TROPICAL AGRICULTURAL RESEARCH

AND HIGHER EDUCATION CENTER

Education Division

Graduate School

Climate Change Governance: the case of land-use based emissions MRV systems in Central America and the Dominican Republic

Gracia Andrea Pacheco Figueroa

Thesis submitted to the Graduate School as a requirement to qualify for the degree of Master of Science in Management and Conservation of Tropical Forests and Biodiversity

Turrialba, Costa Rica

2017

This Master's thesis has been accepted in its present form by the Division of Education and the Graduate School Program of CATIE and by the advisory committee of the student, considering that it fills the requirements necessary for the student to present the final defense as well as participate in the final exam.

***MAGISTER SCIENTIAE* IN MANAGEMENT AND CONSERVATION OF TROPICAL FORESTS AND BIODIVERSITY**

SIGNATORIES:

Raffaele Vignola, Ph.D.
Thesis Director

Miguel Cifuentes, Ph.D.
Member of the Advisory Committee

Mario Chacón, M.Sc.
Member of the Advisory Committee

Mario A. Piedra Marín, Ph.D.
Dean of the Graduate School

Gracia Andrea Pacheco Figueroa
Candidate

Acknowledgements

This study has been possible thanks to the support of the United States Agency for International Development (USAID) through the Regional Program for Climate Change. The contents and opinions expressed are not the responsibility of the Regional Program for Climate Change and do not necessarily reflect the opinions of USAID or the United States government. CATIE does not assume the responsibility for the opinions and affirmations expressed by the author. The author's ideas do not necessarily reflect the institution's point of view. The total or partial reproduction of the information in this document is authorized as long as the source is cited.

Thank you to Gaby Alonso, Proyecto Fortalecimiento REDD+ y Cooperación Sur-Sur (CSS), ONUREDD+, as well as Estrategia Mesoamericana de Sustentabilidad Ambiental (EMSA) through Proyecto de Integración y Desarrollo de Mesoamérica, for providing the information and data that jumpstarted this research.

A special thank you to all the people and institutions in all countries who were so willing to sit down, talk to me, and reflect about the state of climate change governance in our countries. This research was carried out with your work in mind, hoping to contribute in some small way to better understand the challenges and potential we all share.

To Raffaele Vignola, for all his guidance, philosophical conversations, academic advice, and more.

To the rest of my advisory committee, Mario Chacón and Miguel Cifuentes, for their time, patience, guidance, and tough questions. This thesis would not be up to shape without them.

To my forestry classmates, "boscosos", for teaching me so much about forests and life, Carolina, Marilyn, Samuel, Luis Pedro, Vanesa, Mario, Nati and Dani: thank you for everything.

To all other classmates, teachers, and peers who provided thoughtful advice for this thesis, thank you for your patience.

To Jorge, not only for his willingness to help with my analysis, but also for all the encouragement and understanding (even if it's only 30%).

To Andrea Paiz, for all her support in the initial process of reviewing literature and transcribing interviews, but also for her sincere friendship.

To Carlos and the Godoy-Liere family for their hospitality in Guatemala.

To Karem and Maleja. Thank you for all the inside jokes, the travelling, the pets, and overall friendship throughout the last two years.

To all of my family, Abuelos Manuel y Lety, from whom I inherited scholarship and persistence, Tita and Alex, who push and inspire me continually to strive higher, and my parents and brothers for their unwavering support throughout the years.

Contents

Acknowledgements iii
Figures v
Tables vi
Acronyms and Abbreviations vii
Abstract viii
Resumen ix
1. Introduction 1
1.1 Antecedents: International context for the MRV mechanism 1
1.2 REDD+ and MRV 3
1.3 Technical complexities of MRV: challenges for developing countries 4
1.4 Governance of MRV 5
1.5 Importance and Justification of the study 7
1.6 Objectives 9
2. Methods 10
2.1 Study area: Monitoring GHG emissions in Central America and the Caribbean 10
2.2 Data Collection and Analysis 13
2.2.1 Data collection 13
3. Results 26
3.1 QCA Results 26
3.2 Governance Performance Results 28
4. Discussion 32
5. Conclusions and Recommendations 35
Bibliography 36
Annex 1: Arguments for indicator prioritization during the variable reduction process 41
Annex 2: QCA Analysis and Results 42
Annex 3: List of Indicators excluded from QCA Analysis 45
Annex 4: Interview protocol 46

Figures

Figure 1: Types of MRV of mitigation (Singh et al. 2016) 3
Figure 2: Methodological conceptual map 13
Figure 3: Methodological steps for QCA Analysis..... 25
Figure 4: Capacities and Methods Index 29
Figure 5: Legal and Political Framework Index 29
Figure 6: Institutionality and Coordination Index 30
Figure 7: Transparency and Accountability Index..... 30

Tables

Table 1: Definition of the Components of governance analysis 6
Table 2: Definition of 5 Elements for Good Governance 6
Table 3: Forest cover and GHG emissions in Central America 10
Table 4:Country-level progress of MRV for mechanisms in AFOLU sector 11
Table 5: Summary of secondary sources analyzed 14
Table 6: Example of the structure of WRI's forest governance indicator framework 15
Table 7: Summary of the Interviews conducted by country and institution 15
Table 8: Definitions of four Condition Sets for governance analysis 17
Table 9: Summary of all indicators present in each Condition Set 18
Table 10: Variable Reduction Process within Condition Sets for the definition of four final conditions for csQCA 21
Table 11: QCA terminology 23
Table 12: Operationalization of the outcome: definition of presence or absence of outcome variable (MRVGHG) 24
Table 13:Truth table for crisp set QCA: configurations associated with a positive outcome of MRV (MRVGHG = 1) 26
Table 14 :Truth table for crisp set QCA: configurations associated with a positive outcome of MRV (MRVGHG = 1) 27
Table 15: Elements for MRV that all countries have in common (i.e. indicators filtered out from the QCA analysis) 45

Acronyms and Abbreviations

AFOLU: Agriculture, Forestry, and Other Land Uses
BUR: Biennial Update Reports
CCAD: Comisión Centroamericana de Ambiente y Desarrollo
CDM: Clean Development Mechanism
CMA: Conference Meeting Agreements
CMNUCC: Convención Marco de las Naciones Unidas para el Cambio Climático
CONAFOR: Comisión Nacional Forestal (Mexico)
COP: Conference of the Parties
EMSA: Estrategia Mesoamericana de Sustentabilidad Ambiental
ERPD: Emissions Reductions Program Document
ER-PIN: Emissions Reductions Program Idea Note
FAO: Food and Agriculture Organization of the United Nations
GHG: Green House Gases
ICA: International Consultative Analysis
IGEI: Inventario Nacional de Gases de Efecto Invernadero (National GHG Inventory)
INDC: Intended Nationally Determined Contributions
IPCC: Intergovernmental Panel on Climate Change
IPPU: Industrial Processes and Product Use
MRV: Measurement, Reporting, and Verification
NAMA: Nationally Appropriate Mitigation Activities
NFMS: National Forest Monitoring System
NDC: Nationally Determined Contributions
RELs: Reference Emission Levels
REDD+: Reducing Emissions from Deforestation and Forest Degradation
R-PP: Readiness Preparation Proposal
UNFCCC: United Nations Framework Convention on Climate Change
USAID: Unites States Agency for International Development
WRI: World Resources Institute
QCA: Qualitative Comparative Analysis

Abstract

Measuring, reporting, and verifying (MRV) is a UNFCCC mechanism for monitoring climate change mitigation and greenhouse gas emissions data. Although establishing MRV is a priority in international discourse, it is a challenge for developing countries characterized by poor governance and a historic lack of resources. This study is a Qualitative Comparative Analysis (QCA) of six different countries in Central America and the Caribbean, aiming to compare the different governance conditions limiting or facilitating the construction of robust MRV systems in the region. Data collection involved reviewing information from secondary sources complemented with interviews with technical experts throughout the region. The data was prepared for analysis by selecting four final specific governance conditions through a variable reduction process involving three prioritization filters. QCA results suggest that "Institutionality and Coordination" and "Disclosure of Information for Transparency and Accountability" are conditions that are associated with higher levels of capacity for the construction of MRV. The absence of the condition "Institutionality and Coordination" is associated with lower levels of capacities for MRV. These results imply that, although there are many governance elements that are key for the design and construction of MRV in a country, investing in institutional infrastructure is elemental for long-term success of MRV.

Key words: institutionality, coordination, transparency, climate change mitigation, developing countries

Resumen

La medición, reporte, y verificación (MRV) es un mecanismo de la CMNUCC para el monitoreo de datos de emisiones de gases de efecto invernadero y la mitigación del cambio climático. Aunque el establecimiento de MRV es una prioridad de la cooperación internacional, es un reto para países en vías de desarrollo caracterizados por una gobernanza débil y una falta de recursos. Esta investigación es un análisis cualitativo comparativo (QCA) de seis países diferentes en Centroamérica y el Caribe, que busca comparar las condiciones de gobernanza que facilitan o limitan la construcción de sistemas robustos de MRV en la región. La recolección de datos involucró una revisión de documentos de fuentes secundarias complementadas con entrevistas con expertos técnicos de la región. Los datos fueron preparados para análisis seleccionando cuatro condiciones finales de gobernanza por medio de un proceso de reducción y priorización de variables utilizando tres filtros de selección. Los resultados del QCA sugieren que las condiciones de "Institucionalidad y Coordinación" y "Divulgación de Información para la Transparencia y Rendición de Cuentas" están asociadas a altos niveles de capacidades para la construcción de sistemas de MRV. La ausencia de la condición "Institucionalidad y Coordinación" está asociada con niveles bajos de capacidades para MRV. Estos resultados implican que, aunque existen muchos elementos de gobernanza claves para el diseño y construcción de MRV en un país, la inversión en infraestructura institucional es elemental para el éxito de MRV a largo plazo.

Governance Conditions for the Construction of MRV Systems for Land-Use Based Emissions: A Qualitative Comparative Analysis (QCA) in Central America and the Dominican Republic

To be submitted to *Environmental Science and Policy.*

1. Introduction

1.1 Antecedents: International context for the MRV mechanism

The need to create an international policy framework that keeps global temperatures from rising over 1.5-2ºC is pressing, especially taking into account the recent ratification of the Paris Agreement, which entered into full force on November 4th, 2016 (UNFCCC 2016). The Paris Agreement and the subsequent meeting of the Parties imply that all countries involved must be capable of regularly reporting their emissions and commitments to mitigate and adapt to climate change (UNFCCC, 2016). The monitoring of greenhouse gas (GHG) emissions is one of the key elements for the successful implementation of these international agreements, as well as the effective mitigation of climate change. Consequently, the creation of an international framework relies on the efficient monitoring of emissions, as well as the ability to track progress of mitigation efforts (Smith et al. 2014, Sebastian 2014, UNFCCC 2014, 2016).

An important step in the creation of an international policy framework for mitigation and adaptation, was the the submission of Intended Nationally Determined Contributions (known as INDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) at the 21st Conference of the Parties (COP21) in Paris. As of January 2017, the Paris Agreement has been ratified or otherwise joined by 127 Parties (representing 79% of global emissions), and a total of 163 INDC's have been submitted, representing 190 countries (and 98.9% of global emissions) (WRI 2015). However, the sum of these commitments outlined in the INDCs would collectively still lead to a rise of 2.7ºC in global temperatures, as an early analysis of the contributions of 187 Parties shows (Wucke et al. 2016). This figure is clearly far off from the ideal 1.5-2ºC established in the Paris Agreement; thus, the concept of monitoring emissions is unavoidably central for the successful mitigation of the impacts of climate change (Wucke et al. 2016, UNFCCC 2016).

MRV of climate change mitigation is a framework being designed as a common system of transparency that is applicable to all member countries of the UNFCCC (UNFCCC 2014). It is a mechanism that is also meant to indicate emissions trends, inform decisions to prioritize emissions reduction efforts, provide accountability for technical and financial support, as well as provide robust information for decision-making and policy building (Singh et al. 2016, Lütken et al. 2012, Wartmann et al. 2013, Kurdziel y Roeser 2015, UNFCCC 2014, Elsayed 2013). The design of effective national MRV systems for mitigation can ultimately help countries design more effective strategies as part of their programs (Singh et al. 2016).

Under the UNFCCC and within the concept of MRV, measurement (M) is defined as the collection of all the data and information on emissions, mitigation actions, and support. Reporting (R) is the compilation and disclosure of the information measured into standardized reports (mainly through National Communications and/or Biennial Update Reports). The verification (V) involves periodically and independently corroborating the information reported to ensure the information is in accordance with established procedures (Singh et al. 2016, UNFCC 2014, Wartmann et al. 2013, Elsayed 2013, Sebastian 2014, Fransen 2009). While the measurement and reporting should be conducted domestically, the verification is outsourced, and involves an International Consultation and Analysis (ICA), a process that includes the revision of reports by a team of technical experts as well as a facilitative sharing of views (UNFCCC 2014). Thus, the concept of MRV is inherently related to those of transparency, accountability, and ultimately, good governance (Singh et al. 2016, UNFCCC 2014).

MRV of mitigation can be categorized into three main types (Singh et al. 2016):

1. MRV of GHG emissions: measures and monitors the GHG emissions and removals associated with activities of countries, organizations, or facilities. Reports the collected data in a GHG inventory. It can happen at national, organizational, and at individual levels.
2. MRV of mitigation actions: assesses the effects of interventions, commitments, goals, policies, projects of GHG emission reductions, as well as the overall progress toward mitigation goals (for example, NDC progress).
3. MRV of support: assesses climate finance, transfer of technologies, and/or capacity building. This includes the provision of support, receipt of support, and the results or impact of this support.

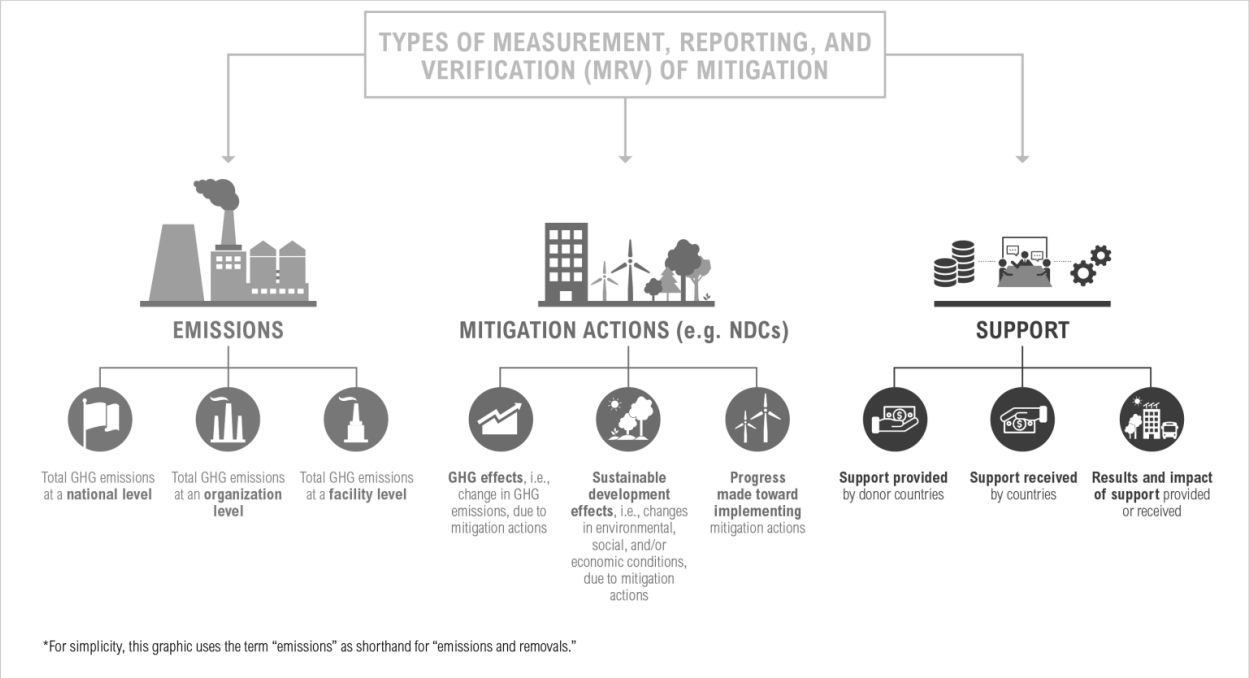

Figure 1: Types of MRV of mitigation (Singh et al. 2016)

National level MRV of emissions is materialized in national GHG inventory reports which are usually included in National Communications and/or Biennial Update Reports (BURs) submitted to the UNFCCC. National GHG inventory reports categorize data into four economic sectors: energy; industrial processes and product use (IPPU); agriculture, forestry and other land use (AFOLU); and waste (Singh et al. 2016, Smith et al. 2014).

Measuring reporting and verification (MRV) is employed in a variety of instances. The Clean Development Mechanism (CDM) applies MRV to ensure that methodology and requirements are met (Lütken et al. 2012). Nationally Appropriate Mitigation Actions (NAMAs) are actions by developing country parties carried out in the context of sustainable development supported and enabled by technology financing and capacity building (Lütken et al. 2012). MRV is a key part of proposed NAMA projects as it provides standard requirements for measuring emission reductions, as well as their environmental sustainability. REDD+ (Reducing Emissions from Deforestation and Forest Degradation, the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries) is a strategy which also requires MRV (Parra et al. 2014, UN-REDD 2014). Altogether, these three mechanisms are currently the only ones exclusively aimed towards addressing mitigation measures in the AFOLU sector by the UNFCCC (Castro y Chacón 2014).

1.2 REDD+ and MRV

REDD+ is one of the most visible mitigation initiatives in the tropics, and has received much investment over the past years (Smith et al. 2014). It is a nationally implemented mechanism, where participant countries receive results-based financing for the reduction of emissions as a

result of the implementation of national policies (Hiepe and Kanamaru 2008, Larson and Petkova 2011).

REDD+ requires establishing a National Forest Monitoring System (NFMS) alongside a specific MRV system for REDD+. Both should be aligned with National Greenhouse Gas Inventory System, and/or a National system of MRV or climate change metrics (Kowler and Larson 2016). As an important step for implementing REDD+ national strategies, countries must prepare Forest Reference Emission Levels (REL), which will serve as benchmarks for assessing the reduction of emissions due to the implementation of REDD+. RELs are expressed as tons of CO_2 equivalent per year for a reference period against which the emissions and removals will be compared (Parra et al. 2014, Herold y Skutsch 2011, Kowler y Larson 2016, Kojwang y Ulloa 2012) and should be consistent with the country's national GHG inventory reports (UNFCCC 2014).Through the establishing of the RELs, REDD+ participant countries have taken parallel steps in creating institutional capacities for MRV in the forestry sector, such as updating land-use maps, and preparing activity data and emissions factors (Chacón et al. 2017).

REDD+ has generated high hopes regarding the impact that it could have towards the conservation of forests and the mitigation of climate change in the region and in tropics around the world (Kowler y Larson 2016). However, progress has been slower than expected, and multiple studies concur that the functioning of REDD+ depends a great measure on good governance, as reducing deforestation and forest degradation implies economic, political and structural changes for developing countries (Kowler y Larson 2016, Larson y Petkova 2011, Cronkleton et al. 2011, Hiepe y Kanamaru 2008, Brockhaus et al. 2014, Korhonen-Kurki et al. 2014, Kanowski et al. 2011).

1.3 Technical complexities of MRV: challenges for developing countries

MRV is concerned with monitoring general effectiveness of mitigation efforts, specifically by monitoring emissions in a transparent and accountable ways. However, monitoring emissions is difficult due to the methodological complexity of estimating climate change metrics and because these emissions are linked to many complex factors (e.g. economic growth, energy structures, and changing policy priorities) (Yale Center for Environmental Law and Policy 2016).

Globally, the AFOLU sector is responsible for approximately a quarter of anthropogenic GHG emissions (Smith et al. 2014, Vermeulen et al. 2012, Aide et al. 2013). The monitoring of emissions from the AFOLU sector, which involves both sources and sinks of CO_2 and non-CO_2 emissions (primarily from agriculture), is particularly problematic, as compared to other sectors. First, because it is not always possible to separate anthropogenic emissions and natural GHG fluxes and second, the necessary data is based on country-level statistics and remote-sensing information (Smith et al. 2014), both of which present high levels of uncertainty. While other sectors usually have 10-15% estimation uncertainty, agriculture (crops and livestock production) emissions estimates range form 10-150% (Tubiello et al. 2014). On the other hand, monitoring deforestation requires interpretation of remotely sensed

data supported by on-the-ground information, which can imply high costs (i.e. data and technical capacities) (DeFries et al. 2007). Thus, the monitoring of emissions in the AFOLU sector can be expensive, technically difficult (i.e. requiring specific levels of expertise), and the data can often be unreliable.

In order to build an MRV system that is legitimate, countries should ensure that the political processes behind the technical ones should be participatory, inclusive and transparent (Kowler & Larson 2016). Many developing countries face difficult technical challenges in implementing MRV; however, technical decisions often have social, economic, and political implications as well. Indeed, the construction of a national MRV requires technical preparation (maps, activity data, and the preparation of emissions factors); but it also involves creating an institutional framework that defines who reports what, in what manner, and how the information of the reports is utilized (Kowler & Larson 2016).

In order to account for methodological challenges in a standardized way, and to be able to make cross-country comparisons, the Intergovernmental Panel on Climate Change (IPCC) proposes a tiered approach for measurements: Tier 1, the simplest to use, is based on globally available activity data and default emissions values, Tier 2 is based on country – or region – specific data, and Tier 3 uses higher-order, spatially explicit data to obtain greater certainty (IPCC 2006).

Nevertheless, it is still a steep challenge for developing countries to measure, report, and verify data for the estimation of GHG emissions in a rigorous, transparent, and accountable way. Although the technical criteria established by the IPCC describe the priorities for the international context for mitigation, the specific governance elements needed to carry out these mechanisms are still unclear. Currently, the only reporting (i.e. the R of MRV) evidencing the process of MRV is presented in the national GHG inventory reports, periodically submitted to the UNFCCC through National Communications (and, more recently also through Biennial Update Reports (BURs)) (UNFCCC 2014). For these reasons, the data tiers, uncertainty levels, and the periodicity of national GHG inventory reports, currently provide the most concrete indications concerning quality of emissions estimation data, the coordination process, the actors and institutions involved, and the overall level of governance experience in carrying out MRV.

1.4 Governance of MRV

In this study, the analysis of governance is based on the definition of governance as a complex relationship between structures, processes, relationships, and organizations whose decisions are influenced by institutions, rules and power relationships (Pagiola et al. 2004, Arts 2014, United Nations 2015). Good governance is characterized by clear, concise, comprehensive decision-making, and the promotion of values such as equity, participation, pluralism, transparency, accountability, and the rule of law (CIFOR 2013, Fosyth 2007, United Nations 2015, Kauffman et al. 2011, Pagiola et al. 2004, Arts 2014, Larson y Petkova 2011).

This study utilized WRI's forest governance indicator framework (Davis et al. 2013) in defining three principal components of governance (Table 3) and five elements for good governance (Table 4), concepts that were used as an overall guideline for governance analysis.

Table 1: Definition of the Components of governance analysis (Davis et al. 2013)

Principal components of governance	**Definition**
Actors	Range of people and institutions (may include government agencies, legislatures, companies, communities, the media, and civil society)
Rules	Policies, laws and regulations that affect MRV
Practices	How actors develop and apply rules to drive practices at an operational level.

Table 2: Definition of 5 Elements for Good Governance (Davis et al. 2013)

Elements for good governance:	
Transparency	Transparency is the process of revealing actions so that outsiders can scrutinize them. Facilitating access to information is critical in order to inform and engage public constituents. Attributes of transparency include the comprehensiveness, timeliness, availability, and comprehensibility of information.
Participation	Diverse and meaningful input helps decision-makers consider different issues, perspectives, and options when defining a problem and solution. It allows them to gather new knowledge, integrate public concerns into decision-making, and manage social conflicts by bringing different stakeholders and special interest groups together at an early stage. Elements of access to participation include formal space for participation in relevant forums, the use of appropriate mechanisms to invite participation, the inclusiveness and openness of such processes, and the extent to which gathered input is taken into account.
Accountability	Accountability exists when the actions and decisions taken by an actor are subject to oversight, so as to guarantee that they meet stated objectives and respond to the needs of the stakeholders they are meant to benefit. The concept of accountability involves two dimensions: answerability and enforcement. Answerability refers to the obligation to provide information about decisions and actions and justify them to stakeholders and other overseeing entities. Enforcement requires sanction and redress when the actor fails to meet its obligations.
Coordination	Coordination exists when different actors whose decisions impact the construction of MRV work together and share information in order to advance common objectives.
Capacity	Capacity can be broadly interpreted in terms of financial, human, technological, legal, and institutional resources to perform a function.

1.5 Importance and Justification of the study

As developing countries commit to mitigation – and conservation – actions, and the Paris Agreement enters into full force, the challenges become greater to collect the relevant emissions data (i.e. activity data, emissions factors, land-use maps, etc.). Still, the Agreement hinges on countries' capacities to asses this data in a transparent way (Singh et al. 2016). The inference that institutional processes are as important to define as the technical ones (Kowler & Larson 2016), confirms the need to also invest in researching the governance of MRV processes.

Previous studies concerning mitigation efforts in the AFOLU sector have addressed issues of governance and institutional processes. These include distinct emphases on the REDD+ mechanism, such as the governance features for the successful implementation of REDD+ (Pettenella & Brotto 2012), REDD+ as a form of governance (Hosonuma et al. 2012), as well as technical data emphases such as identification of tropical deforestation drivers, forest cover changes, and carbon emissions, removals their estimation (DeFries et al. 2007, Redo et al. 2012). Still, as far as MRV, most studies have focused on it's relevance for REDD+ readiness (Joseph et al. 2013). Aside from the handbooks and guidelines published by international institutions which address technical aspects and infrastructure for implementation (such as the UNFCCC, the International Partnership on Mitigation and MRV, and USAID (UNFCCC 2014, Elsayed 2013, Kurdziel & Roeser 2015, Pang et al. 2013, Wartmann et al. 2013, Parra et al. 2014)) there is a gap in literature addressing national-level MRV governance experiences for developing countries.

In Latin America, where in 2008, 40% of its GHG emissions came from the AFOLU sector (Calvin et al. 2014), due mostly to the conversion of forests to agriculture during the period of 2001-2010 (FAO, 2016), it is evident that monitoring AFOLU emissions implies monitoring one of the highest GHG emitting sectors. This indicates that mitigating the impacts of this sector will involve drastically changing its model of governance as well. Although many studies concur about the elemental role of good governance for the success of mechanisms tackling climate change mitigation in the AFOLU sector (Korhonen-Kurki et al. 2014, Brockhaus et al. 2014, Brockhaus & Di Gregorio 2014, Holmes & Potvin 2014, Cerbu et al. 2011, Schroeder & McDermott 2014), few sources focus specifically on the importance of good governance for the implementation of MRV (Kowler & Larson 2016).

This study aims to analyze governance conditions of Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panamá, and the Dominican Republic that limit or facilitate the construction of MRV of emissions in the AFOLU sector. For this, we propose the use of Qualitative Comparative Analysis (QCA), a case-oriented research approach, ideal for governance analyses (Kooiman 2010, Ragin & Benoit 2008). QCA has been used to compare the establishment of REDD+ in contexts of weak governance around the world (Korhonen-Kurki et al. 2014). Consequently, this study aims to conduct a similar, cross-case comparison

analysis, in Central America, a context where this type of analysis has never been employed. Through this comparative analysis of governance conditions, we expect to find that different governance conditions are associated on different levels with the success or failure of MRV design and implementation. Thereby, the goal of the study is to provide input for decisions concerning climate change response actions, and to inform about the best investments for countries preparing for MRV design and implementation.

1.6 Objectives

The main objective of this study is to analyze the elements of governance that drive the design of national MRV frameworks for the AFOLU sector, by applying a Qualitative Comparative Analysis (QCA) in Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, Panama, and the Dominican Republic.

1.6.1. Specific Objectives and Research Questions

1. Identify the technical elements and central actors that are involved in the design and implementation of MRV of emissions systems for the countries of the study.
    a. What is being measured, reported and verified? Who measures, reports, and verifies this data? How is this data measured, reported, and verified?
    b. Currently, who are the central actors involved in the design and implementation of MRV of emissions in the AFOLU sector?
2. Identify the legal and institutional frameworks involved in the design and implementation of MRV of emissions systems.
    a. What legal, political, and institutional aspects currently exist in the countries studied?
3. Comparatively analyze the governance conditions that drive the construction and implementation of MRV of emissions in the AFOLU sector.
    a. What are the necessary and sufficient governance conditions that indicate capacities for MRV of emissions in the AFOLU sector?
    b. How do the countries' governance conditions compare?

2. Methods

2.1 Study area: Monitoring GHG emissions in Central America and the Caribbean

In Latin America, monitoring emissions implies a set of specific circumstances, for the most part related to the challenges of monitoring emissions in the AFOLU sector. Consequently, many mitigation efforts in the region have been directed to the AFOLU sector (Smith et al. 2014, FAO 2016), however, mostly through sustainable agriculture and livestock management (Smith et al. 2014). A recent study suggests that in the 2001-2010 period, the Mexico and Central American region has actually seen a significant reforestation, experiencing a net gain in woody vegetation in Mexico, Honduras, Costa Rica and El Salvador, while Nicaragua and Guatemala experienced woody vegetation loss (Aide et al. 2013). Satellite analysis reporting forest coverage and emissions data for the AFOLU sector is seen in Table 3:

Table 3: Forest coverage and GHG emissions in Central America.

Country	**% Forest Coverage (2010)**	**Source**	**Total GHG emissions from Agriculture $MtCO_2e$* (2012)**	**Total GHG emissions from Land-use change and forestry $MtCO_2e$* (2012)**	**Source**
Costa Rica	46%	Redo et.al. 2012	3.41	-7.6	CAIT Climate Data Explorer
El Salvador	21%	Redo et.al. 2012	2.84	1.36	CAIT Climate Data Explorer
Guatemala	37%	Redo et.al. 2012	8.33	16.05	CAIT Climate Data Explorer
Honduras	41%	Redo et.al. 2012	5.88	27.9	CAIT Climate Data Explorer
Nicaragua	29%	Redo et.al. 2012	7.69	28.83	CAIT Climate Data Explorer
Panama	39%	Informe Estado del Ambiente (ANAM) 2016	3.52	6.06	CAIT Climate Data Explorer
Dominican Republic	39%	Estudio uso y cobertura de suelos (2012)	7.85	0	CAIT Climate Data Explorer

*MtCO2e: Million metric tons of carbon dioxide equivalent

In the Central American region, major challenges for MRV refer to a context characterized by weak institutions manifested in illegality, insecurity, corruption, and conflict (Larson & Petkova 2011, CCAD 2010). Although all the countries in the region have advanced in building their national forest monitoring systems (NFMS), the level of progress is uneven for several reasons. One reason is that the majority of activities related to NFMS are concerned with addressing deforestation, and few are working with carbon forest degradation or the increase in carbon stock (CONAFOR 2014). For instance, in Central America, Guatemala is

the only country simultaneously working on the baseline for all three (i.e. deforestation, degradation, and increase in carbon stock) (Catalán, M. (2016, May 24). Personal interview). Another reason is that most countries are currently concerned with compiling information and developing methodologies for the estimation of emissions (CONAFOR 2014, EMSA 2015), so there is no experience with implementation in the current governance context. Third, technical capacity building has been prioritized more in some countries than others; Colombia, Guatemala, Mexico, and Nicaragua were identified as countries with the highest capacities to offer technical cooperation within the region, evidencing that some countries count with the technical capacities to carry out MRV while others are still lacking (CONAFOR 2014, EMSA 2015).

In terms of progress in the construction of MRV systems specifically in the AFOLU sector (mechanisms such as NAMA's, CDM, and REDD+), the countries of the study also show different levels of progress. No specific level of progress was found for CDM, however Table 4 shows the levels of MRV progress concerning NAMAs, REDD+, and potential national MRV systems/national climate change metrics systems. It should be noted that the NAMAs mentioned here are not yet under implementation, as they are currently seeking support (only NAMAs found in the UNFCCC registry were included in this table). Levels of progress for REDD+ (and thus, MRV for REDD+) involve the documentation presented (from Readiness Preparation Proposals (R-PPs) to Emissions Reductions Program Documents (ERPDs)). Although specific documents or plans for national MRV systems were not found during the revision of secondary sources, interviews with technical experts throughout the region provided this information.

Table 4:Country-level progress of MRV for mechanisms in AFOLU sector

	NAMAs	**MRV for NAMAs** + : mentions MRV as part of the proposal - : does not mention MRV as part of the proposal	**REDD+ report progress** + : each "+" represents a submitted REDD+ report (R-PP, ER-PIN, ERPD)	**MRV for REDD+ + :** MRV is mentioned in reports as part of proposals ++: progress in MRV is mentioned in the latest update report to the FCPF	**National MRV System or CC metrics system***
Costa Rica	Livestock	+	+++	++	+
	Low-emissions Coffee	+			
El Salvador	no NAMAs registered		+	+	-
Guatemala	no NAMAs registered		++	++	+
Honduras	no NAMAs registered		+	++	-
Nicaragua	no NAMAs registered		++	+	N/A
Panama	no NAMAs registered		+	+	-
Dominican Republic	Tourism and Waste	-	++	+	+
	Blue Carbon	-			

	Reducing GHG emissions from pig farms	-
	Energy Efficiency in the Public Sector	+
	Cement/Co-processing and Waste Sector	+

*Costa Rica is designing its National System for Climate Change Metrics (Sistema Nacional de Métrica de Cambio Climático (SINAMECC)). Guatemala is designing a National Information System for Environment and Climate Change (Sistema Nacional de Información Ambiental y Cambio Climático (SNICC)). The Dominican Republic is designing a national MRV system.

Consequently, although there is technical expertise in the region, enabling countries to tackle the methodological challenges of MRV, there is a lack of experience in managing the circumstantial challenges associated with context of governance (EMSA, 2015). Differences in technical and governmental capacities (i.e. strong institutions, coordination, transparency, legal and political frameworks) suggest that by comparing cases on a regional level, it is possible to identify what factors are influential in the construction of MRV processes in contexts of weak governance.

On the other hand, although there has been progress in monitoring the emissions from the forest and land-use sectors, there is a gap in literature and technical experiences for the national monitoring of emissions from the agricultural sector (Tubiello et al. 2014) . For instance, land-use emissions are calculated and reported in National Forest Inventories and RLs; agricultural emissions are only reported when preparing National Communications, and emissions are not mentioned in existing national agricultural censuses (INEC 2015, INEI 2012). Yet, harmonizing both of these sectors is another elemental challenge, not only for the preparation of national inventory reports, but also for the coordination of national MRV systems in order to prevent leakages and double counting of information (UNFCCC 2014, Tubiello et al. 2014).

2.2 Data Collection and Analysis

The data collection process involved a few main steps (illustrated in Figure 2): 1) A review of documents from secondary sources of information (i.e. national communications, national GHG inventories, national forest inventories, etc.) concerning the progress MRV of the AFOLU sector in the countries assessed; and having identified the information gaps from these sources, 2) Semi-structured interview-surveys with local technical experts involved in the design of MRV. Throughout both of these first two steps, WRI's toolkit for governance analysis (Davis et al. 2013) was consulted to define the type of information needed for the analysis. 3) A final data base with all the information collected was constructed by adapting WRI's toolkit to the aims of this study. 4) These data were then prepared for QCA analysis through a variable reduction process, which categorized information into Condition Sets, each set composed of several indicators. 5) Finally, the QCA Analysis was conducted to identify the interaction of governance conditions for MRV construction.

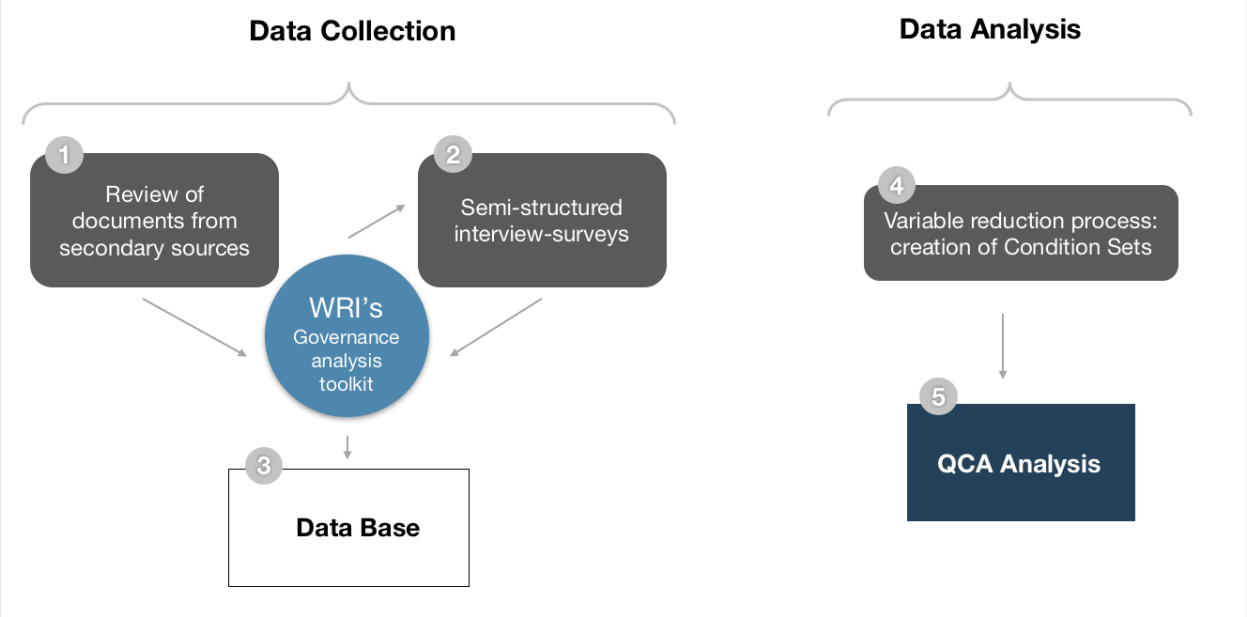

Figure 2: Methodological conceptual map

2.2.1 Data collection

Data collection consisted of three main steps. First, a thorough review of documents from secondary sources was conducted of the main countries' reports, including all existing national communications and national inventory reports, both prepared and submitted to the UNFCCC. Additionally, REDD+ reports, existing national forest inventories or agricultural censuses, as well as legislation and policies related to the general climate change framework of the countries were also reviewed (Table 5). Other secondary sources such as interviews and surveys conducted by the Mesoamerican Strategy of Environmental Sustainability (*Estrategia Mesoamericana de Sustentabilidad Ambiental*, EMSA) through the South-South Cooperation and REDD/CCAD Project, as well as data from the "Mechanisms and Networks of technology

transference related to climate change in Latin America and the Caribbean" Project were utilized (EMSA 2015, Chacón et. al 2017).

*Table 5: Summary of secondary sources analyzed**

Document type	Source	Output provided by the documents	Countries
National Communications	National online publications, UNFCCC	• Technical capacities (emissions data reported, activity data, emissions factors, mapping) • Reports (periodicity of publications/submissions) • Institutional capacities • Financial capacities • Existing institutional arrangements • Legal arrangements • Political arrangements • Level of progress and readiness for REDD+	All countries
National Inventory Reports			All countries
National Strategies for Climate Change			All countries
INDCs			Costa Rica, Guatemala, El Salvador, Honduras, Panama, Dominican Republic
National Forest Inventories	National online publications		Guatemala, Nicaragua
National Agriculture Censuses	National online publications		Costa Rica, El Salvador, Guatemala, Nicaragua
REDD+ reports	National online publications, UN-REDD, the REDD-desk		All countries
EMSA Workshop survey answers	REDD/CCAD/GIZ and Cooperación Sur-Sur		All countries
Other documents related to climate change and forest policies, laws, technical reports, strategies or projects	Official national publications		All countries

* all documents can be found in the references section.

This study utilized WRI's forest governance indicator framework (Davis et al. 2013) in defining three principal components of governance (Table 1) and five elements for good governance (Table 2), concepts that were used as an overall guideline for governance analysis.

The overarching guideline for governance analysis utilized was WRI's forest governance indicator framework (Davis et al. 2013). The framework is composed of 6 thematic areas (i.e. Forest Tenure, Land Use, Forest Management, Forest Revenues, Cross-Cutting Institutions, and Cross-Cutting Issues). Of these thematic areas, only the final two, Cross-Cutting Institutions and Cross-Cutting Issues, were utilized in the study due to their relevance to the topic of MRV. Each thematic area is composed of several subthemes. In this case, Cross-Cutting Institutions include the subthemes of: 1) Legislature, Judiciary, 2) Executive agencies, 3) Private sector, and 4) Civil society; and Cross-Cutting Issues included the subthemes of: 1) Public participation in decision-making, 2) Public access to information, 3) Financial transparency and accountability, and 4) Anticorruption measures (Davis et al. 2013). The subthemes contain a list of indicators, which are, in turn, composed of a diagnostic question and 3-6 elements of quality that answer the question.

This WRI indicator framework drove the identification of variables for the remainder of the analysis. However, because the toolkit is geared towards forest governance analysis, only a few elements of quality were selected from each of the relevant indicators. Table 6 exemplifies the structure of the indicator framework, and how the elements of quality were adapted to fit the topic of MRV.

Table 6: Example of the structure of WRI's forest governance indicator framework

Theme	Cross-Cutting Issues
Subtheme	Public Access to Information
Indicator	Legal basis for forest transparency ⇒ *Legal basis for transparency in MRV*
Diagnostic question	To what extent do government agencies promptly and proactively disclose information to the public?
Elements of quality	• *Publication of laws.* Laws and regulations are published in a timely manner. • *Disclosure.* Government agencies regularly disclose all information required by law. • *Information platforms.* Government agencies have dedicated platforms for managing and disclosing information to the public. • *Disclosure methods.* Methods of disclosing information are adapted to meet the needs of different groups. • *Timeliness.* Government agencies respond to public requests for information in a timely manner.

Having identified the key elements necessary for governance analysis, and organized the information collected from secondary sources into a data base, we identified the information gaps remaining after the revision of information from secondary sources. To address these gaps, we created an interview protocol (based on the indicators adapted from WRI), and conducted a total of 23 semi-structured interview-surveys with technical experts of the region. Interview-surveys were conducted with experts actively engaged in the design of national and REDD+ MRV systems (this included actors from the national environment ministries, climate change, and/or forestry and agricultural offices from each of the countries studied (see Table 5), and were identified through a list of monitoring experts provided by the Regional Program of Climate Change (PRCC for its Spanish acronym). Additionally, snowball sampling was employed during the interviews, asking the interviewees to identify other relevant informants, due to the fact that governmental positions change often and suddenly. Table 5 shows that we were able to conduct only one interview in Nicaragua, thus excluding it from the rest of the study due to the lack of information necessary for the analysis.

Table 7: Summary of the Interviews conducted by country and institution

Country	**Institutions**	**Interviews Conducted**
Costa Rica	FONAFIFO (Fondo Nacional de Financiamiento Forestal)	2
	IMN (Instituto Meteorológico Nacional)	2
El Salvador	MAG (Ministerio de Agricultura y Ganadería)	1

	MARN (Ministerio de Ambiente y Recursos Naturales)	1
Guatemala	INAB (Instituto Nacional de Bosques)	2
	MARN (Ministerio de Ambiente y Recursos Naturales)	1
	CONAP (Consejo Nacional de Áreas Protegidas)	1
	CEAB/UVG (Centro de Estudios Ambientales y de Biodiversidad, Universidad del Valle de Guatemala)	1
Honduras	MiAmbiente/SERNA (Secretaría de Recursos Naturales y Ambiente)	3
	ICF (Instituto de Conservación y Desarrollo Forestal, Áreas Protegidas, y Vida Silvestre)	1
	ESNACIFOR	1
Nicaragua	INAFOR	1
Panama	MiAmbiente (Ministerio de Ambiente)	2
Dominican Republic	Ministerio de Medio Ambiente y Recursos Naturales	4
	Total Interviews Conducted	**23**

The interview findings were systematically coded using the 5 good governance elements (transparency, participation, accountability, coordination, and capacity) described in Table 2, as well as other key elements for MRV that were identified (UNFCCC 2014, Elsayed 2013, Sebastian 2014, Pang et al. 2013), such as methodologies, financing, data quality and systems, capacities (i.e. technical, institutional, and legal), and tools.

Interviews were transcribed and a final data base was created with both the information collected from secondary sources and the interview-surveys. The data was prepared to conduct qualitative comparative analysis, and the indicators were sorted into four categories, hereinafter referred to as "Condition Sets", this in congruence with the QCA terminology (see Table 11). The condition sets are Capacities and Methods, Institutionality and Coordination, Legal and Political Framework, and Transparency and Accountability (see Table 8).

Table 8: Definitions of four Condition Sets for governance analysis

Condition Set	Definition
Capacities and Methods:	Countries have sufficient technical, institutional, and financial resources to build a national MRV system accounting for the country's total GHG emissions in the AFOLU sector. The methods employed are adapted to the country's capacities, while complying with the requirements established by the UNFCCC
Institutionality and Coordination:	Presence of institutions and agencies in place that efficiently coordinate the process of MRV of mitigation in the AFOLU sector
Legal and Political Framework:	There is an overall coherence of the legal framework (legislation) and the political framework (policies) establishing the necessary legal procedures for MRV of emissions
Transparency and Accountability:	Information concerning MRV of emissions in the AFOLU sector is readily available to relevant actors and to the public

These four condition sets are each composed of several indicators (weighted appropriately) from various sources, as summarized in Table 9:

Table 9: Summary of all indicators present in each Condition Set

Condition Set	Indicators in Condition Set	Source	Evaluation	Total number of indicators
Capacities and Methods	Generation of activity data for: degradation	EMSA data	1=presence, 0=absence	10
	Generation of activity data for: deforestation	EMSA data	1=presence, 0=absence	
	Generation of activity data for: conservation	EMSA data	1=presence, 0=absence	
	Generation of activity data for: increase in carbon stocks and/or sustainable forest management	EMSA data	1=presence, 0=absence	
	Capacities to produce maps: kinds of coverage	EMSA data	1=presence, 0=absence	
	Defined emissions factors	EMSA data	1=presence, 0=absence	
	Sufficient tools and resources for emissions estimation	EMSA data was supplemented with interviews	1=presence, 0=absence	
	Dependency on consultants	Interviews	2 = occasionally 1= often dependent (but consultants are usually national) 0= total dependency (foreign)	
	Methods are verified	Interviews	2= externally 1= domestically 0=not verified	
	No dependency on external finance	EMSA data and Interviews	1=presence, 0=absence	
Institutionality and Coordination	Focal point for the UNFCC is defined	Secondary sources	1=presence, 0=absence	9
	Defined institutional roles and responsibilities	Secondary sources and interviews	1=presence, 0=absence	
	Specific institutional coordination groups and platforms	Secondary sources and interviews	1=presence, 0=absence	
	Specialized technical institutions	Secondary sources and interviews	1=presence, 0=absence	
	Established national office/direction for climate change	EMSA data	1=presence, 0=absence	
	Established national information system for climate change and/or forests	EMSA data	1=presence, 0=absence	
	Political and institutional volatility	EMSA data and Interviews	0= volatility present 1= volatility absent	

Condition Set	Indicators in Condition Set	Source	Evaluation	Total number of indicators
	Participatory process in preparing INDC's	Interviews	1=presence, 0=absence	
	Established guidelines for financing	Interviews	1=presence, 0=absence	
Legal and Political Framework	Legal mandate for national GHG inventory reports, creating activity data, emission factors, and reports	EMSA data	1=presence, 0=absence	4
	Institutional coordination conflicts or malfunctioning due to legal framework	WRI tool	0= conflicts present 1 = conflicts absent	
	Technical criteria is included when preparing relevant legal and political instruments	Interviews	1=presence, 0=absence	
	Defined legal-political framework	Secondary sources and interviews	1=presence, 0=absence	
Transparency and Accountability	Legislation for transparency/access to public information	Secondary sources	1=presence, 0=absence	6
	Disclosure of information is proactive and delivered in a timely manner	Interviews	1=presence, 0=absence	
	Platforms for disclosure of information	Secondary sources and interviews	1=presence, 0=absence	
	Utilize diverse platforms and methods for information disclosure	Interviews	1=presence, 0=absence	
	Accountability mechanisms between institutions/agencies involved	Interviews	1=presence, 0=absence	
	Keep a record of lessons learned	Interviews	1=presence, 0=absence	

Having defined the four governance condition sets, a variable reduction process was carried out in order to be able to conduct the QCA analysis as recommended (i.e. not including indicators that do not vary across cases, and maintaining a low number of conditions as compared to the number of cases) (Ragin & Benoit 2008). As seen in Table 9, it involved a total of three prioritization filters for each one of the condition sets:

- 1st Prioritization Filter: all indicators that did not vary at all across cases were not prioritized for the analysis and were filtered out.
- 2nd Prioritization Filter: the only indicators prioritized were those where more than two countries differed in their answers (e.g. for the indicator "Generation of activity data for: degradation" only El Salvador and Panama answered that they did not have this capacity, the remaining countries did).
- 3rd Prioritization Filter: this filter was only applied to the condition sets "Capacities and Methods" and "Institutionality and Coordination". The indicator "Dependency on consultants" (under "Capacities and Methods") was prioritized as it was considered more telling that the two other indicators concerning specific technical capacities. The indicators "Specific institutional coordination groups and platforms" and "Specialized technical institutions" were prioritized over the perception indicator of "Political-institutional volatility".[1] "Legal and Political Framework" and "Transparency and Accountability" used all the remaining indicators from the 2nd prioritization filter.

Lastly, to define a binary variable (either 1 or 0) from each of the four condition sets, an index was created including the 1-2 variables per condition set that remained from the prioritization process. These final four values were calculated for the definition of the conditions for carrying out crisp-set QCA (csQCA), and the definition of their presence (1) or absence (0) is outlined in Table 9.

At the end of the variable reduction process, through the creation of four final indexes originating from the four condition sets, four final, specific **conditions** for csQCA analysis are defined as:

1. RES: there is little or no dependency on external consultants, indicating that there are sufficient human and technical resources for designing and implementing MRV.
2. INST: existence of specialized technical institutions and/or coordination platforms for the institutions involved in the construction of MRV.
3. LEG: a defined legal and political framework is established for the design and implementation of national MRV.
4. DISC: proactive disclosure of information is facilitated in a timely manner by the existence of available and accessible platforms.

[1] For a more detailed description of the conceptual decisions behind this final prioritization see Annex 1.

Table 10: Variable Reduction Process within Condition Sets for the definition of four final conditions for csQCA

Condition set	**1st Prioritization Filter:** indicators where all countries responded the same were not prioritized	⇒	**2nd Prioritization Filter:** Prioritize indicators where only > 2 countries differ in their answer*	⇒	**3rd Prioritization Filter:** Prioritize indicators conceptually*	**Final number of indicators**	**Creation of an Index composed of final number of indicators** ⇒	**Definition of variable presence/absence for csQCA Analysis**
Capacities and Methods			Generation of activity data for: degradation		Defined emissions factors	1		code name for analysis: **[RES]** Presence and absence for QCA Analysis defined as: 1≥ presence, 0 = absence
			Generation of activity data for: deforestation					
			Generation of activity data for: conservation		Sufficient tools and resources for emissions estimation			
			Generation of activity data for: increase in carbon stocks and/or sustainable forest management					
			Capacities to produce maps: kinds of coverage					
			Defined emissions factors					
			Sufficient tools and resources for emissions estimation		**Dependency on consultants**			
			Dependency on consultants					
			Methods are verified					
			No dependency on external finance					
Institutionality and Coordination			Focal point for the UNFCC is defined		Defined institutional roles and responsibilities: it was found to be a condition necessary and sufficient for MRV, thus not prioritized for the comparative analysis (See results section for detailed explanation).	2		code name for analysis: **[INST]** Presence and absence for QCA Analysis defined as: 1≥ presence, 0 = absence
			Defined institutional roles and responsibilities					
			Specific institutional coordination groups and platforms					
			Specialized technical institutions		**Specific institutional coordination groups and platforms**			
			Established national office/direction for climate change					
			Established national information system for climate change and/or forests					
			Political and institutional volatility		**Specialized technical institutions**			
			Participatory process in preparing INDC's		Political and institutional volatility			

		Established guidelines for financing				
Legal and Political Framework		Legal mandate for national GHG inventory reports, creating activity data, emission factors, and reports Institutional coordination conflicts or malfunctioning due to legal framework Technical criteria is included when preparing relevant legal and political instruments **Defined legal-political framework**	⇒	**Defined legal-political framework**	1	code name for analysis: **[LEG]** Presence and absence for QCA Analysis defined as: 1 = presence, 0 = absence
Transparency and Accountability		Legislation for transparency/access to public information **Disclosure of information is proactive and delivered in a timely manner** **Platforms for disclosure of information** Utilizing diverse platforms and methods for information disclosure Accountability mechanisms between institutions/agencies involved Keep a record of lessons learned	⇒	**Disclosure of information is proactive and delivered in a timely manner** **Disclosure of information is proactive and delivered in a timely manner**	2	Code name for analysis: **[DISC]** Presence and absence for QCA Analysis defined as: Combined score of > 1 = presence Combined score of < 1 = absence

***Bolded indicators are those that survived the prioritization process.**

2.2.2 Data Analysis: Qualitative Comparative Analysis (QCA)

This research uses Qualitative Comparative Analysis (QCA) to study the governance conditions in Central America and the Dominican Republic that limit and/or facilitate the construction of robust MRV systems. Through QCA, the aim is to address some of the usual reductionist analytical issues of standard statistical analysis by using principles of complex causality and cross-case comparisons in case-oriented research (Ragin & Benoit 2008, Ragin 2014, Legewie 2013). In QCA the main objective is to associate configurations of causally relevant conditions to their outcomes. This refers to the concept of "complex causality" of social phenomena, meaning that it is a combination of factors, and their interactions, that lead to a specific event or result (Legewie 2013, Ragin et al. 2008, Ragin 2014). QCA allows for a "dialogue" between theory and evidence throughout the process of analysis, and for these reasons, it is becoming more widely adopted in the social sciences (Basurto & Speer 2012, Legewie 2013, Sehring et al. 2013).

Ultimately, QCA examines set-theoretic sufficiency relations, and is meant for small to medium numbers of cases. The emphasis of the analysis lies upon the combination of conditions that correlate with a certain outcome (see Table 11 for terminology); therefore, the results presented in this study do not prove causal relation, but instead describe patterns of associations (Ragin et al. 2008, Ragin 2014, Basurto and Speer 2012, Legewie 2013). In this case, the analysis describes how specific governance conditions are associated with a positive outcome of MRV of emissions.

Table 11: QCA terminology (Ragin and Benoit 2008)

QCA terminology	Definition
Crisp-set QCA	a variant of QCA that operates exclusively with binary values (i.e., values are either 0 or 1).
Conditions	an explanatory variable that may affect the outcome.
Outcome	the variable to be explained by the conditions; usually the outcome is the main focus of a study.
Configuration	a combination of conditions relevant to a given outcome. It may correspond to one, more than one, or no empirical case(s). It corresponds to one row of a truth table.
Necessary condition	a condition is necessary for an outcome if it is always present when the outcome occurs, and if it is never absent when the outcome occurs (thus the outcome cannot occur in the absence of the condition).
Sufficient condition	a condition (or combination of conditions) is sufficient for an outcome if the outcome always occurs when the condition (or combination) is present (however, the outcome can occur for other reasons as well).
Minimal formula	reduced expression, minimal equation, solution: formula obtained through Boolean or set-theoretic minimization.
Consistency	the degree to which empirical evidence supports the claim that a set theoretic relation exists. A subset relation may signal a necessary or a sufficient condition, depending on which is the subset, the cause (sufficiency), or the outcome (necessity).

Coverage	an assessment of the way the respective terms of the minimal formulas "cover" observed cases (three types of coverage: raw coverage, unique coverage, and solution coverage).

The specific analysis conducted was a crisp-set QCA using the R package (Dusa & Thiem 2013, Thomann & Wittwer 2016, Thiem & Dusa 2013), which follows Boolean algebra and uses binary logic for the causal conditions and outcomes, assessing them as being present (1) or absent (0) for each case (country). The combination of conditions and their outcomes are presented in a truth table after determining what combinations of conditions are necessary and/or sufficient for the determined outcome. The software calculates a minimal formula, using Boolean minimization logic, which presents a final simplified configuration of conditions (Sehring et al. 2013, Thiem & Dusa 2013).

Having defined the conditions used in the analysis (see Table 9), it was also necessary to define the outcome. Under this study, the outcome is meant to be a dependable, yet straightforward measure of countries' capacities to measure, report, and verify the total amount of GHG emissions and removals resulting from human activities, in their AFOLU sector. Due to the fact that the most concrete results of emissions reporting throughout the past couple of decades have been the national GHG inventory reports, and the governance experience that these documents represent, it was determined that the amount of reports, by baseline year, was a forthright measure of capacities of MRV of emissions.

In order to conduct crisp-set QCA, using only dichotomous values, it was necessary to define the threshold for presence or absence for the outcome variable (number of inventory reports). Due to the range of different amounts of inventories that all six countries had (from a minimum of 2 reports to a maximum of 6), it was established that countries with more than 2 reports (Costa Rica, El Salvador, Guatemala, and Dominican Republic) would qualify as having a higher presence of capacities for MRV (1). As seen in Table 12, the countries with only two reports (Honduras and Panama), were defined as having low capacities of MRV for emissions (0).

Table 12: Operationalization of the outcome: definition of presence or absence of outcome variable (MRVGHG)

Case	Baseline years of national GHG inventory reports	Total Number of national GHG inventory reports	MRV of emissions [MRVGHG] If number of inventory reports are > 2 = 1 If number of inventory reports are ≤ 2 = 0
Costa Rica	1990, 1995,2000, 2005, 2010, 2012	6	1
El Salvador	1994, 2000, 2005	3	1
Guatemala	1990, 1994, 2000, 2005	4	1
Honduras	1995, 2000	2	0
Panama	1994, 2000	2	0
Dominican Republic	1990, 1994, 1998, 2000, 2010	5	1

Once all variables were defined [MRVGHG] as the outcome, and [RES], [INST], [LEG], and [DISC] as the conditions, a crisp-set QCA analysis was carried out which involved a few basic steps (see Figure 3). Firstly, a necessity test is performed; which yields all possible combinations of conditions as configurations with corresponding scores on necessity coverage

and necessity inclusion. These scores provide evidence for the necessity of a certain combination for the outcome.

Next, a sufficiency test is performed to yield the truth table, which is the central part of the analysis. The truth table is a data matrix that summarizes the information observed in the cases, explains the possible combinations of conditions, and also provides an inclusion score, evidencing a condition's sufficiency for the outcome. Utilizing this truth table, it was possible to perform a Boolean minimization of the configurations, yielding a simplified formula that ultimately explains the configurations that lead to an outcome from the observed study cases (Ragin et al. 2008, Ragin 2014, Sehring et al. 2013, Legewie 2013, Thiem and Dusa 2013).

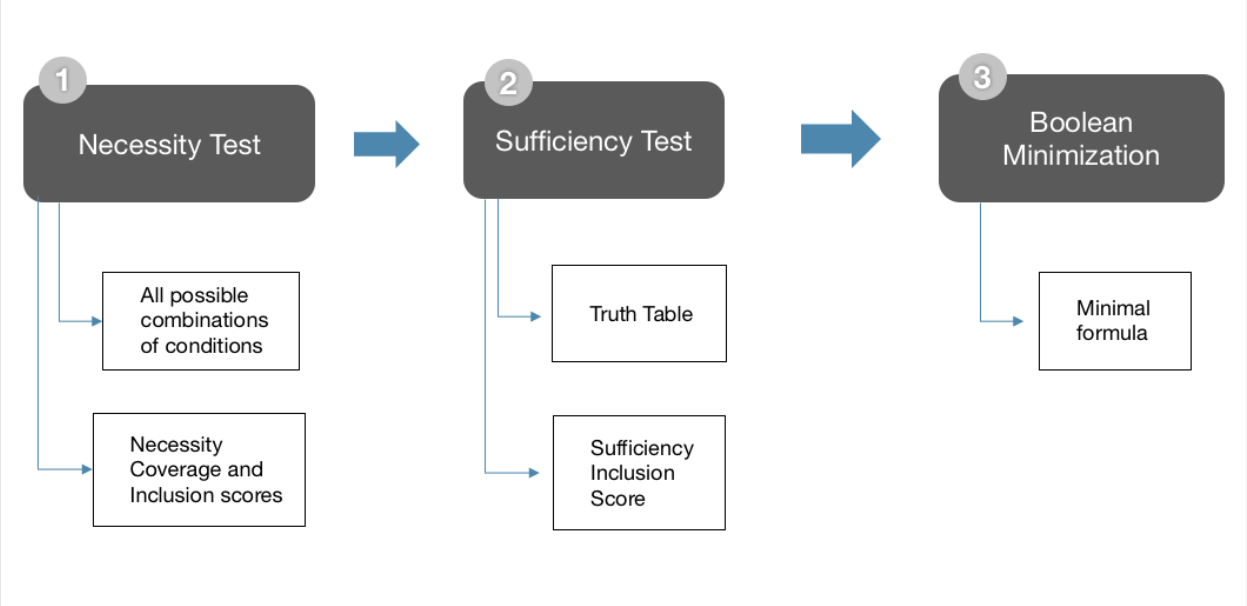

Figure 3: Methodological steps for QCA Analysis

This entire procedure is implemented twice, once for the affirmation of the outcome, MRVGHG = 1, and once for its negation, mrvghg = 0. This repetition is necessary because it is not expected that the analysis will have perfect, causal symmetry (the minimal formula might not be the same for the 0 outcome than it is for the 1 outcome) (Ragin et al. 2008, Ragin 2014, Sehring et al. 2013, Legewie 2013, Thiem and Dusa 2013).

The final results from the analysis yielded a minimal formula, calculated through Boolean algebra. This final formula provided conclusions concerning the combination of elements that are associated with positive and negative outcomes for MRV. This allows inferences to be drawn concerning the prioritization of certain governance elements over others, and the overall levels and shortcomings of governance in the region.

3. Results

The study identifies what governance conditions are necessary and/or sufficient for the design and implementation of national MRV systems, in the specific cases of Costa Rica, El Salvador, Guatemala, Honduras, Panama, and the Dominican Republic. The combination of governance conditions associated with high numbers of national GHG inventory reports are presented through the results of the QCA Analysis. Additionally, an overall picture of governance performance is presented through four indexes, allowing for broader views of the state of governance in the region.

3.1 QCA Results

The following results presented use QCA notation, where, following Boolean algebra logic (Sehring et al. 2013, Thiem and Dusa 2013):

- the use of upper-case letters designates the presence of a condition.
- the use of lower-case letters indicates absence of a condition.
- "+" signifies "or".
- "*" means "and".

Table 13 shows the application of the process of necessity and sufficiency tests (see Figure 5), where it can be seen that three countries El Salvador, Costa Rica, and Guatemala, and their configurations are associated with a positive outcome for MRV. Honduras, the Dominican Republic and Panama are not associated with a positive outcome for MRV. The inclusion score indicates the configurations and the cases for which the outcome is 1; thus the configurations associated with this positive outcome, high numbers of national inventory reports are:

res*inst*LEG*disc, RES*INST*leg*DISC, RES*INST*LEG*DISC

Table 13: Truth table for crisp set QCA: configurations associated with a positive outcome of MRV (MRVGHG = 1)

Conditions				**Outcome**			
RES	INST	LEG	DISC		incl	PRI	Cases
0	0	1	0	1	1.000	1.000	El Salvador
1	1	0	1	1	1.000	1.000	Costa Rica
1	1	1	1	1	1.000	1.000	Guatemala
1	1	0	0	0	0.500	0.500	Honduras, Dominican Republic
1	0	0	1	0	0.000	0.000	Panama

incl: sufficiency inclusion score.
PRI: proportional reduction in inconsistency.

The R software runs a Boolean minimization of these observed configurations and generates a minimal formula of configurations associated with the positive outcome in MRV (MRVGHG

= 1). This minimization process also incorporates logical remainders (i.e. possible configurations that were not empirically evidenced in the cases). The configurations are reduced to:

INST*DISC => MRVGHG

This statement can be understood as: "the combination of specialized institutions and coordination platforms AND disclosure of information is associated with high capacities for MRV of GHG emissions, defined by higher number of national GHG inventory reports".

Because perfect symmetry is not necessarily expected in social phenomena, the same procedure (see Figure 3) is repeated for the negation of the outcome, mrvghg = 0. For this analysis, having performed the necessity tests and the sufficiency tests, Table 14 shows the configurations associated with low numbers of national inventory reports. It can be seen that only Panama is associated with this outcome (mrvghg=0).

Table 14 : Truth table for crisp set QCA: configurations associated with a positive outcome of MRV (MRVGHG = 1)

Conditions				**Outcome**			
RES	INST	LEG	DISC		incl	PRI	Cases
1	0	0	1	1	1.000	1.000	Panama
1	1	0	0	0	0.500	0.500	Honduras, Dominican Republic
0	0	1	0	0	0.000	0.000	El Salvador
1	1	0	1	0	0.000	0.000	Costa Rica
1	1	1	1	0	0.000	0.000	Guatemala

incl: sufficiency inclusion score.
PRI: proportional reduction in inconsistency.

Repeating the procedure of Boolean minimization and incorporation of logical remainders, the following configurations are associated with the negation of the outcome, which is mrvghg=0:

inst*DISC => mrvghg

inst*leg => mrvghg

RES*inst => mrvghg

In a less abbreviated form, these formulas read as: the combination of the lack of Institutionality AND a presence of Disclosure of information (**inst*DISC)**, the combination of a lack of Institutionality AND a lack of a Legal and Political Framework (**inst*leg)**, and the presence of Resources (low dependency on consultants) AND a lack of Institutionality (**RES*inst)** are all associated with low numbers of national GHG inventory reports. This demonstrates that poor institutionality is the common element associated with low numbers of national GHG inventory reports (mrvghg=0).

Finally, it is important to mention that through the variable reduction process (see Table 9), the indicator "Defined institutional roles and responsibilities" was found to be both necessary and sufficient for a positive outcome of MRV. This means that, across all cases, whenever

there was a positive outcome for MRV (MRVGHG=1), there was also a presence of this indicator. Consequently, although the indicator was not included in the comparative analysis, it is a governance element that plays an essential role in the successful construction of MRV.

3.2 Governance Performance Results

Although the main objective of the study was to compare the different governance elements that facilitate or limit the construction of MRV of emissions in Central America, there are many elements that countries had in common, and as such, are not included in the QCA analysis (see Annex 3 for the full list of elements in common). Many of these elements are still key for the construction and design of national MRV.

It is important to highlight the importance of a legal framework, and the fact that all countries reported having a legal mandate for the creation of national GHG inventory reports, for activity data, and for emission factors. Additionally, all countries reported having involved technical and expert criteria throughout the process of creating their existing legal and political instruments. However, all countries reported a heavy dependency on external financing for MRV.

It is important to describe the other governance elements involved in the construction of MRV, which reflect higher or lower levels of governance across the countries studied. The following indicators (see Figures 4-7) more fully describe the governance elements compiled throughout the study, as they detail four main categories of governance:

- Capacities and Methods
- Legal and Political Framework
- Institutionality and Coordination
- Transparency and Accountability

Each index scores the countries through weighted indicators, out of different possible totals (ranging from 4-9 maximum scores).

Governance Performance Indexes:

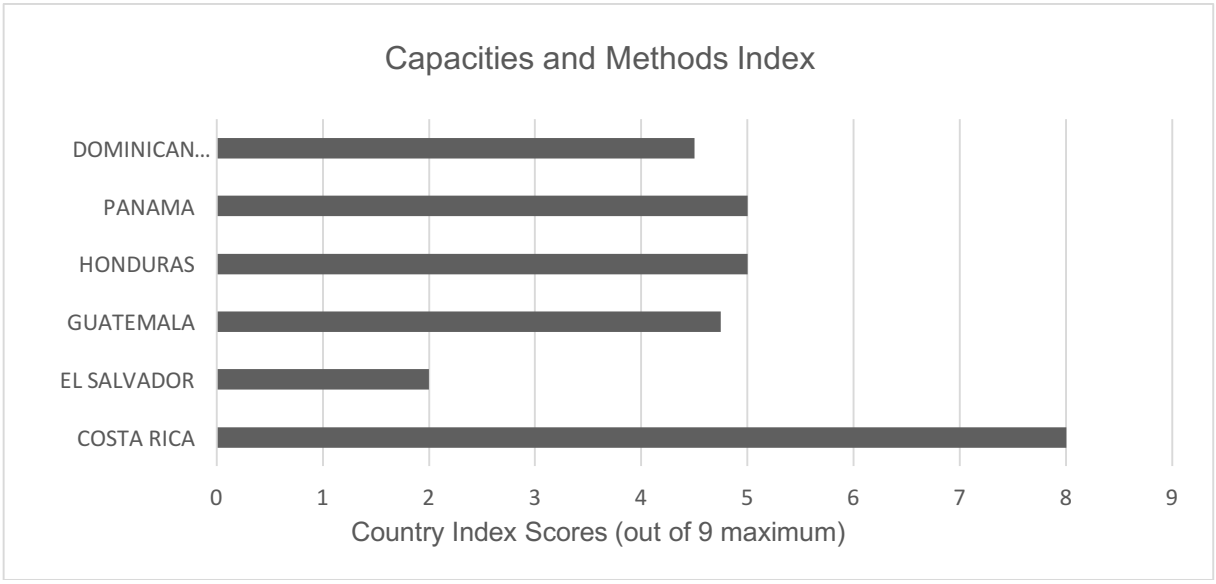

Figure 4: Capacities and Methods Index

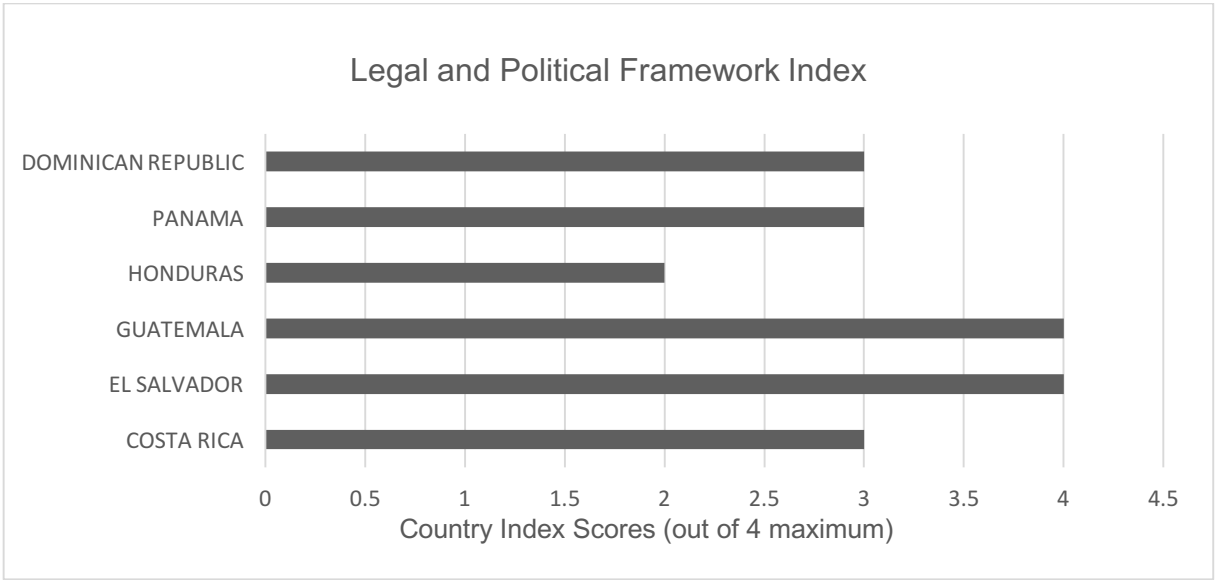

Figure 5: Legal and Political Framework Index

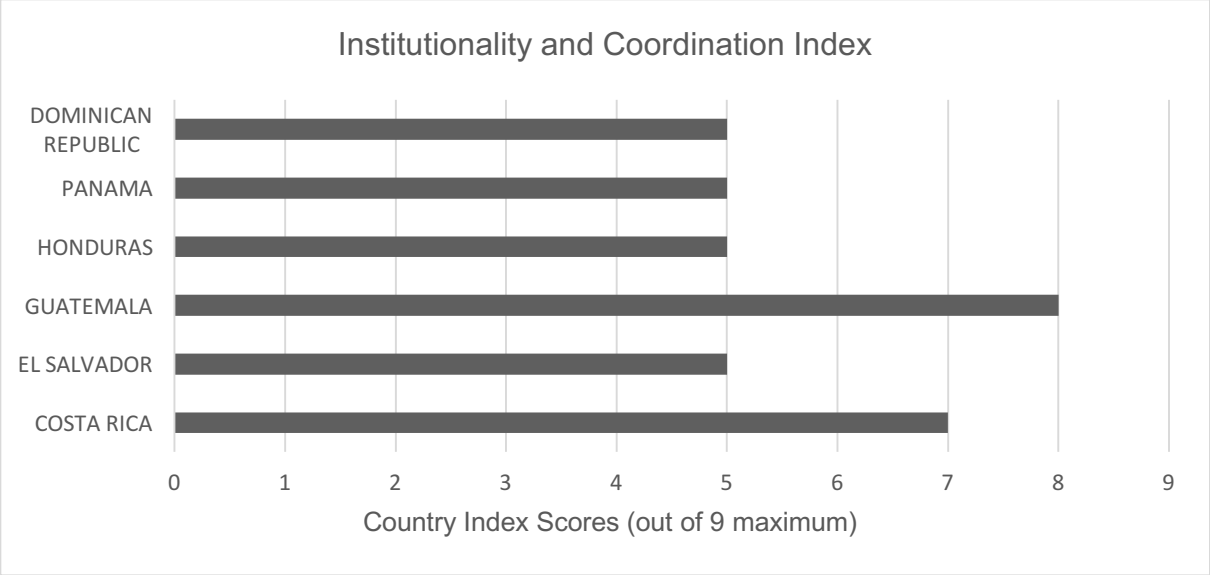

Figure 6: Institutionality and Coordination Index

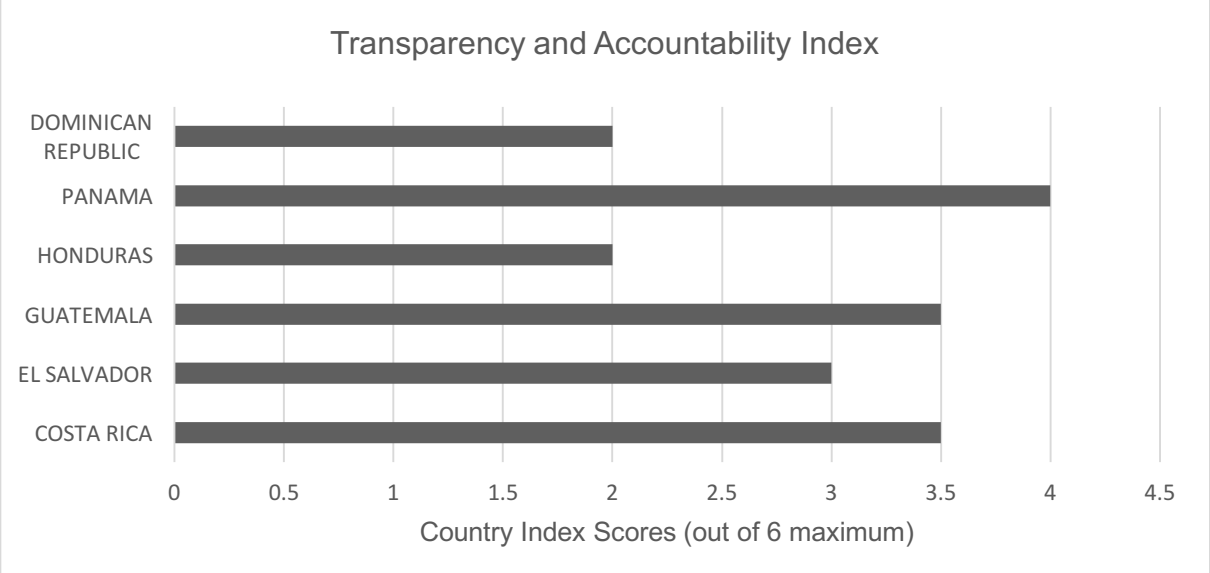

Figure 7: Transparency and Accountability Index

From these indexes (Figures 4-7) it can be seen that, although there are different levels of governance across the region (progress is uneven), there are some trends that can be observed. For instance, from the Capacities and Methods Index, it can be seen that there is a stark contrast between Costa Rica (with an almost perfect score of 8) and El Salvador (with the lowest score of 2). The Legal and Political Framework Index shows a level of progress that is comparatively even, with most countries (except Honduras) scoring between 3 and 4. Finally, the Transparency and Accountability Index demonstrates how all countries are lacking important elements in this area, as the highest score (Panama) was 4 out of a possible 6.

Overall, the indexes show that Guatemala and Costa Rica are the highest scoring countries across the board, which coincides with the results from the QCA analysis; where Guatemala, Costa Rica, and El Salvador were associated with the highest numbers of GHG inventory reports.

4. Discussion

The results from the analysis of governance conditions confirm the uneven levels of progress concerning the design and implementation of MRV systems in the region (CONAFOR 2014, EMSA 2015), evidencing the need for further prioritization and directed investment in the region. Still, the results from the analysis emphasize the interaction of these governance conditions for MRV; and they stress how the lack of institutionality is associated with lower capacities for MRV.

The importance of strong institutionality (i.e. institutions with clearly defined boundaries, where benefits and costs are equated, and where local users influence decisions (Becker and Ostrom 1995)) coincides with the findings form a recent study in Peru which analyzed the politics of developing an MRV system, where better intra- and inter-institutional coordination is recommended for better efficiency of resources (Kowler & Larson 2016). It also concurs with recent experiences in establishing GHG inventories for the LULUCF sector in Colombia, where the need for improving institutional processes was evident (Bhattacharya 2012).

The outcome of MRVGHG=1, however, was associated with a combination of conditions, demonstrating that elements of institutionality and coordination are not sufficient for MRV; they must exist alongside elements of transparency and accountability.

The condition "Institutionality and Coordination" was created referring specifically to the "Presence of institutions and agencies in place that efficiently coordinate the process of MRV of mitigation in the AFOLU sector". Understanding institutional infrastructure for MRV as referring to who reports what, how it is reported, and how the information is used (Kowler & Larson 2016), the best examples of successful institutional infrastructure currently in place are seen in Costa Rica and Guatemala, both countries associated with higher capacities for MRV.

In Costa Rica these governance elements are exemplified through the role of the National Meteorological Institute (IMN, Instituto Meteorológico Nacional), a specific technical institution that is directly responsible for the creation of national GHG inventory reports. As a separate, independent body, the IMN functions as a coordinating body that compels other institutions (i.e. forestry and agriculture ministries and organizations) to organize their data and deliver it efficiently to the IMN. In Guatemala, the environmental sector is characterized by having many entities responsible for different aspects of environmental management. This decentralized environmental sector requires high levels of coordination to comply with reporting requirements to the UNFCCC. Specific coordination platforms and groups (i.e. GIMBUT, Grupo Interinstitucional para el Monitoreo de Bosques y Uso de la Tierra) have been formed for the sole purpose of coordinating the compilation of data (Convenio Cooperación Técnica 2015).

Honduras and the Dominican Republic were the only cases not associated with either result (inclusion scores for both analyses < 1.00). This is explained by the fact that both of these countries share the same combinations of conditions (RES*INST*leg*disc), yet the raw data shows that the Dominican Republic has a high number of inventory reports (a total of 5), and

Honduras a low number of inventory reports (a total of 2). This indicates other governance conditions could be influencing the high and low numbers of inventory reports in these countries, for instance, Honduras' institutional framework, although defined informally, has not yet been defined legally (May 2016. Personal interviews), leading to much confusion for technicians working in coordination with several institutions. The difference could also be due to financial capacities and availability of funding, factors which were out of the scope of this analysis. Still, further research is needed to discern the specific differences that affect the capacities for MRV in these countries, and future research should incorporate important financial issues.

In relation to the results for Honduras and the Dominican Republic, it is also important to acknowledge certain drawbacks or limitations to using the number of national GHG inventory reports as a sole dependent variable, as many factors actually influence a country's ability to produce a national inventory report. This includes the unpredictability of funding, data availability, and even political agendas and atmosphere. Additionally, there are other reports that also demonstrate a country's progress in its ability to monitor GHG emissions; however, this measure is consistent with other standards that also describe countries' progress in capacities to MRV emissions. The countries with a higher number of GHG inventory reports are those that publish their uncertainties, the ones that use the latest 2006 IPCC methodologies, and whose data have higher tiers. Thus, the number of national inventory reports of GHG emissions was the most robust measure of current national MRV capacities that were found useful to this analysis.

Another limitation of the study is its restricted scope, as it included little empirical diversity due to its small number of cases. This limits the generalization of the results to other geographical regions, and demonstrates the need for further research in the area to better improve the understanding of the most important governance elements for MRV construction in developing countries. This limitation in scope is a common drawback of QCA analyses (Korhonen-Kurki et al. 2014), that can be improved as more countries start implementing MRV (as well as REDD+).

As is the case with other analyses of governance conditions for REDD+ policies (Korhonen-Kurki et al. 2014, Sehring et al. 2013), the design and implementation of MRV systems in the AFOLU sectors of Central America and the Caribbean are highly dynamic systems whose components (i.e. actors and institutions) are constantly changing. Although this limits the application of the methodology of this study, it also sheds light on the governance dynamics of the region, and evidences the need for continual research in this field.

This study contributes toward the implementation of REDD+ in the region, as its economic an political dimensions require effective MRV of emissions and removals from forests (Herold & Skutsch 2011, Joseph et al. 2013). The findings also contribute towards other research that has been carried out in the Latin American region focused on the implementation of REDD+ (i.e. investigating the enabling conditions for REDD, or early proposals for the design of MRV systems for REDD+), as well as specific QCA analyses carried out in developing countries

around the world (Kowler & Larson 2016, Korhonen-Kurki et al. 2014, Herold & Skutsch 2011).

The results of the study are also relevant to understanding the social and political implications of tackling these emission estimates and mitigation potential in the AFOLU section of Central America and the Caribbean. Taking into account the context of violence, crime, and poor governance of the region (McSweeney et al. 2014, Cuellar et al. 2011); our findings provide input for international decision-makers articulating the mechanisms that determine climate change response actions (Tubiello et al. 2014). This ability to prioritize action is especially important in the environmental sector, where funding competes with numerous other priorities (Held & Hervey 2011, Singh & Bacher 2015, Bhattacharya 2012).

Although MRV is usually presented as a technical issue (i.e. emphasizing the need for investment in technical capacity building), broad based MRV systems require strong institutional design and governance in order to provide accurate and useful data in ways that meet multiple needs (Kowler & Larson 2016). The results from this study provide input for decision-makers of the region investing in the design of MRV, aiming at more efficient investments that meet not only international reporting requirements, but also address domestic monitoring needs.

5. Conclusions and Recommendations

As all UNFCCC member countries prepare to build and implement MRV mechanisms as a common system for transparency, the need for regular updates of AFOLU emission estimates are crucial not only for science, but also for policy reasons. Through this monitoring of emissions, more effective and efficiently implemented mitigation strategies will be possible.

The results of this study evidence that, in the AFOLU sector, the establishment of MRV systems involves not only technical, but also governmental challenges for developing countries. In Central America, these challenges include a constant threat to democracy, human rights, and rule of law due to the context of violence and crime, making the roadmap to good governance, and to the establishment of MRV, all the more difficult.

Another challenge for the implementation of MRV in the region is how the environmental sector competes for funding with many other priorities. However, all countries reported a heavy dependency on external financing for MRV, underlining how the construction of MRV hinges on the results of this study emphasize the important role of institutionality for successful implementation of MRV systems. Countries without robust institutions face the biggest hurdles in designing and implementing MRV systems; and addressing these specific shortcomings involves addressing the greater context of poor governance. This is evidenced in the results, as the QCA analysis implies that strong institutional infrastructure is not enough for positive results in MRV; it should be linked to elements of transparency, such as proactively disclosing information to relevant audiences through accessible platforms.

The consequences of dependency in the availability of international funds are not only seen in the lacking of technical capacities, but also in employment of professionals (i.e. the actors that make up institutions). The results of this study contribute towards the prioritization of investments for MRV; but they also suggest that, notwithstanding the importance of technical resources (i.e. for equipment and training), investment in institutional capacities should also be a financial priority.

In summary, there are many diverse challenges for the successful design and implementation of MRV systems for emissions in the AFOLU sector in the Central American and Caribbean region. The results of this study contribute towards untangling some of these governance challenges, and recommend the investment of resources in institutional infrastructure paired with mechanisms for transparency. Both of these are elements that have far-reaching implications for better governance of the region's environmental sector, and respond not only to international agenda requirements, but also domestic monitoring needs.

Bibliography

Aide, TM; Clark, ML; Grau, HR; López-Carr, D; Levy, MA; Redo, D; Bonilla-Moheno, M; Riner, G; Andrade-Núñez, MJ; Muñiz, M. 2013. Deforestation and Reforestation of Latin America and the Caribbean (2001-2010). Biotropica 45(2): 262-271.

Aide, TM; Clark, ML; Grau, HR; López-Carr, D; Levy, MA; Redo, D; Bonilla-Moheno, M; Riner, G; Andrade-Núñez, MJ; Muñiz, M; Vermeulen, SJ; Campbell, BM; Ingram, JSI; Uk, PS; Brazil, MB. . 2013. Climate Change and Food Systems. Biotropica 45(1): 195-222.

Arts, B. 2014. Assessing forest governance from a 'Triple G' perspective: Government, governance, governmentality. Forest Policy and Economics 49: 6-11.

Basurto, X; Speer, J. 2012. Structuring the Calibration of Qualitative Data as Sets for Qualitative Comparative Analysis (QCA). Field Methods 24: 155-174.

Becker, CD; Ostrom, E. 1995. Human Ecology and Resource Sustainability: The Importance of Institutional Diversity. Annual Review Ecological Systems 26: 113-33.

Bhattacharya, S. 2012. Producing a National Ghg Inventory for the Land Use, Land-Use Change, and Forestry (Lulucf) Sector: Case Study From India. 2012.

Brockhaus, M; Di Gregorio, M. 2014. National REDD + policy networks: from cooperation to conflict. Ecology and Society 19(4): 14.

Brockhaus, M; Di Gregorio, M; Mardiah, S. 2014. Governing the design of national REDD+: An analysis of the power of agency. Forest Policy and Economics 49: 23-33.

Calvin, K. V.; Beach, R; Gurgel, A; Labriet, M; Loboguerrero Rodriguez, AM. 2014. Agriculture, forestry, and other land-use emissions in Latin America. Energy Economics 56: 615-624.

Castro R.; Chacón, M. Eds. Agriculture, forestry and other land-use in the climate negotiations : a Latin American perspective issues Series (2014, s.l.). 2014.

Cerbu, G a.; Swallow, BM; Thompson, DY. 2011. Locating REDD: A global survey and analysis of REDD readiness and demonstration activities. Environmental Science and Policy 14(2): 168-180.

Chacón et al. 2017. El estado del monitoreo forestal en Latinoamérica y el Caribe: tipos de iniciativas y uso de tecnologías. *In progress.*

CIFOR. 2013. Análisis de REDD+. Eds. A Angelsen; M Brockhaus; WD Sunderlin; L V. Verchot. Bogor, ID, Center for International Forestry Research.

EMSA, 2015. Plan de trabajo a Largo Plazo en Materia de Monitoreo Forestal de la Estrategia Mesoamericana de Sustentabilidad Ambiental.

Estrategia Regional de Cambio Climático (2010, s.l.). 2010. Ed. Comisión Centroamericana de Ambiente y Desarrollo (CCAD). s.l.

Estado de la implementación de los Sistemas Nacionales de Monitoreo Forestal en Mesoamérica (2014, Mexico). 2014. Ed. Comisión Nacional Forestal. Mexico.

Cronkleton, P; Bray, DB; Medina, G. 2011. Community forest management and the emergence of multi-scale governance institutions: Lessons for REDD+ development from

Mexico, Brazil and Bolivia. Forests 2(2): 451-473.

Territorial Dynamics in Central America: context and challenges for rural communities (2011, San Salvador, El Salvador). 2011. Ed. Cuellar, N.; Candel, S.; Davis, A.; Díaz, O.; Luna, F.; Ortiz, X. San Salvador, El Salvador.

Davis, C; Williams, L; Lupberger, S; Daviet, F. 2013. Assessing Forest Governance: the Governance of Forests Initiative Indicator Framework. s.l., s.e., 72 p.

DeFries, R; Achard, F; Brown, S; Herold, M; Murdiyarso, D; Schlamadinger, B; de Souza, C. . 2007. Earth observations for estimating greenhouse gas emissions from deforestation in developing countries. Environmental Science and Policy 10(4): 385-394.

Dusa, A; Thiem, A. 2013. QCA: A package for qualitative comparative analysis. R Package Version 2.0. The R Journal 5(June): 87-97.

Knowledge Product: Institutional Arrangements for MRV (2013, s.l.). 2013. Ed. Elsayed, S. s.l.

FAO. 2016. State of the World's Forests 2016. Forests and agriculture: land-use challenges and opportunities. Rome, s.e., 126 p.

Fosyth, T. 2007. Multilevel, Multiactor Governance in REDD+: Participation, integration and coordination. Building REDD+ institutional architecture and processes. s.l., s.e., p.113-122.

Enhancing Today's MRV Framework to Meet Tomorrow' s Needs : The Role of National Communications and Inventories (2009, Washington DC). 2009. Ed. Fransen, T. Washington DC.

Held, D; Hervey, A. . 2011. Democracy, Climate Change and Global Governance: Democratic Agency and the Policy Menu Ahead. The Governance of Climate Change 2011: 89-110.

Herold, M; Skutsch, M. 2011. Monitoring, reporting and verification for national REDD + programmes: two proposals (on line). (Environmental Research Letters).

Hiepe, C; Kanamaru, H. . 2008. Review of literature on monitoring to support REDD. 2008: 24.

Holmes, I; Potvin, C. 2014. Avoiding Re-Inventing the Wheel in a People-Centered Approach to REDD+. Conservation Biology early view(0): 1-14.

Hosonuma, N; Herold, M; De Sy, V; De Fries, RS; Brockhaus, M; Verchot, L; Angelsen, A; Romijn, E. 2012. An assessment of deforestation and forest degradation drivers in developing countries. Environmental Research Letters 7(4): 44009.

INEI. 2012. IV Censo Nacional Agropecuario. Resultados Definitivos. IV Censo Nacional Agropecuario no.Cenagro: 62.

Instituto Nacional de Estadísticas-INEC. 2015. VI Censo Nacional Agropecuario. s.l., s.e., 146 p.

Joseph, S; Herold, M; Sunderlin, WD; Verchot, L V. 2013. REDD+ readiness: early insights on monitoring, reporting and verification systems of project developers. Environmental Research Letters 8(3): 34038.

Kanowski, PJ; McDermott, CL; Cashore, BW. 2011. Implementing REDD+: Lessons from analysis of forest governance. Environmental Science and Policy 14(2): 111-117.

Kauffman, D; Kraay, A; Mastruzzi, M. 2011. The Worldwide Governance Indicators: Methodology and Analytical Issues. Hague Journal on the Rule of Law 3(2): 220-246.

Kojwang, H; Ulloa, G. 2012. Country Needs Assessment: a report on REDD+ Readiness among UN_REDD Programme and FCPF Member Countries. no.October: 217.

Kooiman, J. 2010. Governance and Governability. The New Public Governance? New York, NY, Routledge, p.72-86.

Korhonen-Kurki, K; Sehring, J; Brockhaus, M; Di Gregorio, M. . 2014. Enabling factors for establishing REDD+ in a context of weak governance. Climate Policy 14(2): 167-186.

Kowler, L; Larson, A. 2016. Beyond the technical: The politics of developing the MRV system in Peru. CIFOR infobrief no.133.

Global Good Practice Analysis 2.0: on INDCs, LEDS, NAMAs and MRV (2015, s.l.). 2015. Ed. Kurdziel, M-J; Roeser, F. s.l.

Larson, AM; Petkova, E. 2011. An introduction to forest governance, people and REDD+ in latin america: Obstacles and opportunities. Forests 2(1): 86-111.

Legewie, N. 2013. An Introduction to Applied Data Analysis with Qualitative Comparative Analysis (QCA). Forum Qualitative Sozialforschung / Forum: Qualitative Social Research. Forum: Qualitative Social Research 14(3): 1-33.

Lütken, S; Aalders, E; Pretlove, B; Peters, N; Holm, K. 2012. Measuring Reporting Verifying: a primer on MRV for Nationally Appropriate Mitigation Actions. Ed. M Hinostroza. Roskilde, Denmark, UNEP Risø Centre, 32 p.

McSweeney, K; Nielsen, EA; Taylor, MJ; Wrathall, DJ; Pearson, Z; Wang, O; Plumb, ST. 2014. Drug policy as conservation policy: narco-deforestation. Science 343(6170): 489–490.

Pagiola, S; Navarro, G; Velasquez Villatoro, MM; Nukui, H; Robledo, C; Leal, MJ de los R de. . 2004. Session 4 : Establishing robust governance and institutional arrangements lessons and challenges. ITTO Tropical Forest Update 23(1): 6.

Pang, Y; Thistlethwaite, G; Watterson, J; Okamura, S; Harries, J; Varma, A; Cornu, E Le. . 2013. Measurement, Reporting, Verification: How to set up national MRV systems. 2013: 200.

Parra, A; Smith, G; Shoch, D; Musinsky, J; Stolle, F; Austin, K; Angeletti, I. . 2014. REDD+ Measurement, reporting and Verification (MRV) Manual Version 2.0. Eds. J Hewson; M Steininger; S Pesmajoglou. Washington, DC, USA, USAID-supported Forest Carbon, Markets and Communities Program, 209 p.

Pettenella, D; Brotto, L. 2012. Governance features for successful REDD+ projects organization. Forest Policy and Economics 18: 46-52.

Ragin, CC. . 2014. The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies. s.l., University of California Press.

Ragin, CC; Benoit, R. 2008. Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques: 51 (Applied Social Research Methods). s.l., Sage Publications.

Ragin, CC; Strand, SI; Rubinson, C. 2008. User's Guide to Fuzzy-Set / Qualitative Comparative Analysis. s.l., s.e., 87 p.

Redo, DJ; Grau, HR; Aide, TM; Clark, ML. 2012. Asymmetric forest transition driven by the interaction of socioeconomic development and environmental heterogeneity in Central America. Proceedings of the National Academy of Sciences of the United States of America 109(23): 8839-44.

Romijn, E; Herold, M; Kooistra, L; Murdiyarso, D; Verchot, L. . 2012. Assessing capacities of non-Annex I countries for national forest monitoring in the context of REDD+. Environmental Science and Policy 19-20(March): 33-48.

Romijn, E; Lantican, CB; Herold, M; Lindquist, E; Ochieng, R; Wijaya, A; Murdiyarso, D; Verchot, L. . 2015. Assessing change in national forest monitoring capacities of 99 tropical countries. Forest Ecology and Management 352: 109-123.

Schroeder, H; McDermott, C. 2014. Beyond carbon: Enabling justice and equity in REDD+ across levels of governance. Ecology and Society 19(1): 2-4.

MRV and the International Climate Change Negotiations: Coming to Terms with MRV (2014, Eschborn, Germany). 2014. Ed. Sebastian, W. Eschborn, Germany.

Sehring, J; Korhonen-Kurki, K; Brockhaus, M. 2013. Qualitative Comparative Analysis (QCA) An application to compare national REDD + policy processes. 2013: 34.

Guide for Designing Mandatory Greenhouse Gas Reporting Programs (2015, s.l.). 2015. Ed. Singh, N; Bacher, K. s.l.

MRV 101: Understanding Measurement, Reporting, and Verification of Climate Change Mitigation (2016, Washington DC). 2016. Ed. Singh, N; Finnegan, J; Levin, K. Washington DC.

Smith, P; Bustamente, H; Ahammad, H; Clark, H; Dong, EA; Elsiddig, H; Haberl, R; Harper, J; House, M; Jafari, O; Masera, C; Mbow, NH; Racindranath, CW. 2014. Agriculture, Forestry and Other Land Use (AFOLU). Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. s.l., s.e., p.811-922.

Thiem, A; Dusa, A. 2013. Qualitative Comparative Analysis with R: a User's Guide. s.l., Springer, 1-108 p.

Thomann, E; Wittwer, S. 2016. Performing fuzzy- and crisp set QCA with R.

Tubiello, FN; Salvatore, M; Cóndor Golec, RD; Ferrara, a.; Rossi, S; Biancalani, R; Federici, S; Jacobs, H; Flammini, A. 2014. Agriculture, Forestry and Other Land Use Emissions by Sources and Removals by Sinks. FAO - e Food and Agriculture Organization of the United Nations 2: 4-89.

UN-REDD. 2014. MRV and Monitoring. 2014 Annual Report of the UN-REDD Programme Fund. s.l., UN-REDD Programme Fund, p.1-2.

UNFCCC. 2014. Handbook on Measurement, Reporting and Verification. Bonn, Alemania, United Nations Climate Change Secretariat, 56 p.

United Nations. 2015. Global Issues: Govenance. Consultado 20 oct. 2015. Available at http://www.un.org/en/globalissues/governance/

United Nations Framework Convention on Climate Change (UNFCCC). 2016. Paris Agreement - Status of Ratification. Available at http://unfccc.int/paris_agreement/items/9444.php

Vermeulen, SJ; Campbell, BM; Ingram, JSI. 2012. Climate Change and Food Systems. Annual Review of Environment and Resources 37(1): 195-222.

Knowledge Product: Elements and Options for National MRV Systems (2013, s.l.). 2013. Ed. Wartmann, S; Larkin, J; Eisbrenner, K; Jung, M. s.l.

WRI. 2015. CAIT Climate Data Explorer: Paris Contributions Map. Available at http://cait.wri.org/indc/#/

Challenges and lessons learned in the preparation of Intended Nationally Determined Contributions (INDCs) On behalf of: Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB) (2016, s.l.). 2016. Ed. Wucke, A; von Lüpke, H; Herrmann, L; Tsegaye, M; Martin, R; Meyer, T-P; Rentzmann, C; Gajo, M; Korneffel, P; Böthling, J. s.l.

Yale Center for Environmental Law and Policy. 2016. Global Metrics for the Environment. 2016: 123.

Annex 1: Arguments for indicator prioritization during the variable reduction process

As seen in Table 9, the remaining indicators for each condition set were prioritized conceptually, taking into account the in-depth knowledge of the cases. For the first condition set, Capacities and Methodologies, the definition of emission factors was filtered out as an indicator because it was considered only one of the specific technical details that were measured. Instead of being a holistic reflection of countries' capacities, it could be attributed to methodological choices and priorities.

Technicians' perception about whether they have enough tools and resources for the estimation of emissions data was also filtered out because perception data was difficult to compare across cases. "Dependency on consultants" was kept as the sole indicator for this condition set.

The condition set of Capacities and Methodologies combined the score of both indicators "Sufficient tools and resources for emissions estimation" and "Dependency on consultants". As outlined in Table 9, the condition [RES] "Sufficient resources available" was defined, where the presence [1] of [RES] was a score greater than or equal to 2, and an absence [0] less than 2.

For the second condition set, Institutionality and Coordination, the indicators "Political and institutional volatility" and "Participatory process in preparing INDCs" were not prioritized as determining factors for measuring capacities of MRV of emissions. Truly participatory processes are difficult to standardize between countries, and INDCs were prepared with different levels of rigor. Although volatility in politics and institutions may affect accumulated institutional performance, this usually happens at a national level. As explained in the interviews, volatility does not affect the technical level in the same way; although positions may switch around, the same basic group of people continues working in the area because technical capacities in this subject are usually limited to a handful of experts in each country.

The index for the condition set Institutionality and Coordination was created by combining the scores of "Specific institutional coordination groups and platforms" and "Specialized technical institutions". Thus, the condition [INST] was defined, and a combined score of $\geqq 1$ designated presence (1), and < 1 as absence (0).

Annex 2: QCA Analysis and Results

Results of QCA Analysis for outcome (MRVGHG=1)

1) Necessity Test:

incl: necessity inclusion score (how often the condition has been present (=1), given the presence of the outcome (=1), in relation to the overall presence of the outcome.)
RoN:
cov.r: necessity coverage score (how often the condition has been present (=1), given the presence of the outcome (=1), in relation to the overall presence of the condition.)

	incl	RoN	cov.r
INST+disc	1.000	0.500	0.800
INST+LEG	1.000	0.500	0.800
res+INST	1.000	0.500	0.800
RES+disc	1.000	0.000	0.667
RES+LEG	1.000	0.000	0.667
RES+inst	1.000	0.000	0.667
inst+leg+DISC	1.000	0.000	0.667
res+leg+DISC	1.000	0.000	0.667

2) Sufficiency test: Truth table

RES
INST
LEG
DISC
OUT: outcome value
n: number of cases in configuration
incl: sufficiency inclusion score
PRI: proportional reduction in inconsistency
cases: ESA (El Salvador), CR (Costa Rica), GT (Guatemala), HND (Honduras), DR (Dominican Republic), PNM (Panama)

RES	INST	LEG	DISC	OUT	n	incl	PRI	cases
0	0	1	0	1	1	1.000	1.000	ESA
1	1	0	1	1	1	1.000	1.000	CR
1	1	1	1	1	1	1.000	1.000	GT
1	1	0	0	0	2	0.500	0.500	HND, DR
1	0	0	1	0	1	0.000	0.000	PNM

3) Boolean minimization

M1: RED*INST*DISC + res*inst*LEG*disc => MRVGHG

	incl	PRI	cov.r	cov.u	cases
RES*INST*DISC	1.000	1.000	0.500	0.500	CR, GT
res*inst*LEG*disc	1.000	1.000	0.250	0.250	ESA
M1	1.000	1.000	0.750		

4) Incorporating Logical remainders

M1: INST*DISC + (LEG) => MRVGHG
M2: INST*DISC + (res) => MRVGHG
M3: INST*DISC + (inst*disc) => MRVGHG

	incl	PRI	cov.r	cov.u	(M1)	(M2)	(M3)
INST*DISC	1.000	1.000	0.500	0.250	0.250	0.500	0.500
LEG	1.000	1.000	0.500	0.000	0.250		
res	1.000	1.000	0.250	0.000		0.250	
inst*disc	1.000	1.000	0.250	0.000			0.250
M1	1.000	1.000	0.750				
M2	1.000	1.000	0.750				
M3	1.000	1.000	0.750				

Results of QCA Analysis for Negation of the Outcome (mrvghg=0)

1) Necessity test

	incl	RoN	cov.r
leg	1.000	0.500	0.500
RES	1.000	0.250	0.400
RES*leg	1.000	0.500	0.500
inst+disc	1.000	0.500	0.500
INST+DISC	1.000	0.250	0.400

2) Sufficiency test: Truth table

RES	INST	LEG	DISC	OUT	n	incl	PRI	cases
1	0	0	1	1	1	1.000	1.000	PNM
1	1	0	0	0	2	0.500	0.500	HND, DR
0	0	1	0	0	1	0.000	0.000	ESA
1	1	0	1	0	1	0.000	0.000	CR
1	1	1	1	0	1	0.000	0.000	GT

3) Boolean minimization

M1: RES*inst*leg*DISC => mrvghg

	incl	**PRI**	**cov.r**	**cov.u**	**cases**
RES*inst*leg*DISC	1.000	1.000	0.500	-	PNM
M1	1.000	1.000	0.750		

4) Parsimonious solution

M1: inst*DISC => mrvghg
M2: inst*leg => mrvghg
M3: RES*inst => mrvghg

	incl	PRI	cov.r	cov.u	(M1)	(M2)	(M3)
inst*DISC	1.000	1.000	0.500	0.000	-		
inst*leg	1.000	1.000	0.500	0.000		-	
RES*inst	1.000	1.000	0.500	0.000			-
M1	1.000	1.000	0.500				
M2	1.000	1.000	0.500				
M3	1.000	1.000	0.500				

Annex 3: List of Indicators excluded from QCA Analysis

Table 15: Elements for MRV that all countries have in common (i.e. indicators filtered out from the QCA analysis)

Condition set	Indicators present in all countries
Capacities and Methods	1. All cases report capacities to prepare maps of kinds of coverage 2. All cases report dependency on external finance
Institutionality and Coordination	1. All cases report that they have a defined focal point for the UNFCCC 2. All cases report that they have a national direction or a national office for CC
Legal and Political Framework	1. All cases report that there is a legal mandate for creating the national GHG inventory reports, for the activity data, for emission factors, and for reports 2. All cases report that they involve technical/expert criteria in the process of creating legal and political instruments
Transparency and Accountability	1. All cases report that they have transparency/public information access laws 2. No cases employ diversity of methods for disclosure of information 3. No cases have formal accountability mechanisms between institutions

Annex 4: Interview protocol

Mayo 2016
Proyecto de Tesis: Gobernanza de MRV de mitigación con base en uso de la tierra: un análisis comparativo en Centroamérica y República Dominicana
Programa de Posgrado: Maestría en Manejo y Conservación de Bosques Tropicales y Biodiversidad

Objetivo:

El MRV es una parte técnica esencial dentro de las medidas de mitigación y adaptación que los países de la región deberán ir construyendo en los próximos años. La gobernanza de todos estos aspectos a nivel nacional e internacional es clave para la creación de sistemas de monitoreo transparentes y creíbles, y ultimadamente para que los gobiernos implementen metas ambiciosas pero alcanzables, identificando barreras y facilitando cambios de dirección cuando sea necesario.

Por medio de esta investigación, se espera poder generar recomendaciones, lineamientos y pautas que los tomadores de decisión y los técnicos de estos sistemas de monitoreo puedan usar para la mejor preparación e implementación de sistemas MRV.

Entrevista (duración aproximada: 1 hora)

Fecha	
Duración	
Lugar y Contexto	
Sujeto	

Introducción

Mi nombre es Andrea Pacheco, hondureña, soy estudiante de la maestría manejo y conservación de bosques en el CATIE. Para mi tesis estoy trabajando el tema de sistemas de MRV en Centroamérica y República Dominicana – MRV, específicamente de mitigación en el sector AFOLU (sectores de agricultura, silvicultura/bosques, y otros usos de la tierra).

En esta entrevista, mi objetivo es aprender más sobre el sistema de MRV nacional (del sector AFOLU) en Guatemala llenando vacíos que he encontrado y poder confirmar los datos que tengo en este momento. Además, me interesa su perspectiva sobre las capacidades actuales en Guatemala para establecer un sistema nacional de monitoreo, y ultimadamente un sistema de MRV. Las preguntas que le voy a hacer van a ayudarme a identificar las condiciones de gobernanza necesarias y suficientes para el establecimiento de este sistema, al igual que las barreras que limitan el avance del sistema.

Le recuerdo que sus respuestas son completamente anónimas. Su nombre y toda la información que usted me provea es confidencial *(preguntar si están de acuerdo con que se les grabe)*.

Introducción (5 mins)
Cuénteme un poco sobre usted, y cuáles son sus temas de experiencia, qué conoce sobre el tema de MRV, el monitoreo forestal y/o de emisiones en su país.

Arreglos Institucionales, políticos y legales (15 min)

Pregunta	Condiciones	Indicador	Sub-indicadores
1) Comenzar enseñando y explicando el mapa institucional del sistema nacional de monitoreo elaborado con la EMSA, ¿Podría validar y llenar los vacíos de este mapeo institucional del sistema de monitoreo en el país?	Arreglos institucionales		
2) ¿Existe un marco legal que define los roles y responsabilidades para las agencias de gobierno de manera clara? a) ¿Define la división de poderes ejecutivos y responsabilidades a través de los diferentes niveles de administración? b) ¿Existen sistemas de rendición de cuentas entre estas agencias ejecutivas? ¿cuáles? c) ¿Han tenido tensiones o conflictos de funcionamiento institucional debido al marco legal?	Arreglos institucionales Coordinación Capacidades	Base legal para roles y responsabilidades Capacidades legales	Mandatos institucionales División de poderes Rendición de cuentas Coherencia
3) ¿A qué nivel las agencias divulgan información al público de manera puntual y proactiva? a) ¿Las leyes y regulaciones se publican de manera puntual? b) ¿Qué plataformas de información tienen dedicadas a el manejo y divulgación de información al público? (¿son convenientes, asequibles, útiles?) c) ¿Qué diversidad de métodos emplean para alcanzar las necesidades de grupos distintos?	Acceso a datos, sistemas de colección, y calidad de datos Transparencia Rendición de cuentas	Transparencia de agencias de gobierno	Publicación de leyes Divulgación Plataformas de información Puntualidad (timeliness)
4) Guatemala cuenta también con _____ (arreglos políticos/legales). En la elaboración de estos instrumentos, ¿Los legisladores involucran en el proceso el	Arreglos institucionales	Capacidades legislativas	

criterio de expertos, o información generada por otras organizaciones de sociedad? ☐si ☐no ☐a veces/no siempre ☐no sabe ¿De qué maneras? ¿Considera que estos instrumentos son suficientes para la construcción de un sistema nacional de MRV? ☐si ☐no ☐parcialmente ☐no sabe ¿Por qué?	Capacidades y herramientas Participación sociedad civil Capacidades Coordinación	Participación de otros sectores en la toma de decisiones Percepciones/visión a futuro	

1) Metodologías y datos (15 min)

Pregunta	**Condiciones**	**Indicador**	**Sub-indicadores**
5) ¿En <u>SU PAÍS</u> se cuentan con los suficientes recursos y herramientas técnicas para elaborar los DA y FE? a) ¿Existe una dependencia de consultores externos? b) ¿Por qué? (¿falta de financiamiento?, ¿falta de capacitaciones?)	Metodologías Acceso a datos, sistemas de colección, calidad de datos Capacidades y herramientas Capacidades	Capacidades técnicas Capacidades financieras Dependencia externa	
6) ¿Qué procesos de verificación para la estimación de emisiones (DA, FE) existen internamente/de manera doméstica? (confiabilidad, precisión, etc.) a) ¿Se han llevado a cabo verificaciones externas ya? b) Considera que las metodologías para la elaboración de los datos de actividad y las factores de emisión son precisas y confiables? (percepción)	Arreglos institucionales Metodologías Capacidades y herramientas Rendición de cuentas Capacidades	Confiabilidad y precisión de datos Percepciones sobre eficacia	

7) Actualmente en SU PAÍS ¿hay NAMAs?¿Cómo se puede abordar el monitoreo de emisiones en el sector agrícola?, ¿Qué factores influyen por sobre la inclusión/exclusión de remociones por este sector? (MRV del sector agrícola)	Alcance Arreglos institucionales Metodologías Capacidades	Capacidades sector agrícola Capacidades de reporte	Tensiones entre sectores agro y bosques
8) Existen lecciones aprendidas sistematizadas sobre la elaboración de estos reportes (CN's, IGEI, REL)? ☐si ☐no ☐parcialmente ☐no sabe ¿Quién las tiene, y cómo se podrían implementar?	Acceso a datos, sistemas de colección, calidad de datos Rendición de cuentas		

2) Financiamiento, incentivos, y conflictos de interés (15 min)

Pregunta	Condiciones	Indicador	Sub-indicadores
9) ¿Dónde se establecen las pautas para el financiamiento del MRV (de dónde proviene, cómo se distribuye)? a) ¿Cómo considera que debería funcionar la provisión de fondos a largo plazo?	Arreglos institucionales Capacidades	Arreglos institucionales financieros Marco legal para el financiamiento Capacidades legales	Visión a futuro para el marco legal de la distribución de fondos
10) ¿Cuáles son los costos reales para un sistema nacional de MRV?	Capacidades y herramientas Capacidades	Capacidades financieras	Visión a futuro para sostenibilidad de MRV

11) ¿Qué áreas considera que deberían ser prioritarias para el financiamiento? ☐capacidades técnicas ☒capacidades institucionales ☐capacidades financieras ☐otro:	Capacidades y herramientas Capacidades	Capacidades financieras	Recomendaciones inmediatas
Caso de estudio: *12) ¿Quién decide cómo funciona la distribución de beneficios del financiamiento recibido para los sistemas nacionales de monitoreo? ¿Por qué?*	Arreglos Institucionales Transparencia Coordinación	Conflictos de Interés Tensiones de poder	
13) *En experiencias previas, ¿se han visto conflictos de interés en la distribución de este financiamiento?* a) Existen mecanismos para asegurar: i) Divulgación de conflictos de interés ii) Divulgación de activos financieros iii) Restricciones de regalos/obsequios iv) Penalidades por incumplimiento	Arreglos Institucionales Coordinación	Conflictos de Interés	Divulgación información Mecanismos para evitar conflictos
14) *¿Qué consecuencias se ven en los procesos de construcción del sistema debido a estos conflictos?* ☐atrasos en el proceso ☐distribución de fondos no equitativa ☐pérdida de personal ☐otro:	Capacidades y herramientas Capacidades	Capacidades afectadas por el financiamiento	Consecuencias

3) Preguntas Finales (10 min)

15) Según el INDC de <u>SU PAÍS se comprometen con reducir las emisiones por XX%</u> ¿Cómo se propone que sea el componente de MRV para estos compromisos?

16) ¿Algún otro tema o asunto que no mencionamos que le gustaría retomar?