 2018.

[36] World Resources Institute, "CAIT Climate Data Explorer," 2015. [Online]. Available: http://cait.wri.org/historical/Country%20GHG%20Emissions?indicator%5b%5d=Total%20GHG%20Emissions%20Excluding%20Land-Use%20Change%20and%20Forestry&indicator%5b%5d=Total%20GHG%20Emissions%20Including%20Land-Use%20Change%20and%20Forestry&year%5b%5d=2014&country%5b%5d=Bolivia&sortIdx=1&sortDir=desc&chartType=bars, Accessed on: May 03, 2018.

[37] Ley 071. Ley de Derechos de la Madre Tierra. [Online]. Available: https://bolivia.infoleyes.com/norma/2689/ley-de-derechos-de-la-madre-tierra-071, Accessed on: May 13. 2018.

[38] Ley 300. Ley Marco de la Madre Tierra y Desarollo Integral para Vivir Bien. [Online]. Available: http://www.fao.org/fileadmin/user_upload/FAO-countries/Bolivia/docs/Ley_300.pdf, Accessed on: May 13. 2018.

[39] United Nations REDD Programme, "Overwiew of National Programmes," N/A. [Online]. Available: http://www.unredd.net/support/

support-mechanisms/national-programmes.html, Accessed on: May 03, 2018.

[40] J. Kuper, "REDD in Bolivia," N/A. [Online]. Available: https://theredddesk.org/countries/bolivia, Accessed on: May 03, 2018.

[41] Ministry of Foreign Affairs, Ministry of Environment and Water, Vice ministry of Environment, Biodiversity, Climate Change and Forest, Management and Development, "Joint Mitigation and Adaptation Mechanism for the Comprehensive and Sustainable Management of Forest and the Mother Earth," Ministry of Foreign Affairs, Ministry of Environment and Water, Vice ministry of Environment, Biodiversity, Climate Change and Forest, Management and Development, La Paz, Bolivia, N/A 2012. [Online]. Available: http://www.redd-monitor.org/wp-content/uploads/2012/10/JOINT-MITIGATION-2.pdf, Accessed on: May 03, 2018.

[42] Global Environment Facility, "GEF Assistance to Address Adaptation," Global Environment Facility, N/A, N/A, GEF/C.23/Inf.8/Rev.1, 2004. [Online]. Available: https://www.thegef.org/sites/default/files/council-meeting-documents/C.23.Inf_.8.Rev_.1_Adaptation_Council_paper_FINAL_5.pdf, Accessed on May 03, 2018.

[43] United Nations Development Programme, "Community.Based Adaptation Project," N/A. [Online]. Available: http://www.adaptation-undp.org/projects/spa-community-based-adaptation-project, Accessed on: May 03, 2018.

[44] United Nations Development Programme, "CBA Bolivia: Water Source Protection and Soil Conservation through Reforestation in Batallas," N/A. [Online]. Available: http://www.adaptation-undp.org/projects/spa-cba-bolivia-water-source-protection-and-soil-conservation-through-reforest Accessed on: May 03, 2018.

[45] United Nations Development Programme, "GEF SPA CBA Country Programme Report (2008-2012)-Bolivia," N/A. [Online]. Available: http://www.adaptation-undp.org/resources/annual-reports/gef-spa-cba-country-programme-report-2008-2012-bolivia, Accessed on: may 03, 2018.

[46] United Nations Development Programme, "CBA Bolivia: Participatory Adaptation Learning to Reduce Food Insecurity in Ancorimes (Plan Int'l)," N/A. [Online]. Available: http://www.adaptation-undp.org/projects/spa-cba-bolivia-participatory-adaptation-learning-reduce-food-insecurity-ancor Accessed on: May 03, 2018.

[47] United Nations Development Programme, "CBA Bolivia: Sustainable Management of the Cherimoya Crop for Climate Change Adaptation in Saipina (FAN)," N/A. [On-

line]. Available: http://www.adaptation-undp.org/projects/spa-cba-bolivia-sustainable-management-cherimoya-crop-climate-change-adaptatio Accessed on: May 03, 2018.

[48] United Nations Development Programme, "CBA Bolivia: Knowledge and Tools for Sustainable Management of Water and Soils in Moro Moro (Natura)," N/A. [Online]. Available: http://www.adaptation-undp.org/projects/spa-cba-bolivia-knowledge-and-tools-sustainable-management-water-and-soils-mo Accessed on: May 03, 2018.

[49] United Nations Development Programme, "CBA Bolivia: Rural Water and Climate Risk Management in the Alto Seco Area (ICO)," N/A. [Online]. Available: http://www.adaptation-undp.org/projects/spa-cba-bolivia-rural-water-and-climate-risk-management-alto-seco-area-ico, Accessed on: May 03, 2018.

[50] United Nations Development Programme, "CBA Bolivia: Recovery of Tarwi Seeds for Adaptation in the Carabuco Municipality near Lake Titicaca (CUNA Association)," N/A. [Online]. Available: http://www.adaptation-undp.org/projects/spa-cba-bolivia-recovery-tarwi-seeds-adaptation-carabuco-municipality-near-la Accessed on: May 03, 2018.

[51] P.L. Ibisch, "Access and benefit-sharing regulations in Bolivia: consequences for research and biodiversity conservation," 2005. [Online]. Available: http://www.bsi.org/bsi_info/conservation/ABS_Regulations_Bolivia.pdf, Accessed on: May 13, 2018.

4 Brazil

[52] L. Martins, P. E. James, R. M. Schneider, E. B. Burns, R. P. Momsen, R. E. Poppino, "Brazil," in Encyclopaedia Britannica. Britannica Academic, Chicago, IL, USA: Encyclopædia Britannica Inc., 2018. [Online]. Available: https://www.britannica.com/place/Brazil, Accessed on: May 08, 2018.

[53] E. L. La Rovere, C. B. S, Dubeux, C. M. Walter, A. M. R. Méndes and I. F. Zicarelli, "Cenário de Emissão de GEE – 2050: Setor de Agricultura, Floresta e Outros Usos da Terra - Relatório Técnico," CENTRO CLIMA/-COPPE/UFRJ, Rio de Janeiro, Brazil, 2016. [Online]. Available: http://www.centroclima.coppe.ufrj.br/images/documentos/ies-brasil-2050/2_-_Cenario_de_Emiss%C3%B5es_de_GEE_-_Setor_de_Agricultura_Floresta_e_Outros_Usos_da_Terra_-_IES_Brasil_2050.pdf, Accessed on: May 08, 2018.

[54] Food and Agriculture Organisation of the United Nations, "FAOSTAT Brazil", 2018. [Online]. Available: http://www.fao.org/faostat/en/#country/21,

Accessed on: May 08, 2018.

[55] United Nations Framework Convention on Climate Change, Bonn, Germany, "Greenhouse Gas Inventory Data - Detailed data by Party," 2018. [Online]. Available: http://di.unfccc.int/detailed_data_by_party, Accessed on: May 08, 2018.

[56] M. M. C. Bustamante, C. A. Nobre, R. Smeraldi, A. P. D. Aguiar, L. G. Barioni, L. G. Ferreira, K. Longo, P. May, A. S. Pinto, J. P. H. B. Ometto, "Estimating greenhouse gas emissions from cattle raising in Brazil," Springer Science+Business Media, Berlin/Heidelberg, Germany. 2012. doi: 10.1007/s10584-012-0443-3, [Online]. Available: https://www.researchgate.net/profile/Peter_May10/publication/235704269_Estimating_greenhouse_gas_emissions_from_cattle_raising_in_Brazil/links/55f6202208ae63926cf4fa97/Estimating-greenhouse-gas-emissions-from-cattle-raising-in-Brazil.pdf?origin=publication_detail, Accessed on: May 08, 2018.

[57] Federal government of Brazil, Brasilia, Brazil, "Federative Republic Of Brazil Intended Nationally Determined Contribution: Towards Achieving The Objective Of The United Nations Framework Convention On Climate Change," 2015. [Online]. Available: http://www4.unfccc.int/submissions/INDC/Published%20Documents/Brazil/1/BRAZIL%20iNDC%20english%20FINAL.pdf, Accessed on: May, 2018.

[58] Ministério da Agricultura - Pecuária e Abastecimento, Brasilia, Brazil, "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)," 2012. [Online]. Available: http://www.agricultura.gov.br/assuntos/sustentabilidade/plano-abc/arquivo-publicacoes-plano-abc/download.pdf, Accessed on: May 08, 2018.

[59] Ministry of Environment, Brasilia, Brazil, "National Adaptation Plan to Climate Change Volume II: Sectoral and Thematic Strategies," 2016. [Online] Available: http://www4.unfccc.int/nap/Documents%20NAP/English_PNA_Part2%20v4.pdf, Accessed on: May 08, 2018.

[60] B. Soares-Filho, R. Rajão, M. Macedo, A. Carneiro, W. Costa, M. Coe, H. Rodrigues, A. Alencar, "Cracking Brazil's Forest Code," Science Magazine, 2014. [Online]. Available: http://science.sciencemag.org/content/sci/344/6182/363.full.pdf, Accessed on: May 08, 2018.

[61] World Wide Fund for Nature, "Brazil's new Forest Code: A guide for decision-makers in supply chains and governments", Brasilia, Brazil, 2016. [Online]. Available: http://assets.wwf.org.uk/downloads/wwf_brazils_new_forest_code_guide_1.pdf?_ga=2.28030393.42718366.

1523954145-1573158724.1523954145 Accessed on: May 08, 2018.

[62] PoundSterlingLive, Wokingham, England, "Historical Rates for the USD/BRL currency conversion on 31 December 2015 (31/12/2015)," 2016. [Online]. Available: https://www.poundsterlinglive.com/best-exchange-rates/us-dollar-to-brazilian-real-exchange-rate-on-2015-12-31, Accessed on: May 08, 2018.

[63] B. McLoughlin, "Brazil goes green," Petrolium Economist, 2017. [Online] Available: http://www.petroleum-economist.com/articles/low-carbon-energy/renewables/2017/brazil-goes-green, Accessed on: May 08, 2018

[64] F.R. Marin, G. B. Martha, G. K. Cassman, P. Grassini, "Prospects for Increasing Sugarcane and Bioethanol Production on Existing Crop Area in Brazil," BioScience, Volume 66, Issue 4, 1 April 2016. [Online]. Available: https://academic.oup.com/bioscience/article/66/4/307/2464026, Accessed on: May 08, 2018.

[65] The World Bank, "Brazil's INDC Restoration and Reforestation Target," Washington, DC, USA, 2017. [Online] Available: https://openknowledge.worldbank.org/bitstream/handle/10986/28588/AUS19554-WP-P159184-PUBLIC-Brazils-INDC-Restoration-and-Reforestation-Target.pdf?sequence=1&isAllowed=y, Accessed on: May 08, 2018.

[66] M. den Elzen, A. Admiraal, M. Roelfsema, H. van Soest, A. F. Hof, and N. Forsell, "Contribution of the G20 economies to the global impact of the Paris agreement climate proposals," Climatic Change, vol. 137, no. 3-4, pp. 655–665, August 2016. doi: https://doi.org/10.1007/s10584-016-1700-7, [Online]. Available: SpringerLink, https://link.springer.com/article/10.1007%2Fs10584-016-1700-7, Accessed on: May 11, 2018.

[67] E. L. La Rovere, W. Wills, C. B. S. Dubeux; D. F. Oberling, C. Grottera, A. O. Pereira Jr., C. Gesteira; S. H. F. da Cunha; M. W. de Abreu, F. C. B. dos Santos, G. Castro, T. Santos., "Emissões totais consolidadas (GgCO2e) - IES Brasil 2050," CENTRO CLIMA/COPPE/UFRJ, Rio de Janeiro, Brazil, 2016. [Online]. Available: http://www.centroclima.coppe.ufrj.br/images/documentos/ies-brasil-2050/11_-_Emiss%C3%B5es_totais_consolidadas_GgCO2e_-_IES_Brasil_2050.xlsx, Accessed on: May 08, 2018.

[68] Climate Action Tracker, [N/A], "Brazil," 2018. [Online] Available: http://climateactiontracker.org/countries/brazil/ Accessed on: May 08, 2018.

5 Burkina Faso

[69] H. J. Deschamps, J. Dresch, P. H. Guiguemde, M. Echenberg, “Burkina Faso,” in *Encyclopaedia Britannica. Britannica Academic*, Chicago, IL, USA: Encyclopædia Britannica Inc., 2018. [Online]. Available: https://academic.eb.com/levels/collegiate/article/Burkina-Faso/110768, Accessed on: May 08, 2018.

[70] The Food and Agriculture Organization of the United Nations, Rome, Italy, “FAOSTAT Burkina Faso,” 2018. [Online]. Available: http://www.fao.org/faostat/en/#country/233, Accessed on: May 08, 2018.

[71] The World Bank, Washington, D.C., "CO2 emissions (metric tons per capita)" (2018). .” 2018. [Online]. Available: https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=BF-1W, Accessed on: May 09, 2018.

[72] United Nations Development Programme New York, NY,USA, “Burkina Faso,” N/A. [Online]. Available: http://adaptation-undp.org/explore/western-africa/burkina-faso, Accessed on: May 09, 2018.

[73] Comité Permanent Inter-états de Lutte contre la Sécheresse dans le Sahel (CILSS), *Landscapes of West Africa – A Window on a Changing World*, Garretson, SD, UNITED STATES: Geological Survey EROS, 2016. [Online]. Available: https://eros.usgs.gov/westafrica/sites/default/files/ebook-English/index.html#p=1Accessed on: May 08, 2018.

[74] The Food and Agriculture Organization of the United Nations, Rome, Italy, “Burkina Faso,” 2018. [Online]. Available: http://www.fao.org/countryprofiles/index/en/?iso3=BFA, Accessed on: May 08, 2018.

[75] World Resource Institute, Washington, D.C., "CAIT Climate Data Explorer," 2015. [Online]. Available: http://cait.wri.org/historical/Country%20GHG%20Emissions?indicator[]=Total%20GHG%20Emissions%20Excluding%20Land-Use%20Change%20and%20Forestry&indicator[]=Total%20GHG%20Emissions%20Including%20Land-Use%20Change%20and%20Forestry&indicator[]=Land-Use%20Change%20and%20Forestry&indicator[]=Agriculture&indicator[]=Energy&indicator[]=Waste&indicator[]=Industrial%20Processes&indicator[]=Bunker%20Fuels&year[]=1990&year[]=1991&year[]=1992&year[]=1993&year[]=1994&year[]=1995&year[]=1996&year[]=1997&year[]=1998&year[]=1999&year[]=2000&year[]=2001&year[]=2002&year[]=2003&year[]=2004&year[]=2005&year[]=2006&year[]=2007&year[]=2008&year[]=2009&year[]=2010&year[]=2011&year[]=2012&year[]=2013&year[]=2014&country[]=Burkina%20Faso&sortIdx=NaN&sortDir=desc&chartType=geo, Accessed on: May 08, 2018.

[76] Government of Burkina Faso, Ouagadougou, Burkina Faso,"Intended Na-

tionally Determined Contribution (INDC) in Burkina Faso" 2015. [Online]. Available: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Burkina%20Faso%20First/INDC%20Burkina_ENG.%20version_finale.pdf, Accessed on: May 08, 2018.

[77] Government of Burkina Faso, Ouagadougou, Burkina Faso, "Burkina Faso National Climate Change Adaptation Plan (NAP), 2015. [Online]. Available: http://www4.unfccc.int/nap/Documents/Parties/PNA_Version_version%20finale[Transmission].pdf, Accessed on: May 12, 2018.

[78] Climate Investment Funds, "Sustainable forests" 2018. [Online]. Available: http://www.climateinvestmentfunds.org/topics/sustainable-forests, Accessed on: May 12, 2018.

[79] Climate Investment Funds, "Burkina Faso," 2018. [Online]. Available: http://www.climateinvestmentfunds.org/country/burkina-faso, Accessed on: May 1, 2018.

[80] The World Bank, " Carbon Credits Serve up Clean Cooking Options for West African Farmers " Washington, DC, USA, 2018. [Online] Available: http://www.worldbank.org/en/news/feature/2018/03/06/carbon-credits-serve-up-clean-cooking-options-for-west-african-farmers, Accessed on: May 08, 2018.

[81] United Nations Framework Convention on Climate Change, "CDM: CPA 9977-0001 : National Biodigester Programme Burkina Faso – CPA01", 2018. [Online]. Available: https://cdm.unfccc.int/ProgrammeOfActivities/cpa_db/OZDCSWJ4N0L6HVEU579MYR3XQGK21T/view, Accessed on: May 14, 2018.

[82] Partnership on Transparency in Paris Agreement, "Burkina Faso Biomass Energy NAMA" 2018. [Online]. Available: https://www.transparency-partnership.net/sites/default/files/ws15223_burkina_faso_gpa2015_en_long-03.pdf, Accessed on: May 12, 2018.

[83] SNV, The Hague, The Netherlands, "Improved cookstoves value chain development for dolo production," 2018. [Online]. Available: http://www.snv.org/project/improved-cookstoves-value-chain-development-dolo-production, Accessed on: May 14, 2018.

[84] The Livelihoods funds, "BURKINA FASO: fighting desertification increasing food security with 30,000 families" 2018. [Online]. Available: http://www.livelihoods.eu/projects/tiipaalga/, Accessed on: May 12, 2018.

6 Guyana

[85] J. K. Menke, B. C. Richardson, "Guyana", in *Encyclopædia Britannica. Britannica Academic*, Chicago, IL, USA: Encyclopædia Britannica inc., 2018. [Online]. Available: https://www.britannica.com/place/Guyana, Accessed on: May 05, 2018.

[86] The World Bank, Washington D.C., USA, "Forest area (% of land area)", 2018. [Online]. Available: https://data.worldbank.org/indicator/AG.LND.FRST.ZS, Accessed on: May 08, 2018.

[87] Indufor and the Guyana Forestry Commission, "Guyana REDD+ Monitoring Reporting Verification System (MRVS): Year 4 Interim Measures Report 1 January 2013 -– 31 December 2013", 2015. [Online]. Available: http://www.forestry.gov.gy/wp-content/uploads/2015/09/MRVS-Interim-Measures-Report-Year-4-V3.pdf, Accessed on: May 08, 2018.

[88] Food and Agriculture Organization of the United Nations, "FAOSTAT Guyana", 2017. [Online]. Available: http://www.fao.org/faostat/en/#country/91, Accessed on: May 08, 2018.

[89] Government of Guyana, Georgetown, "Guyana's Revised Intended Nationally Determined Contribution", 2016. [Online]. Available: http://www4.unfccc.int/ndcregistry/PublishedDocuments/Guyana%20First/Guyana%27s%20revised%20NDC%20-%20Final.pdf, Accessed on: Apr 12, 2018.

[90] Guyana Bureau of Statistics, Georgetown, Guyana, "Trade and Prices Department: Exports by Item (Including Re-Exports)", 2017. [Online]. Available: http://www.statisticsguyana.gov.gy/trade.html#partners1, Accessed on: Apr 17, 2018.

[91] World Resources Institute, Washington D.C., "CAIT Climate Data Explorer: Historical Emissions", 2018. [Online]. Available: http://cait.wri.org/historical/Country%20GHG%20Emissions?indicator[]=Total%20GHG%20Emissions%20Excluding%20Land-Use%20Change%20and%20Forestry&indicator[]=Total%20GHG%20Emissions%20Including%20Land-Use%20Change%20and%20Forestry&year[]=1990&year[]=1991&year[]=1992&year[]=1993&year[]=1994&year[]=1995&year[]=1996&year[]=1997&year[]=1998&year[]=1999&year[]=2000&year[]=2001&year[]=2002&year[]=2003&year[]=2004&year[]=2005&year[]=2006&year[]=2007&year[]=2008&year[]=2009&year[]=2010&year[]=2011&year[]=2012&year[]=2013&year[]=2014&country[]=Guyana&sortIdx=NaN&chartType=geo, Accessed on: May 08, 2018.

[92] World Resources Institute, Washington D.C., "CAIT Climate Data Explorer:

CAIT - Frequently Asked Questions", 2018. [Online]. Available: http://cait.wri.org/faq.html, Accessed on: May 12, 2018.

[93] Guyana Forestry Commision, Georgetown, Guyana, "Guyana REDD+ Monitoring Reporting Verification System (MRVS): Year 6 Interim Measures Report 1 January 2015 to 31 December 2016", 2017. [Online]. Available: http://www.forestry.gov.gy/wp-content/uploads/2017/12/MRVS-Interim-Measures-Report-Year-6-Version-1.pdf, Accessed on: May 13, 2018.

[94] European Forest Institute, "What is FLEGT?," 2018. [Online]. Available: http://www.euflegt.efi.int/what-is-flegt, Accessed on: May 02, 2018.

[95] Government of Guyana, Georgetown, "The Reference Level for Guyana's REDD+ Program," 2014. [Online]. Available: http://redd.unfccc.int/files/guyana_proposal_for_reference_level_for_redd_.pdf, Accessed on: May 03, 2018.

[96] Ministry of the Presidency of Guyana, Georgetown, "Draft for Consultation: Climate Resilience Strategy and Action Plan for Guyana," 2015. [Online]. Available: https://www.lcds.gov.gy/index.php/documents/reports/national/self-assessment-and-action-plan/262-climate-resilience-strategy-and-action-plan-for-guyana/file, Accessed on: April 24, 2018.

[97] A. Angelsen, "REDD+ as Result-based Aid: General Lessons and Bilateral Agreements of Norway", *Review of Development Economics*, vol. 21, issue 2, pp. 237-264, June 2016. doi: 10.1111/rode.12271, [Online]. Available: https://onlinelibrary.wiley.com/doi/full/10.1111/rode.12271, Accessed on: May 08, 2018.

[98] S. Henders, M. Ostwald, "In the aftermath of a REDD+ bilateral agreement", 2011. Focali Brief No 2011:01, Gothenburg. [Online]. Available: http://www.focali.se/en/articles/artikelarkiv/brief-in-the-aftermath-of-a-redd-bilateral-agreement, Accessed on: May 11, 2018.

[99] Office of the President, Republic of Guyana, Georgetown, Guyana, "Saving the World's Forests Today: Creating Incentives to Avoid Deforestation," 2008. [Online]. Available: https://theredddesk.org/sites/default/files/resources/pdf/2011/booklet_on_avoided_deforestationf.pdf, Accessed on: May 08, 2018.

[100] Office of the President, Republic of Guyana, Georgetown, Gyuana, "Low Carbon Development Update: Transforming Guyana's Economy While Combating Climate Change," 2013. [Online]. Available: https://www.lcds.gov.gy/index.php/the-lcds/207-low-carbon-development-strategy-update-march-2013/file,

Accessed on: March 30, 2018.

[101] Ministry of Agriculture of Guyana, Georgetown, "A National Strategy for Agriculture in Guyana 2013 – 2020," 2013. [Online]. Available: https://caricom.org/documents/11264-moa_agriculture_strategy_2013-2020_-_cd.pdf, Accessed on: February 28, 2018.

7 India

[102] The World Bank, Washington, D.C., "Population, total," 2018. [Online]. Available: https://data.worldbank.org/indicator/SP.POP.TOTL?end=2010&locations=IN&start=1994&view=chart&year_high_desc=false, Accessed on: May 08, 2018.

[103] European Commission, "CO2 time series 1990-2015 per region/country," 2017. [Online]. Available: http://edgar.jrc.ec.europa.eu/overview.php?v=CO2ts1990-2015&sort=des9, Accessed on: May 08, 2018.

[104] A. L. Srivastava et al., "India," in Encyclopaedia Britannica. Britannica Academic, Chicago, IL, USA: Encyclopædia Britannica Inc., 2017. [Online]. Available: https://academic.eb.com/levels/collegiate/article/India/111197, Accessed on: May 08, 2018.

[105] Government of India, New Delhi, India, "INDIA'S INTENDED NATIONALLY DETERMINED CONTRIBUTION: WORKING TOWARDS CLIMATE JUSTICE," 2015. [Online]. Available: http://www4.unfccc.int/ndcregistry/PublishedDocuments/India%20First/INDIA%20INDC%20TO%20UNFCCC.pdf, Accessed on: May 08, 2018.

[106] Food and Agriculture Organisation of the United Nations, "FAOSTAT India," 2018. [Online]. Available: http://www.fao.org/faostat/en/#country/100, Accessed on: May 08, 2018.

[107] Forest Survey of India, Ministry of Environment & Forests, Dehradun, India, "India State of Forest Report 2017, Carbon Stock in India's Forests," 2017. [Online]. Available: http://fsi.nic.in/isfr2017/isfr-carbon-stock-in-india-forest-2017.pdf, Accessed on: May 08, 2018.

[108] World Development Indicators database, "India," 2018. [Online]. Available: http://databank.worldbank.org/data/Views/Reports/ReportWidgetCustom.aspx?Report_Name=CountryProfile&Id=b450fd57&tbar=y&dd=y&inf=n&zm=n&country=IND, Accessed on: May 08, 2018.

[109] World Resource Institute, Washington, D.C., "CAIT Climate Data Explorer," 2015. [Online]. Available: http://cait.wri.org/historical/Country%

20GHG%20Emissions?indicator[]=Energy&indicator[]=Industrial%20Processes&indicator[]=Agriculture&indicator[]=Waste&indicator[]=Land-Use%20Change%20and%20Forestry&indicator[]=Bunker%20Fuels&year[]=1990&year[]=1991&year[]=1992&year[]=1993&year[]=1994&year[]=1995&year[]=1996&year[]=1997&year[]=1998&year[]=1999&year[]=2000&year[]=2001&year[]=2002&year[]=2003&year[]=2004&year[]=2005&year[]=2006&year[]=2007&year[]=2008&year[]=2009&year[]=2010&year[]=2011&year[]=2012&year[]=2013&year[]=2014&country[]=India&sortIdx=NaN&chartType=pie, Accessed on: May 08, 2018.

[110] N. Ravindranath, and I. Murthy, "Greening India Mission," Current Science, vol. 99, no. 4, pp. 444-449, August 2010. http://www.jstor.org/stable/24109567 [Online]. Available: http://www.currentscience.ac.in/php/toc.php?vol=099&issue=04, Accessed on: May 08, 2018.

[111] Government of India, Ministry of Environment & Forests, Deharadun, India, "Environmental Policy 2006," 2006. [Online]. Available: http://envfor.nic.in/sites/default/files/annual_report/nep2006e.pdf, Accessed on: May 08, 2018.

[112] Government of India, New Delhi, India, "Constitution of India (Full text), Parts I to XXII," 2015. [Online]. Available: https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text, Accessed on: May 08, 2018.

[113] P. Patra, "Joint Forest Management in India," Spatial Diversity and Dynamics in Resources and Urban Development, vol. 1, pp. 449-460, 2015. doi: https://doi.org/10.1007/978-94-017-9771-9_24, [Online]. Available: SpringerLink, https://link.springer.com/chapter/10.1007%2F978-94-017-9771-9_24#citeas, Accessed on: May 08, 2018.

[114] Government of India, New Delhi, India, "National Action Plan on Climate Change,", 2008. [Online]. Available: http://www.moef.nic.in/downloads/home/Pg01-52.pdf. Accessed on: May 08, 2018.

[115] Prof. N. Ravindranath, private communication, May 2018.

[116] Government of India, Department of Agriculture & Cooperation, Ministry of Agriculture, New Delhi, India, "National Agroforestry Policy," 2014. [Online]. Available: http://www.indiaenvironmentportal.org.in/files/file/Agroforestry%20policy%202014.pdf, Accessed on: May 08, 2018.

[117] M. K. Behera, "REDD+ in India: Achievements and Way Forward," Climate Change and Environmental Sustainability, vol. 4, no. 1, pp. 85-88, April 2016. doi: 10.5958/2320-642X.2016.00011.9, [Online]. Available: ResearchGate, https://www.researchgate.net/publication/301598032_REDD_in_India_Achievements_and_Way_Forward, Accessed on: May 08, 2018.

[118] P. R. Shukla, S. Mittal, JY. Liu, S. Fujimori, H. Dai, and R. Zhang, "India INDC Assessment: Emission Gap Between Pledged Target and 2 °C Target," Post-2020 Climate Action, pp. 113-124, 2017. doi: https://doi.org/10.1007/978-981-10-3869-3_7, [Online]. Available: SpringerLink, https://link.springer.com/chapter/10.1007%2F978-981-10-3869-3_7, Accessed on: May 08, 2018.

[119] A. Aggarwal, "Implementation of Forest Rights Act, changing forest landscape, and "politics of REDD+" in India," Journal of Resources, Energy, and Development, vol. 8, no. 2, pp. 131–148, 2011. doi: 10.3233/RED-120089, [Online]. Available: IOS Press Content Library, https://content.iospress.com/articles/journal-of-resources-energy-and-development/red120089, Accessed on: May 10, 2018.

[120] PoundSterlingLive, Wokingham, England, "Historical Rates for the USD/BRL currency conversion on 1 October 2012 (01/10/2012)," 2016. [Online]. Available: https://www.poundsterlinglive.com/best-exchange-rates/us-dollar-to-indian-rupee-exchange-rate-on-2013-01-01, Accessed on: May 13, 2018.

[121] Planning Commission, Government of India, New Delhi, India, "Twelfth Five Year Plan (2012–2017). Faster, More Inclusive and Sustainable Growth. Volume I," pp. 220, 2013. [Online]. Available: http://planningcommission.nic.in/plans/planrel/fiveyr/12th/pdf/12fyp_vol1.pdf, Accessed on: May 08, 2018.

[122] PoundSterlingLive, Wokingham, England, "Historical Rates for the USD/BRL currency conversion on 13 February 2018 (13/02/2018)," 2016. [Online]. Available: https://www.poundsterlinglive.com/best-exchange-rates/us-dollar-to-indian-rupee-exchange-rate-on-2018-02-13, Accessed on: May 13, 2018.

[123] Press Information Bureau, Government of India, Ministry of Environment, Forest and Climate Change, New Delhi, India, ""Government remains committed to afforestation and increase green cover": Dr. Harsh Vardhan," 2018. [Online]. Available: http://pib.nic.in/newsite/PrintRelease.aspx?relid=176539, Accessed on: May 10, 2018

[124] R. Mathur, and M. K. Shrivastava, "INDC and Low-Carbon Technology Deployment Scenarios: India," 2017. [Online]. Available: https://doi.org/10.1007/978-981-10-4901-9_3, Accessed on: may 08, 2018.

[125] Climate Action Tracker, "India: Rating," 2017. [Online]. Available: http://climateactiontracker.org/countries/india.html, Accessed on: May 08, 2018.

8 Conclusion

[126] Climate Action Tracker, [N/A], "About," 2018. [Online] Available: https://climateactiontracker.org/about/ Accessed on: May 12, 2018.

Appendices

A Results from implementation of the NDC in Bolivia

From [29]: In relation to forests and agriculture, actions will be promoted with a focus on joint mitigation and adaptation to climate change and holistic development, achieving the following results:

- *Zero illegal deforestation by 2020*
- *Increased the surface of forested and reforested areas to 4.5 million hectares by 2030.*
- *Increased forest areas with integrated and sustainable community management approaches with 16.9 million hectares in 2030, in reference to 3.1 million hectares by 2010.*
- *Strengthened environmental functions (carbon capture and storage, organic matter and soil fertility, biodiversity conservation and water availability) in about 29 million hectares by 2030.*
- *Contribution to Gross Domestic Product (GDP) growth of 5.4% in 2030, boosted by agricultural and forestry production complementary to conservation.*
- *Reducing extreme poverty to zero in the population dependent on forests by 2030, based on approximately 350 thousand people by 2010.*
- *Increase net forest cover more than 54 million hectares by 2030, compared to the 52.5 million of 2010.*
- *Contributing to an increase in Gross Domestic Product (GDP) of 5.4% in 2030, furthered by agricultural and forestry production, complementing conservation efforts.*
- *Extreme poverty has been reduced to zero within the population that depends on forests by 2030 from approximately 350 thousand people in 2010.*
- *Net forest coverage has increased in 2030 to more than 54 million hectares compared to the 52.5 million in 2010.*
- *Joint mitigation and adaptation capacity has increased in areas covered by forests, agricultural and forestry systems from 0.35 units in 2010 to 0.78 in 2030, as measured by the Index of Sustainable Forest Life, achieving productivity and 10 conservation systems that are both complementary and resilient.*

B The contributions mentioned in Bolivia's NDC related to the AFOLU sector

Following are the 22 contributions to the AFOLU sector, to be made with national efforts. From [29]:

1. *Resilience being achieved through the strengthening of environmental functions and the productive capacities of agricultural and agroforestry systems.*

2. *Integrated and sustainable management of forests strengthening through the management of timber and non-timber products in an integrated and sustainable manner.*

3. *Conservation of areas with high environmental functions.*

4. *Restoration and recovery of degraded soils and forests.*

5. *Consolidation and strengthening of regenerative capacities of forests and forest systems.*

6. *Implementation of control, monitoring, and tracking systems for the appropriate use of areas of forest life.*

7. *Actions related to supervision and control for the proper management of forests being achieved.*

8. *Actions pertaining to the proper management of protected areas and forest areas with conservation priority have being achieved.*

9. *Consolidation of agroforestry systems.*

10. *Transition to semi - intensive systems of livestock management and integrated management of agroforestry and silviculture techniques.*

11. *Transition to agricultural systems with sustainable management practices.*

12. *Reduction of vulnerabilities in agricultural, fisheries, and agro-forestry systems of production.*

13. *Sustainable use of biodiversity resources, wildlife and aquatic life for food security and sustainable industrialization.*

14. *Control of illegal deforestation and establishment of systems of control and monitoring of deforestation, fires and forest fires.*

15. *Training in technologies adapted to climate change (local knowledge and modern technologies).*

16. *Actions to reduce the vulnerability of production systems in a climate change scenario.*

17. *Usage of better local adapted varieties of species suited for the climate, and resistant to pests and diseases.*

18. *Measures of agricultural and livestock production insurance to include additional conservation actions, making resilient agricultural and forestry production systems.*

19. *Development of research and information on alternatives for climate change and adaptation technologies.*

20. *Strengthening of local capacities for adaptation to climate change.*

21. *Strengthening community based stewardship in forest management and farming systems.*

22. *Forestation and reforestation, forest plantations, parks and urban forests.*