IHS
Making cities work

IHS is the international institute of urban management
of Erasmus University Rotterdam

MSc Programme in Urban Management and Development

Rotterdam, The Netherlands
September 2018

Thesis

Title: Potential drivers and barriers of the integration of mitigation and adaptation action plans from cities in Latin America and the Caribbean

Hyejung Kim
Supervisor: Stelios Grafakos, PhD
Specialization: Urban Environment, Sustainability and Climate Change

UMD 14

IHS
Making cities work

Erasmus Universiteit Rotterdam

MASTER'S PROGRAMME IN

URBAN MANAGEMENT AND DEVELOPMENT

(October 2017 – September 2018)

Potential drivers and barriers of the integration of mitigation and adaptation action plans from cities in Latin America and the Caribbean

Hyejung Kim

South Korea

Supervisor: Stelios Grafakos, PhD

UMD 14 Report number: 1223

Rotterdam, September 2018

Summary

It is widely accepted that the impact of climate change causes socioeconomic and environmental damage and hinder societies from achieving the Sustainable Development Goals (SDGs). In Latin America and the Caribbean (LAC), 80% of the total population lives in cities and estimates show that the extreme poverty rate of the region can increase by an additional 5% by 2030 due to climate change. In this context, LAC countries strive to undertake climate-related actions and discover more efficient and effective measures to cope with climate-related issues. Studies on the integration of mitigation and adaptation action plans have increased since 2007, when the interrelationships between mitigation and adaptation was addressed in the IPCC AR4. However, research on city-level measures have been conducted much less than those on national or international policies, even though local actions are substantial to actualize high level climate policies and to achieve objectives for sustainable development.

This study focuses on identifying potential driving and constraining factors for the level of integration of mitigation and adaptation action plans from 44 cities of 16 countries in the LAC region. Different types of policies, such as climate change plan, sustainable development plan, and strategic plan with climate action plans, are analyzed to evaluate current level of integration of mitigation and adaptation. Institutional, socioeconomic and environmental factors selected from literature review are tested to explain the relationships between factors and the level of integration and to identify potential drivers for and barriers to the level of integration of climate actions in target cities.

The results indicate that 44 target cities show middle-level of integration on average, with 3 potential driving factors and 2 constraining factors identified. The three potential driving factors are: *regional networks (1) Federation of Latin American Cities, Municipalities and Associations (FLACMA)*; *(2) Union of Ibero-American Capital Cities (UCCI)*; and *(3) contributions of donor agencies* to developing climate-related action plans. On the other hand, the potential constraining factors are: *(1) national common climate fund*; and *(2) global network Urban Low Emissions Development Strategy (Urban LEDS)*. What seems common here is that both driving and constraining factors emanate from institutional aspects, and the strongest relationship is observed between the existence of donor agencies' contributions to developing action plans and the level of integration of mitigation and adaptation.

Keywords

Climate change action plan / integration of mitigation and adaptation / level of integration / driving and constraining factors / cities in Latin America and the Caribbean

Acknowledgements

Special thanks to Prof. Stelios Grafakos who made this study possible with valuable guidance throughout the process, as well as to Prof. Lorenzo Chelleri, Hyucksun Kwon, Jaerim You, Aileen Leycano, Prof. Yongchul Shin and Fr. Yongsu Kim S.J.

This research was partially supported by the KOICA/WFK Scholarship funded by the Korea International Cooperation Agency (No. 2018-00062)

Abbreviations

AIIB	Asian Infrastructure Investment Bank
BNDES	Brazilian Development Bank (PT) Banco Nacional de Desenvolvimento Econômico e Social
CC	Climate Change
CCAP	Climate Change Action Plan
ECLAC	Economic Commission for Latin America and the Caribbean (ES) Comisión Económica para América Latina y el Caribe (CEPAL)
FLACMA	Federation of Latin American Cities, Municipalities and Associations (ES) Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas
GCF	Green Climate Fund
GIZ	German Development Agency (DE) Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IBRD	International Bank for Reconstruction and Development
ICES	Initiative for Sustainable Emerging Cities (ES) Iniciativa Ciudades Emergentes y Sostenibles
ICLEI	International Council for Local Environmental Initiatives
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
LAC	Latin America and the Caribbean
NAPs	National Adaptation Plans
OECD	Organisation for Economic Co-operation and Development
PACMUN	Climate Action Plan for Municipalities (ES) Plan de Acción Climática Municipal
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SDGs	Sustainable Development Goals
SEMARNAT	Secretariat of Environment and Natural Resources (ES) Secretaría de Medio Ambiente y Recursos Naturales (de México)
UCCI	Union of Ibero-American Capital Cities (ES) Unión de Ciudades Capitales Iberoamericanas
UN-DESA	United Nations Department of Economic and Social Affairs
Urban LEDS	Urban Low Emissions Development Strategy
WB	World Bank

Table of Contents

Summary iii
Keywords iii
Acknowledgements iii
Abbreviations iv
Table of Contents v
List of Boxes vii
List of Charts vii
List of Figures vii
List of Tables vii
Chapter 1: Introduction 1
1.1. Background 1
1.2. Problem Statement 2
1.3. Research Objective 5
1.4. Provisional Research Questions 5
1.5. Significance of the Study 5
1.6. Scope and Limitations 6
Chapter 2: Literature Review / Theory 8
2.1. State of the Art of the Theories/Concepts of the Study 8
2.1.1. Climate Action Plans 8
2.1.1.1. Policy and Action Plan 8
2.1.1.2. Climate Change Planning Framework 9
2.1.2. Mitigation and adaptation 10
2.1.3. Approaches to governing mitigation and adaptation 12
2.1.3.1. Separated vs. combined mitigation and adaptation plans 12
2.1.3.2. Stand-alone vs. integrated into other policies 13
2.1.3.3. Multilevel governance: Vertical and horizontal integration 15
2.1.4. Potential driving and constraining factors of developing climate change action plans 16
2.2. Conceptual framework 21
Chapter 3. Research Methodology 22
3.1. Revised research question(s) 22
3.2. Research approach and techniques 22
3.3. Operationalization 23
3.4. Sample size and selection 25
3.5. Validity and reliability 27
3.6. Data collection methods 27

3.7. Data analysis methods 28
Chapter 4. Research Findings and Analysis 31
4.1. Overview of target cities 31
4.2. The level of integration of mitigation and adaptation action plans 34
4.2.1. Integration index 34
4.2.2. Interrelationships 35
4.3. Potential driving and constraining factors of the level of integration of mitigation and adaptation action plans 36
4.3.1. Correlation analysis 36
4.3.2. Regression analyses with significant factors 40
Chapter 5. Conclusion and recommendations 44
Bibliography 48
Annex 1: List of target cities and policy documents 54
Annex 2: List of data source 56
Annex 3: Atlas.ti code list 58
Annex 4: Top 10 cities by the level of integration of mitigation and adaptation plans 59
Annex 5: (I)CES program by IDB 60
Annex 6: Result of correlation analysis (all variables) 62
Annex 7: IHS copyright form 64

List of Boxes

Box 1: Result of multiple regression (Method: Enter) **41**
Box 2: Result of multiple regression (Method: Stepwise) **42**

List of Charts

Chart 1: Cities by region (left) and by income group (right) **31**
Chart 2: Number of target cities by country **31**
Chart 3: Cities by type of plan, out of 67 cities **32**
Chart 4: Type of plan by separated/integrated (left) and by policies (right), out of 44 cities **33**
Chart 5: The level of integration **34**
Chart 6: Actions by type of interrelationships (left) and sectors (right) **35**

List of Figures

Figure 1: The complex of the urban growth process **6**
Figure 2: Planning framework for low emissions development and resilience in cities **10**
Figure 3: Climate change risks in the context of sustainable development in LAC **14**
Figure 4: Vertical and horizontal governance **16**
Figure 5: Distribution of population (left) and CC impacts on coastal area in LAC (right) **20**
Figure 6: Conceptual framework **21**
Figure 7: Map of target cities **26**
Figure 8: Distribution map of mitigation, adaptation and integrated plans of target cities **33**

List of Tables

Table 1: Comparison of climate change planning frameworks **9**
Table 2: Comparison of literatures on potential drivers and barriers of mitigation and adaptation efforts **17**
Table 3: Operationalization **23**
Table 4: List of target cities **26**
Table 5: Potential drivers and barriers identified from the literature and factors tested in this study **28**
Table 6: Evaluation framework for the level of integration of mitigation and adaptation action plans **29**
Table 7: Overview of target cities **32**
Table 8: Cities with the stated interrelationships in action plans **36**
Table 9: Potential drivers and barriers of the level of the integration of mitigation and adaptation plans **37**
Table 10: Brazil and Mexico national climate fund **39**
Table 11: Summary of potential drivers and barriers to the level of integration of mitigation and adaptation **45**
Table 12: Summary of potential drivers and barriers to integrated and separate mitigation and adaptation plans **46**

Chapter 1: Introduction

1.1. Background

It is widely accepted that the world's climate continues to change and the incidence of extreme weather events, such as heavy rainfalls, are increasing, resulting in broad environmental and socioeconomic damage. In this sense, climate change mitigation may be considered as compatible with sustainable development. Latin America and the Caribbean (LAC), as an example, is particularly vulnerable to the impacts of climate change. This is due to the region's geographic and climatic situation, as well as socioeconomic, demographic and institutional conditions. The high sensitivity of their nature such as forests and biodiversity to change in climate add to that vulnerability (Bárcena, et al., 2017). Moreover, by 2030, climate change could raise by an additional 5 % the extreme poverty rate in LAC, especially in Colombia, Peru, Bolivia and Haiti where the urban poor are more exposed to climate-related disasters (Hallegatte, et al., 2016).

The LAC region is prone to extreme weather events mostly related to the "El Niño Southern Oscillation (ENSO)", which raise ocean's surface temperature along the coastal areas of Ecuador and Peru (Feld and Galiani, 2015). Principal vulnerable areas in LAC are: the Andes with its glaciers; low altitude coasts; semi-arid zone in Chile, northeast of Brazil and north of Mexico; Central America and the Caribbean which are exposed to more frequent and intensive cyclones; and Amazon region (IPCC, 2014a). According to the Climate Risk Index (CRI), Haiti was the most affected country in 2016 with Bolivia placing ninth (Eckstein, Künzel and Schäfer, 2017).

Despite the increasing necessity of intervention in climate-related issues, middle- and low-income countries frequently face budget limitations, compelling them to select only a component of available climate policies (Feld and Galiani, 2015). This is especially true in the case of LAC local governments, which rely on support from higher level governments or international development assistance. For this reason, fewer cities in LAC have developed climate policies, some of them choosing to focus on either mitigation or adaptation. Mostly mitigation policies have been adopted in the region depending on the state of the regional economy, dependencies on natural resources, and national priorities, in the face of limited financial and administrative resources.

With changing international perspectives on climate policies and actions, urban climate policies in LAC are also transforming to adopt a holistic approach. Significantly, IPCC and World Bank have highlighted not only the integration of mitigation and adaptation policies, but also climate actions linking with sustainable development (IPCC, 2007; IBRD-WB, 2010; IPCC, 2014b; IPCC, 2017). The Paris Agreement, under which developing countries are legally bound to reduce GHG emissions, is also noteworthy. In this regard, it has been reported that developing countries contributed 73% of the global emission growth in 2004 (Raupach, et al., 2007). Considering that the LAC countries' contribution to climate change is relatively low at 8.3 % of the total global emissions in 2014 (Bárcena, et al., 2017), more efforts should be exerted in mitigation activities to achieve the committed GHG emissions reduction goals. In

this context, LAC cities are under pressure to implement mitigation strategies and action plans, along with adaptation measures, through a holistic approach.

In terms of demographic features, LAC consists of 41 countries with 68 cities of one million or more inhabitants (UN-DESA, 2016). Four of these cities are megacities (Bogotá, Buenos Aires, Rio de Janeiro, and São Paulo) with more than 10 million inhabitants (Bárcena, et al., 2017). In the region, approximately 81 % of the total population lives in cities, while the figure is 55 % in the world (UN-DESA, 2018b). It is not surprising, therefore, that cities are a major contributor to GHG emissions; cities account for 75 to 80% of the global emissions and their energy demand constitutes 75% of total demand (Satterthwaite, 2008). In this context, it is worth noting that in LAC, 60 to 70 % of regional GDP will accrue in urban centers (Bárcena, et al., 2017), where the poor, as is the case in developing countries, are known to be the most vulnerable to climate change (Laukkonen, et al., 2009). Capital cities in the Andean region have urbanized so rapidly over the last three decades, such that low-income settlements are located on dangerous slopes and are especially prone to extreme weather events (Hardoy and Pandiella, 2009). Therefore, city-level climate planning of both mitigation and adaptation policies and measures is crucial in LAC, on account of its specific geographic, institutional and socioeconomic features.

Nonetheless, most cities tend to give lower priority to climate actions than other social and economic development plans, in other words, new investments in capital markets and other urgent issues. The general uncertainty of climate change and its potential impacts on the city are the main reasons for this. Among climate actions, mitigation have dominated over adaptation, although the local context is more related to adaptation issues (Bulkeley, et al., 2011; Buob and Stephan, 2011). Even LAC cities that have established climate action plans give priority to mitigation - such as industries, transportation, and built environment - over adaptation, as the international and national levels have done. Besides, the involvement of local actors in implementing climate policies and action plans has been recently started (Hardoy and Lankao, 2011).

1.2. Problem Statement

Based on the common understanding and scientific evidence that climate change is likely to continue, developed countries committed jointly to mobilize at least USD 100 billions for annual climate finance by 2020. In addition, more financial resources in the climate sector are expected as new finance institutions, such as Green Climate Fund (GCF) and Asian Infrastructure Investment Bank (AIIB), were recently created (OECD, 2016). After the Paris Agreement, for instance, the International Finance Corporation (IFC) reported that the market for low-carbon investments in the LAC region is estimated at USD 600 billion by 2030, although this amount is still much less than the USD 16.5 trillion investment needed to transform the energy sector, from 2015 to 2030, with the 2°C target (IFC, 2016). This climate-smart type of investment presents viable opportunities for cities to pursue sustainable development and simultaneously tackle their socioeconomic issues, along with mitigation of and adaptation to climate change.

In this sense, foreign aid agencies and public and private sector entities, as well as cities themselves, as main actors for achieving the Sustainable Development Goals (SDGs), need to find or create good and innovative projects and measures to take advantage of these new opportunities. Besides, they strive to find ways to enhance effectiveness and efficiency of climate-related actions to overcome the lack of financial resources. Solution alternatives relating to climate policy, along with green technology are also needed (IFC, 2016). Notably, the co-benefits from mitigation and adaptation actions, including the benefits derived from integrated (or combined) actions, have begun receiving attention, to maximize the multiple benefits and cost-effectiveness of climate actions (Di Gregorio, et al., 2017; Grafakos, S., et al., 2018).

Transforming to Integration of Mitigation and Adaptation and the Specific Context of LAC

Studies on the integration of mitigation and adaptation measures have increased since the IPCC 4th Assessment Report (AR4) in 2007. They were revisited in AR5 (IPCC, 2014) and also planned to be highlighted in AR6 (IPCC, 2017). This approach to the integration of mitigation and adaptation plans could be an effective way to utilize the increasing climate financial resources and to finance local level actions. Additionally, GCF aims to allocate the fund equally between mitigation and adaptation, which indicates that both mitigation and adaptation measures are considered equally significant at the international level.

According to Hardoy and Lankao (2011), national and local governments maintain differing views on this matter, depending on their particular situation and interests. National governments put more importance on mitigation following international trends (Hardoy and Lankao, 2011; Thornbush, Golubchikov and Bouzarovski, 2013), while local governments address both mitigation and adaptation (Lee and Painter, 2015). In LAC, local governments tend to focus on mitigation, even though a number of central and local governments of the world are also dealing with diverse mitigation and adaptation actions (Hardoy and Lankao, 2011). This implies that cities in LAC still encounter difficulties in implementing adaptation action plans.

At present, the types of city-level climate actions are diverse: on one hand are separate or combined stand-alone action plans for mitigation and/or adaptation; on the other hand, are separate or combined mitigation and adaptation plans incorporated in local development plans. A stand-alone plan may increase a local government's administrative and financial burdens due to the duplication of similar tasks with other single plans. However, combined mitigation and adaptation plans may increase cost-effectiveness of actions by creating synergies (IPCC, 2007). Porteron, et al. (2018) claims that climate actions, in the context of urban complexity and synergies among cross-sectoral polices, ultimately and simultaneously contribute to achieve the objectives of local/national master plans and, globally, the Sustainable Development Goals (SDGs). The example of Quito in Ecuador supports this claim. Quito developed an integrated plan to build a water infrastructure, for example dams, in consideration of underground water sources and water-related risk reduction in the project area. Eventually, this plan influenced a central government to commit to decentralization (Hardoy and Lankao, 2011). In the end, the project resulted in reducing water-related disaster risk, contributing to national transformation, and creating a national target for MDGs.

In addition, it takes considerable time to develop sound projects to utilize climate finance on the ground. This implies that local governments can enhance cost-effectiveness of actions by increasing synergies between mitigation and adaptation measures (Klein, Schipper and Dessai,

2005; IPCC, 2007; Duguma, et al., 2014), and between climate policies and development plans (Klein, Schipper and Dessai, 2005; IPCC, 2007; OECD, 2010).

Institutional, Socioeconomic and Environmental Contexts of Climate Change in LAC cities

In terms of population density from the demographic aspect, the estimated overall population density of the LAC region is 32 inhabitants per square kilometer (km2) in 2016, below the world average total of 57 inhabitants/km2. However, Central America is credited with having the highest population density - 193 inhabitants/km2 - in the world. The Caribbean region also shows a relatively high level of density of 71 inhabitants/km2 (UN-DESA, 2017a).

There is a widely accepted understanding that the poorer communities are more vulnerable to climate change because of their lack of access to basic services and capabilities to cope with climatic challenges (Satterthwaite, et al., 2007; Hardoy and Lankao, 2011). LAC is known for being the most unequal region in the world (UN-Habitat, 2012) and for its informal economy and informal settlements, such as the favelas in Sao Paulo. One peculiar feature of LAC cities is that upper middle to high income populations alike reside in risky areas near rivers or coasts or on slopes. Those groups can afford to improve their housing conditions and to buy insurance. They also wield political influence, such that city governments may implement policies and actions specifically for their benefit (Hardoy and Pandiella, 2009). This implies that local governments' intervention for low-income groups is essential to build their adaptive capacity to climate change and to raise capability to reduce GHG emissions at the local level. The performance of governments varies, depending on their financial capacity and administrative capability to develop and implement policies and actions, in the context of their particular local situation.

As climate change impacts on the local level have become visible through unprecedented extreme weather events, local governments have started participating actively in the process of responding to climatic phenomena by adopting climate policies and action plans. The role of local government is significant to meet ambitious mitigation targets and to build communities' adaptive capacity to climate change. However, due to limited resources and an equally limited capability to implement relevant policies and plans, a significant number of cities still have no climate action plans in place. In this sense, United Nations Economic Commission for Latin America and the Caribbean (ECLAC) highlights the need for coordination between mitigation and adaptation actions to avoid conflicts between them and to create benefits in local development in LAC (ECLAC, 2013).

In this context, this study focuses on explaining the relationship between institutional, socioeconomic and environmental factors and the level of integration of mitigation and adaptation plans from main cities in the LAC region.

1.3. Research Objective

The aim of this research is to explain the relation between institutional, socioeconomic and environmental factors and the level of integration of adaptation and mitigation action plans from major cities in the Latin America and the Caribbean (LAC). This study does not aim to identify the causality between factors and the level of integration. Therefore, factors identified with a significant relationship with the level of integration are to be considered as *potentially* driving or constraining the level of integration.

In the process, factors will be selected based on the contexts of target cities, and the level of integration of mitigation and adaptation action plans will be calculated based on the relevant indicators to planning framework. The end results are a set of potential drivers and barriers to the level of integration based on the relationship between them, as well as possible recommendations for further research that may assist in the development of climate action plans.

1.4. Provisional Research Questions

The main research question of this study is 'to what extent do the institutional, socioeconomic and environmental factors relate to the level of the integration of mitigation and adaptation action plans from cities in Latin America and the Caribbean?'

Sub research questions are: 'which institutional, socioeconomic and environmental factors can be potential drivers or barriers of the integration of climate action plans?', 'what is the current level of integration of mitigation and adaptation in climate action plans of major LAC cities?' and 'how do institutional, socioeconomic and environmental factors relate to the level of integration of mitigation and adaptation plans?'

1.5. Significance of the Study

Studies on the integration of mitigation and adaptation policies and actions have recently increased since IPCC tackled the interrelationship between mitigation and adaptation in the 4th assessment report. However, studies conducted on city-level measures have been much less than those on national or international policies, even though local actions are substantial to actualize high level climate policies and to achieve international and national objectives for sustainable development. There are few studies addressing the integration of climate policies, and those studies are mainly at the national level (Duguma, et al., 2014). Those at the local level only deal with the justification for combining mitigation and adaptation measures (Laukkonen, et al., 2009). To the best of my knowledge, however, there is hardly any similar study for cities in the LAC region. Therefore, this study is expected to contribute to the existing body of knowledge, considering that it is the first one that addresses potential factors associated

with the level of the integration of mitigation and adaptation in local climate change action plans, particularly from cities in LAC.

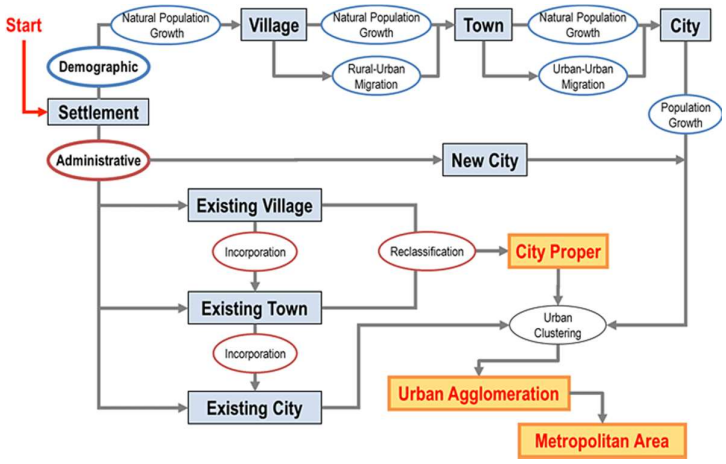
Besides, most of the existing studies on the integration of mitigation and adaptation, such as studies of Klein, Schipper and Dessai (2005), Swart and Raes (2007), Laukkonen, et al. (2009), Thornbush, Golubchikov and Bouzarovski (2013) and Solecki, et al. (2015), and particularly on the factors associated with integration (Duguma, et al., 2014), were conducted before the SDGs and Paris Agreement. A number of cities, however, have revised or newly adopted climate policies and action plans after these two agenda and agreement that dominate across multiple levels and sectors. In this regard, it is significant to explore the trend of integrating mitigation and adaptation plans of cities in LAC under new global circumstances.

This study aims to trigger further research and in-depth analysis on the integration of mitigation and adaptation plans. It may additionally provide recommendations to urban policy makers and practitioners, on how to integrate climate policies.

1.6. Scope and Limitations

This study explains the relation between institutional, socioeconomic and environmental factors and the level of integration of mitigation and adaptation action plans from cities in LAC, dealing with climate action plans which have one million or more inhabitants in condition with the existence of any type of climate action plans: separate or combined mitigation and adaptation action plans in stand-alone climate policies or incorporated in other policies such as a sustainable development plan. The scope of the term "city" in this study is inclusive. In other words, it includes three categories of cities that UN-DESA (2016) defined: city proper, urban agglomeration, and metropolitan area. Each term considers different concepts to delineate the city's boundaries, and in this study, the following terms are treated as: 'city proper' according to an administrative boundary; 'urban agglomeration' according to built-up area; and 'metropolitan area' according to economic and social interconnections (see Figure 1).

Figure 1: The complex of the urban growth process



Source: UN-DESA (2018a)

With regard to limitations, policy documents were collected by way of online search, mainly from the official websites of local governments, so cities with climate action plans that are not published or not shared online may be excluded. The study also did not consider if action plans from collected policy documents have been implemented or not. Moreover, this study does not address the causal relation between the factors and the level of integration of mitigation and adaptation plans.

Chapter 2: Literature Review / Theory

2.1. State of the Art of the Theories/Concepts of the Study

2.1.1. Climate Action Plans

2.1.1.1. Policy and Action Plan

Climate change issues are dealt with in different contexts by multiple stakeholders and efforts to mitigate and/or adapt to climate change are led or supported by government, whether in the form of policy statements or particular development, action and strategic plans or a combination of these.

According to Yanow (1996), policy is variably understood as a piece of legislation or a set of practices to achieve something material or expressive or both, and its meaning may change over different contexts, such as time and geographic space. Similarly, Davidson (1996) states that policy may be strong or weak in the different contexts of countries and cities, and that context is continuously changing.

In addition, Davidson (1996) identifies three types of planning: development planning, action planning, and strategic planning. Urban *development planning* is "a tool of urban management operating within a policy context" and is often embedded into law. Development planning has been needed to combine statutory based plans with "the flexibility, efficiency, effectiveness and commitment of performance-orientated plans" in order to pursue sustainable urban development. Besides, action planning and strategic planning as two distinct forms of performance-oriented planning. *Action planning* is defined as "the participative process of development of a relatively short-term plan to use available resources to meet limited objectives, normally in a defined area" (Davidson, 1996, p 454). With this regard, Baftijari, et al. (2007) adds that action planning transforms strategies into practical programs or activities for implementation. Finally, *strategic planning* of a city is defined as "the participative process of development of a medium-term plan to meet strategic objectives set by key stakeholders in a city. It normally combines physical, financial and institutional aspects." However, this definition of strategic planning cannot be a generally agreed definition because strategic planning is used differently in various contexts of countries and organizations. Moreover, although action planning and strategic planning have substantial similarities, the former embodies practical actions implemented on a neighborhood-level, while the latter involves a framework applied on a city-level. Therefore, the ideal relation between action plan and strategic plan is that a strategic plan is a framework consisting of a series of action plans. Moreover, it is ideal that the statutory development plan and non-statutory action/strategic plans complement each other. If this is not the case, it is necessary to negotiate a modification between them (Baross, 1991; Davidson, 1996).

Since the 'strategy' has been addressed mainly in the context of business management, Skok (1990) stresses that strategic action for public policy aims to increase policy objectives and to maintain or strengthen public agency power. Skok (1990) points out that a firm understanding of power matrix and scenario building/choice is significant for strategic actions. With regard to this characteristic of strategic planning, OECD (2010) states that strategic planning tools

allow policies at the local level to incorporate territorial strategies and sectoral policies together in land-use, natural resources, transportation, built environment, waste and water.

In this context, this study deals basically with action plans and may include other types of mid- to long-term plans, such as strategic plans, considering their similarities and relation to action planning. Development plans that include action plans may also be considered.

2.1.1.2. Climate Change Planning Framework

With climate change now considered an urgent global concern, climate change planning frameworks have become an important focus of academics and international organizations. Such frameworks serve as a guide for developing action plans in different contexts. In some of them, the framework is depicted in the urban context within multilevel governance and applied to planning processes. It is at the policy/action plan formation stage that integrated components of the eventual climate action plans are determined.

As Table 1 demonstrates, climate planning frameworks from the selected literatures of Corfee-Morlot, et al. (2009), UN-Habitat (2015) and Grafakos, et al. (2018) can be divided generally into 3 stages: (1) agenda setting, (2) policy/action plan formulation, and (3) implementation/monitoring and evaluation. In this connection, UN-Habitat (2015, p. 3) suggests that city-level climate action planning should be "ambitious, inclusive, fair, comprehensive and integrated, relevant, actionable, evidence-based, and transparent and verifiable."

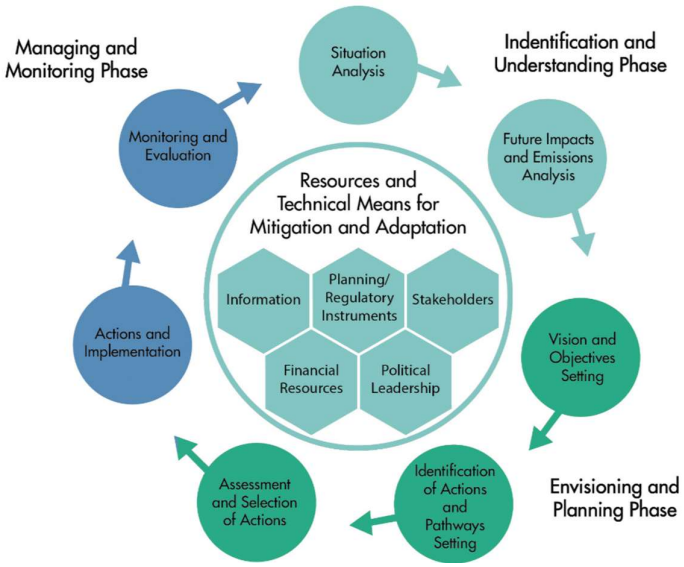
Table 1: Comparison of climate change planning frameworks

Phase \ Literature	Corfee-Morlot, et al. (OECD, 2009)	UN-Habitat (2015)	Grafakos, et al. (2018)
Planning	1. Agenda setting	1. Planning 1.1. Baseline inventories and assessments 1.2. Goals, synergies, and integration 1.3. On-going planning and evaluation	1. Identification and Understanding 1.1. Situation analysis 1.2. Future impacts and emissions analysis 2. Envisioning and Planning 2.1. Vision and objectives setting
	2. Policy formulation and approval	2. Strategies and actions 2.1. Defining actions 2.2. Selecting actions / Beginning to shape a Strategy 2.3. Programming climate actions over time 2.4. The resulting climate action plan: stand-alone or mainstreaming	2.2. Identification of actions and pathways setting 2.3. Assessment and selection of actions
Implementation / Monitoring and evaluation	3. Implementation 4. Feedback evaluation 5. Dissemination of ideas and replication elsewhere	2.5. Implementing and financing city climate action plans	3. Managing and Monitoring 3.1. Actions and implementation 3.2. Monitoring and evaluation

The cited literature address climate-related planning frameworks in the context of cities, particularly the study of Grafakos, et al. (2018) which described the framework while considering the integration of mitigation and adaptation. Hence, the framework suggested by

Grafakos, et al. (2018) is applied to quantify the level of integration of mitigation and adaptation in this study.

Figure 2: Planning framework for low emissions development and resilience in cities



Source: Grafakos, et al. (2018, p. 124)

2.1.2. Mitigation and adaptation

A wide range of climate policies and action plans can be broadly grouped into two categories: mitigation and adaptation (IPCC, 2014). Regardless of the differences, both approaches have a common objective, which is to protect a region against the impacts and ill-effects of climate change. Under this common objective, mitigation and adaptation actions demonstrate different features, in terms of timeframe, actors, technologies, and socioeconomic impact.

Mitigation mainly addresses the production and consumption of energies and CO2 capturing systems aiming to reduce GHGs, a main cause of changing climate (IPCC, 2014). The burden and benefits of mitigation actions accrue across all levels and are considered from a long-term perspective (Buob and Stephan, 2011). Adaptation pertains to the strengthening of adaptive capacities, at individual through to national levels, mainly by way of intervention of infrastructure and basic services, in order to reduce exposure to and sensitivity of climate related risks and damages (IPCC, 2014). That the benefits from adaptation actions are realized in the short-term may serve to incentivize policy makers to undertake adaptation actions, even though higher priorities may be given to mitigation actions, which provide a vertically/horizontally wider range of benefits. In this respect, it is worth noting that high income countries have implemented adaptation measures, as well as GHG mitigation (Buob and Stephan, 2011).

Explaining the matter further, Grafakos, et al. (2018) point to differences between mitigation and adaptation based on scale-related factors. These are: (1) institutional scale factors, such as

laws and regulations, which drive the planning of both mitigation and adaptation; (2) spatial scale factors, which explain the different spatial ranges of benefits between global range of mitigation and city to regional range of adaptation; (3) temporal scale factors, which are linked to different time periods and indicate long-term effects of mitigation and short-term effects of adaptation; and (4) jurisdictional scale factors, such as legal governing institutions involved in the phases of formation and implementation of action plans, which imply national or higher level of institutions for mitigation and national or lower level of institutions for adaptation.

Inter-relationships between mitigation and adaptation

IPCC (2007) identified four types of interrelationships between mitigation and adaptation: "adaptation actions with additional consequences for mitigation"; "mitigation actions with additional consequences for adaptation"; "decisions on trade-off or synergies between mitigation and adaptation"; and "processes with consequences for both mitigation and adaptation." Among those 4 types of interrelationships, trade-offs or synergies between mitigation and adaptation have been addressed significantly in terms of the enhancement of climate policy effectiveness and efficiency. IPCC (2007) defined *trade-off* as "a balancing of adaptation and mitigation when it is not possible to carry out both activities fully at the same time (e.g., due to financial or other constraints)" and *synergy* as "the interaction of adaptation and mitigation so that their combined effect is greater than the sum of their effects if implemented separately."

The literature review of Landauer, Juhola and Söderholm (2015) shows that the statement of conflicts between mitigation and adaptation are found more related to the policy priorities, administrative processes, allocation of resources, and spatial use in the city. On the other hand, synergies are identified more in the built environment, urban greening and alternative energy. Both conflicts and synergies can originate from the difference in governance scales (policy-, organizational-, and practical scales), as well as in temporal and spatial scales. In this sense, scales should be considered to solve conflicts and to enhance synergies. Landauer, Juhola and Klein (2018) extend the statement that these different scales interact in a way that jurisdictional and institutional scales enable the implementation of mitigation and adaptation actions in the practical (management) scale. There are two factors that influence these cross-scale interactions: difference in perceptions and priorities on local climate jurisdictions; and the limited institutional framework for integrating mitigation and adaptation actions. In particular, trade-offs can originate from interactions of jurisdictional-management and institutional-management scales and the perception on scale interactions can solve conflicts and enhance synergies.

The interplays between mitigation and adaptation exist in the regions even where there are non-cooperative actions in deciding mitigation and/or adaptation measures, and in this sense, the mitigation actions improve environmental quality, which ultimately reduces vulnerability and results in requiring less adaptation measures (Buob and Stephan, 2011). Both trade-offs and synergies are related primarily to land use (spatial planning), agriculture and forestry (IPCC, 2007), as well as to the management of urban densification, energy efficiency of buildings, surface runoff and urban heat (Landauer, Juhola and Klein, 2018). In this regard, systematic multi-sectoral strategic planning is required to reduce the trade-offs between climate and other policies and to enhance their synergies (OECD, 2010).

2.1.3. Approaches to governing mitigation and adaptation

2.1.3.1. Separated vs. combined mitigation and adaptation plans

Inasmuch as climate measures are classified as mitigation and adaptation, climate plans that evolve from this classification are of two varieties: *separated* and *combined*. A separated climate plan, as the term implies, addresses only one, either mitigation or adaptation, whereas a combined climate plan includes both mitigation and adaptation actions. With regard to separated climate plans, if a given a city implements mitigation plans, it does not necessarily mean that it would also implement adaptation plans. Besides, mitigation plans can provide co-benefits for adaptation or vice versa regardless of the existence of intention.

In this regard, taking into consideration the interrelationships between mitigation and adaptation, Grafakos, et al. (2018) introduce five types of climate action plans: (1) *stand–alone single approach,* which features either mitigation or adaptation actions; (2) *stand-alone parallel/combined approach,* which features both mitigation and adaptation actions in parallel; (3) *adaptation with mitigation co-benefits*; (4) *mitigation with adaptation co-benefits*; and (5) *integrated (or combined) approach,* which features both mitigation and adaptation purposes. Among the five, the stand-alone single approach - specifically, the mitigation action plan – has so far predominated over other types of climate plans.

Laukkonen, et al. (2009) argue that the vulnerability to climate change is complex and mitigation and adaptation plans, if disjointed or improperly coordinated, can be counterproductive. Nevertheless, both types of plans are interlinked inherently even though mitigation deals with multilevel issues while adaptation applies to the local level. The linkage between mitigation and adaptation creates synergies that support their integration. In addition, the uncertainty of estimating the costs incurred for and benefits derived from mitigation policies requires the integration with adaptation policies, which indicates that adaptation policies tend to depend on the nature and clarity of the current and future mitigation policies. This complementarity can be exemplified by built environment, which can last from 50 up to 150 years under spatial planning. Combining mitigation and adaptation can result in sustainable outcomes when accompanied by "local government competence, capacity or financial support".

Urbanization has brought benefits to human society, except that it has also caused environmental damages that are accelerating climate change. At the city level, challenges derived from climate change need to be tackled with a holistic perspective that considers the short-term pressures of adaptation as well as the long-term pressures of mitigation, under similar objectives for sustainable development (Staden and Musco, 2010). Duguma, et al. (2014) support this holistic approach to climate policies by highlighting synergies between mitigation and adaptation actions and those between climate and development policies.

On the other hand, Duguma, et al. (2014) also present another perspective that the motivation behind the integration of mitigation and adaptation plans is merely to establish an attractive international image and to draw the support and attention of climate change bodies to mobilize climate funds for sustainable development. According to the survey in 2013 (Aylett, 2015), 73% of respondent cities in the world have combined climate plans, 24% have separate mitigation plans and 3% have adaptation plans, while cities in LAC shows 83% with combined plans and the rest 17% with separate mitigation plans. The combined mitigation and adaptation policies and action plans are more dominant over the separated type of climate plans.

Before the Paris Agreement, in the context of LAC, there was no binding international agreement on mitigation. Feld and Galiani (2015) argued that countries in LAC needed to focus mainly on adaptation to climate change based on cost-benefit considerations. Hence, policymakers should compare benefits from other investments in region-specific challenges, such as water and air pollutions. Meanwhile, forests in the region play a critical role as a large carbon sink that contribute to the mitigation of climate change. However, pressures on climate policy have been changed because developing countries also committed to reduce GHG emissions since the Paris Agreement (Carlino, et al., 2016).

2.1.3.2. Stand-alone vs. integrated into other policies

Apart from the different combinations of mitigation and adaptation actions, there are two ways of implementing climate policies and action plans: (1) stand-alone and (2) integrated (or mainstreamed). The first is through stand-alone implementation of climate action plans, while the second is through integration of climate change actions into local development plans or sectoral policies. The latter is in line with mainstreaming climate policies and plans. Klein, Schipper and Dessai (2005) state '*mainstreaming*' in the context of climate change that leads the integration of policies and actions to tackle climate change in ongoing sectoral and development plans, pursuing the sustainable investments and lessening the sensitivity of development measures to climatic circumstances.

The overlap between adaptation and development is especially significant because both plans confront common cross-sectoral issues, such as health, education, water, and electricity as well as other urban infrastructure and services (OECD, 2009). Aylett (2015) states that adaptation plans are more likely to be integrated into other types of plans at the local level. The level of internal support for climate-related actions also substantially impact climate actions, and internal climate change networks of local governments are significantly related to the adaptation and combined climate plans. Five strategies that encourage the mainstreaming by building internal local networks are identified: (1) informal channels of communication, (2) personal contacts and trust between local governmental agencies, (3) climate policies and programs that involve non-climatic local priorities, (4) interdepartmental climate change working groups, and (5) employment of coordinator to link municipal agencies. On the other hand, five challenges of planning and implementation of climate plans are likewise observed such as financially limited resources for implementation, competing priorities, a limited funding for human resources, limited working time, and complications in integrating climate actions into infrastructure budgeting procedures.

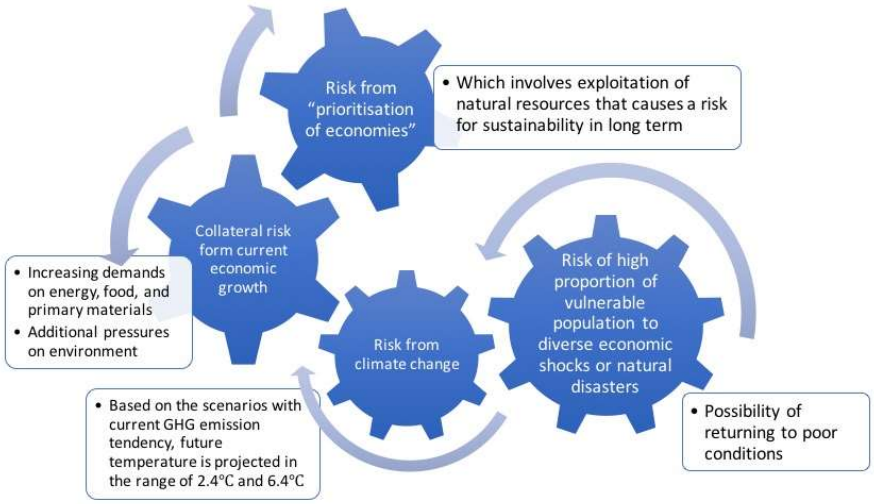
According to Laukkonen, et al. (2009), mitigation and adaptation actions need to be associated and in sync with sustainable development to avoid conflicts of prioritization. The integration of climate and sustainable development plans became a wide-spread approach globally, hence IPCC (2014 and 2017) have dealt with the interaction among mitigation, adaptation and sustainable development and made an outline of the 6th assessment report including urban, sectoral and governance perspectives.

Laukkonen, et al. (2009) state that incorporating mitigation and adaptation plans in development plans, along with combining mitigation and adaptation, is essential for sustainable outcomes because, without argument, climate change is and will continue to cause short-term and long-term challenges across all levels and sectors. Incorporated plans are capable of creating expansive economic opportunities such as smart planning. It is imperative especially

for low- and middle-income cities to implement climate plans based on a local sustainable development framework so that they may enhance their adaptive capacities and, with improved economic conditions, reverse the trend of increasing urban inequality.

In LAC countries, there exist conflicts between climate and development policies, an example being those that concern over-exploitation of natural resources and uncontrolled urbanization (Spikin and Hernández, 2016). Moreover, ECLAC (2015) states that LAC is a region very vulnerable to climate change because of its geographical condition, distribution of population and infrastructure, dependency on natural resources, and prevalence of agricultural and livestock industries. In addition, other factors need to be highlighted, among them being the forests and biodiversity of the region, the limited capacity to take additional resources for adaptation, and other economic, social and demographic characteristics that lead a significant percent of the population to be socially vulnerable. Given this situation, ECLAC (2015) suggests that it is crucial for LAC countries to include climate change adaptation into their sustainable development strategies.

Figure 3: Climate change risks in the context of sustainable development in LAC



Source: Bárcena, et al. (2017, p. 28), translated by author

Furthermore, the inadequacy and failure of responses to climate-related risks may have a negative impact on local and national development. In 1998, more than 1.2 million people in Central American countries fell victim to Hurricane Mitch, which caused massive losses conservatively estimated at USD 8,500 million - more than the combined GDPs of Honduras and Nicaragua (Hardoy and Pandiella, 2009). As aforementioned, a substantial portion of the LAC region's population is still considered as very poor and more than 40% of its urban population works in informal sectors. It is therefore necessary that a pro-poor perspective be adopted when considering climate actions to be incorporated in development plans for the region (Hardoy and Lankao, 2011). Caracas in Venezuela and Manizales in Colombia are examples of LAC cities that are well prepared for natural disasters. Both have recently included risk management in their local development plans to address the periodic incidence of earthquakes and hurricanes in their respective areas (Hardoy and Pandiella, 2009).

2.1.3.3. Multilevel governance: Vertical and horizontal integration

The main global regimes related to urban climate change are SDGs for development, Paris Agreement for climate change, Sendai Framework for disaster risk reduction, and Habitat III for urbanization. Most international organizations have already developed planning and operational frameworks based on those global mainstreams, and such frameworks are now reflected in national and local level policies.

Urban policy frequently engages multiple levels of governance. Cities need to cooperate with other cities, higher level governments, private sector entities, and non-governmental actors to obtain "authority, technical expertise, community support and funding" required to achieve their climate policy goals (OECD, 2010). IPCC (2014) states that effective adaptation and mitigation are determined by policies and actions across multiple scales: international, regional, national, and local. Policies across scales supporting technology innovation, dissemination and transfer, along with financial resources, can supplement and improve the effectiveness of policies that stimulate adaptation and mitigation.

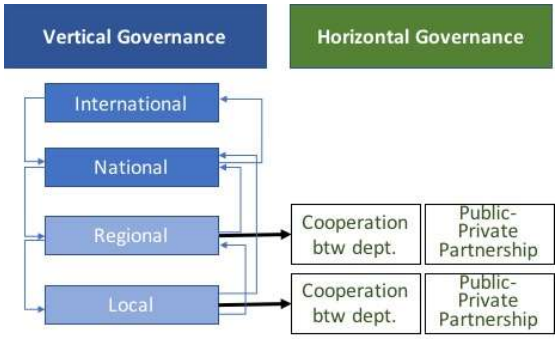
IBRD-WB (2010) indicates that an effective international climate regime incorporates development matters to transcend the dichotomy of environment versus equity. It follows that an effective climate regime integrates climate action plans into development policies. Moreover, international coordination is essential for climate regime at the global level, however, its implementation is dependent on actions within states. In this respect, different approaches to climate actions should be applied to developing and developed countries, based on their different development stages.

Local governments, because they provide a range of vital public services, such as health, education and transportation, directly to their citizens, play a critical role in the proper and effective transition to sustainable development. Considering that climate change has direct and indirect impacts on most sectors, climate policies need to be inclusive and to be developed from a holistic perspective (Staden and Musco, 2010).

There are two generally accepted approaches to multilevel governance - namely, *vertical* and *horizontal* – although the terms used to identify these two types may vary. For instance, Bulkeley and Betsill (2005) use 'hierarchical approach' and 'polycentric model' to refer to vertical and horizontal governance, respectively. Vertical governance involves international, national, regional, and local government in climate policies and action plans. In a similar way, Corfee-Morlot, et al. (2009) define 'vertical integration' as a governance across all levels of stakeholders to align local action plans with national policies. From this vertical perspective, there are two-way interactions: (1) *bottom-up initiative* led by local government which impacts national policies; and (2) *top-down initiative* led by the state which strengthens the national framework (Corfee-Morlot, et al., 2009; Huh, Park and Yang, 2017). Besides, horizontal governance is the coordination of public-private agents and also cross sectors (Huh, Park and Yang, 2017). Corfee-Morlot, et al. (2009) use the term 'horizontal dimension' in reference to a mechanism to boost cross-scale learning within local and regional governments. It bears noting that combining vertical and horizontal integration provides multiple benefits in all policy processes.

Mitigation has been addressed with both vertical and horizontal governance, based on its nature of applicability in all levels and sectors, while adaptation is mostly tackled by horizontal governance at local level, based on the specific realities influenced by a variety of factors of location (Laukkonen, et al., 2009).

Figure 4: Vertical and horizontal governance



Source: Adopted from Huh, Park and Yang (2017)

2.1.4. Potential driving and constraining factors of developing climate change action plans

As the planning of policy includes strategies for all stages and leads to the implementation of action plans, literature related to potential driving and constraining factors of planning and implementation of policies and action plans are reviewed in this study.

The literature reviewed in this section commonly address institutional factors. IPCC (2007) and Duguma, et al. (2014) address factors for effective implementation with regard to policy and institutional contexts and interface between socioeconomic development and climate change impacts. On the other hand, Corfee-Morlot, et al. (2009) describe institutional factors in terms of obstacles of implementing policies and action plans. Bulkeley, et al. (2011) identify four factors as drivers and at the same time barriers for action: leadership, the authority of local governments, resources, and issue framing, which can be classified as institutional factors. Furthermore, Reckien, et al. (2015) explored institutional, socioeconomic and environmental factors as drivers and barriers of the planning of city-level climate change policies, which literature deals with a scope relatively broader than aforementioned studies.

Recently, Fuhr, Hickmann and Kern (2018) presented the result of literature review on drivers for the development of local climate policies: high capacities combined with high problem pressure; local democracy; enabling policy framework; socio-economic environment; and local leadership. In addition, Grafakos, et al. (2018) introduce structural conditions and resources and technical means as factors that can deliver opportunities and challenges in the planning of the integration of mitigation and adaptation measures. Structural conditions, which determine a city's capacity to integrate climate actions, consist of environmental and physical setting, institutions and governance setting, economic development and municipal financial conditions, and sociocultural characteristics of a city. In terms of resources and technical means, key means are stakeholder engagement and participation, as well as information across different dimensions and forms, along with financial resources and mechanisms, and political leadership.

In terms of the phase in the policymaking process and integration approach, Duguma, et al. (2014) and Grafakos, et al. (2018) address driving and constraining factors for the planning and implementation of the integration of climate change plans, while Reckien, et al. (2015) introduce those for the planning of separate mitigation and adaptation plans.

Table 2: Comparison of literatures on potential drivers and barriers of mitigation and adaptation efforts

Literature / Category	Corfee-Morlot, et al. (2009)	Duguma, et al. (2014)	Reckien, et al. (2015)	Fuhr, Hickmann and Kern (2018)	Grafakos, et al. (2018)
Institutional	• Governing structure to coordinate, monitor and control actions within local administrations • Establishment of an expert body or commission • Technical expertise in planning authorities • Funding • Responsibility: relevant jurisdiction • Support from central governments • Relevant national or regional policies • Inter-municipal action	• Relevant national policies and strategies - Country climate policy that addresses M+A - Common climate strategy/action plan for M+A - Country submitted NAMA (Nationally Appropriate Mitigation Actions) /REDD+ R-PP (Readiness Preparation Proposal) and/or NAPA to the UNFCCC • Common institutional arrangements - Common national-level committee - Common implementing body • Common climate fund • Programs and projects - Joint program - Subnational joint projects	• Adoption of national climate change strategies • Member of Climate Alliance Member of C40 member • Member of Covenant of Mayors • Covenant of Mayors: Plan submitted • Member of ICLEI	• High capacities combined with high problem pressure • Local democracy: electoral choices for their citizens and political competition • Enabling policy framework: legal competencies and material resources • Local leadership	• Existing policies • Existing institutions • Municipal financial and governance capability • Stakeholder engagement and participation in the planning and decision-making process** • Planning and regulatory instruments** • Political leadership** • Networking**
Socioeconomic	• GDP	• GDP*	• Population age • Population size • Population density • Gross Domestic Product (GDP) per capita • Unemployment rate • Smart city index	• Environmentally-concerned civil society • Green industry	[Economic development***]
Environmental	• Coastal zone	-	• Proximity to coast • Low elevation coastal zone • Altitude above sea level • Hours of sunshine • Average temperature of warmest month • Average temperature of coldest month		[Environmental and Physical setting] • Physical limits - Land use, availability of freshwater • Local conditions - Traffic pattern and distribution, built environment, land-use zoning, hotspots

			• Number of rainy days • Total amount of rainfall • Proportion of green space • Availability of green space		• Infrastructure system
Others			[Composite vulnerability] • Aggregated Impact • Aggregated vulnerability • Combined adaptive capacity • Combined mitigative capacity		[Sociocultural characteristics] • Perception on climate related risks and climate policies [Resources and technical means] • Information in all dimensions and forms • Financial resources and mechanisms at all stages • Capacity building • Technology transfer • Best practices exchange

* GDP was not an enabling condition for the implementation of integrated climate measures in the literature, however the authors compare different income-level countries in terms of synergy potential.

** Factors are originally classified as resources and technical means in the literature and reclassified as institutional factors for the purpose of this study.

***Economic development is introduced as one of driving factors of cities' adaptive and mitigation capacity, however specific indicators are not provided in the literature.

Institutional factors: institutional capacity and networks

If a department of the government with little or no political authority or influence takes responsibility for climate change, it may be difficult to move forward due to the lack of power and financial resources. Cities in LAC have experienced such difficulty. The capacity of smaller cities' institutions tends to be weaker, making it hard to implement effective mitigation and adaptation actions (Hardoy and Lankao, 2011). Therefore, a responsible department of local government for climate change can be considered as a key factor, in terms of authority to establish policies and action plans.

Uncertainty is one of the distinct features of climate change which has become a main concern for policy makers. Feld and Galiani (2015) state that climate change has impacts on physical and socioeconomic systems, but relevant costs are still uncertain even though a number of scientific and academic research have been conducted. Under this condition of uncertainty, OECD (2010) points out that cities play a significant role as climate policy laboratories to develop innovative policies and actions for specific local geographic, economic and cultural environments. Best practices can be scaled up into regional and national policies through networking. In this context, several scholars theorized local policies as 'governance experiments', grassroots innovations, and urban living labs (Fuhr, Hickmann and Kern, 2018).

Besides, while some local authorities have taken actions autonomously, others have been given guidance from networks of local governments and international networks (OECD, 2010). At the local level, it is important for local authorities to cooperate with community organizations in order to discover community needs and actual capabilities and to effectively reduce local risks, including those from climate change. However, this coordination can hardly be found due to the lack of networks and vehicles of participation (Hardoy and Lankao, 2011).

There are several examples of local networks in LAC: the regional project of risk reduction in Andes capital cities implemented in cities of the Andean region and formed alliances between local mayors sharing knowledge and incorporating risk management into local development plans; the national system for the prevention, mitigation and response to disasters (SNPMAD, abbreviation of Spanish name) implemented by the Nicaraguan central government which combines different government levels, stakeholders, and local committees for risk prevention and alleviation; and an inter-municipal association 'Mancomunidad de los Municipios del Centro de Atlántida (MAMUCA)' in Honduras which created a platform for communication and cooperation in local responses. Apart from that, Central American countries formed cross institutional and sectoral networks for cooperative disaster management, especially after Hurricanes Mitch and Stan, which, however, excluded sufficient coordination with the local level. As a result, the institution in the region still holds the emergency risk of natural disasters (Hardoy and Pandiella, 2009).

In Mexico City, policy making has been limited by two institutional factors: 'the problem of fragmentation in local governance' and 'the lack of institutional capacity'. Policy networks and research groups, together with political leaders, have taken critical roles in promoting a climate agenda. In contrast, a low-income group settlement plan in Manizales, Colombia and in Ilo, Peru may be considered an example of best practices of collaborating local organizations, communities and universities to implement an urban development plan incorporating local risk management (Hardoy and Lankao, 2011).

Socioeconomic factors: population (size and density) and city-level GDP per capita

Satterthwaite, et al. (2007) state that urban vulnerability is mostly determined by the social and economic development context. In a similar way, Laukkonen, et al. (2009) claim that the level of response to climate change differs because each country's adaptive capacity is dependent on natural resources and socio-economic development. Romero, et al. (2014) also points out that societal changes, such as unemployment due to economic dislocation, can result in obstacles and challenges that affect adaptive capacity to climate change.

There is literature addressing the relation between income level and implementation of climate policies and actions. Buob and Stephan (2011) claim that strategic interaction between mitigation and adaptation is influenced by income level. High income regions tend to implement mitigation and adaptation actions simultaneously if marginal costs of adaptation declined with global mitigation, while low income regions do only mitigation actions. In addition, Hardoy and Lankao (2011) claim that income relates to the consumption patterns, which is identified as a key determinant of urban GHG emissions as it leads to the production systems. Poverty, climate change, and disaster risk are strongly interlinked and inter-influential. In this context, since GDP per capita represents the overall production level, GDP per capita of the city is adopted in this study.

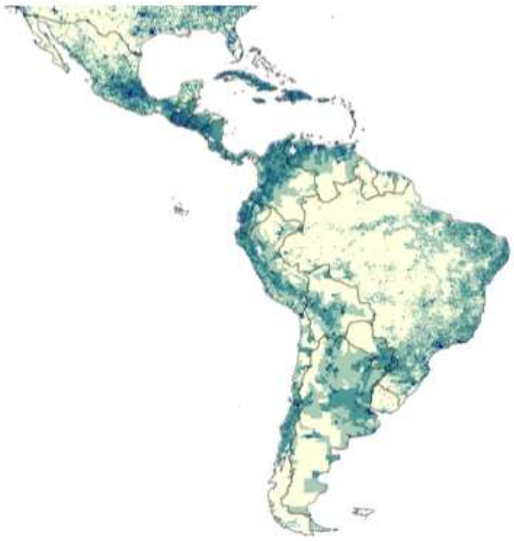
Environmental factors: city-level CO2 emissions per capita, geographical and meteorological conditions

Buob and Stephan (2011) point out that marginal costs of adaptation are influenced by initial environmental conditions. Among a variety of environmental conditions, cities in coastal zones have been noted as a substantial condition in terms of climate change impact. In this regard, Corfee-Morlot, et al. (2009) state that even the local socio-economic development interface with climate change is noticeable in coastal areas. Feld and Galiani (2015) also state that unmanaged or unmanageable human and natural systems, such as coastal cities and river runoffs, are highly vulnerable. Therefore, low-income and tropical regions, such as Latin America, are prone to damages from climatic disasters.

Figure 5 illustrates that most of cities in LAC are located near coastal areas and a significant number of people live in the Andean region. In this regard, ECLAC (2015) projects that the population in coastal areas will still increase considerably. While coastal cities are prone to the risks of rising sea levels and flooding, cities in the high lands are prone to the risk of drought and landslides. Geographical conditions, such as distance from the coast and altitude above sea level, are thus treated as environmental factors in this study.

The LAC region is subject to diverse and extreme climatic events, such as drought due to the rise in average temperature, and the economic, social and environmental consequences are expected to follow such events (IPCC, 2014; ECLAC, 2015). Despite improved economic and social conditions in LAC countries over the last several decades, a significant segment of the population remains vulnerable to climate change and climate related disasters (ECLAC, 2015). In light of these circumstances, meteorological conditions are also included in this study.

Figure 5: Distribution of population (left) and CC impacts on coastal area in LAC (right)



Source: UN-Adjusted Population Count 2015 (NASA EOSDIS SEDAC, 2016)

Source: IPCC (2014, p. 1525)

2.2. Conceptual framework

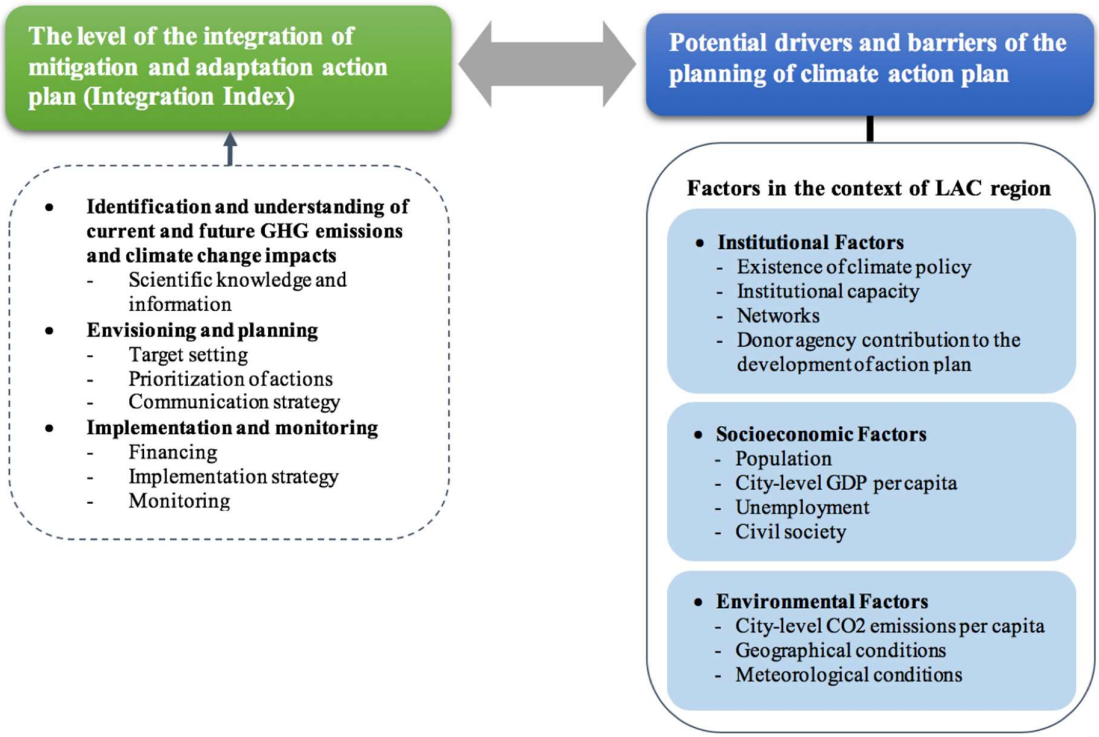
This study aims to explain the relation between institutional, socioeconomic and environmental factors and the level of integration of mitigation and adaptation action plans.

Based on the context of cities in the LAC region, the following institutional, socioeconomic and environmental factors are applied in this study:

- Institutional factors: existing climate policy (Duguma, et al., 2014; Reckien, et al., 2015; Grafakos, et al., 2018), institutional capacity (Corfee-Morlot, et al., 2009; Grafakos, et al., 2018) and networks (Reckien, et al., 2015; Grafakos, et al., 2018)
- Socioeconomic factors: city population (Reckien, et al., 2015), city-level GDP per capita (Corfee-Morlot, et al., 2009; Reckien, et al., 2015) unemployment (Reckien, et al., 2015) and civil society participation (Fuhr, Hickmann and Kern, 2018)
- Environmental factors: city-level CO2 emissions per capita, geographical (Reckien, et al., 2015) and meteorological conditions (Reckien, et al., 2015)

The level of the integration of mitigation and adaptation action plan is quantified by adopting 'the analytical framework to evaluate the level of integration of climate adaptation and mitigation' introduced by (Grafakos, Stelios, et al., Under review).

Figure 6: Conceptual framework



Chapter 3. Research Methodology

3.1. Revised research question(s)

In the provisional research questions, the level at which stage of decision-making are influenced by potential drivers and barriers was not defined. As this study focuses on the development (planning) of climate change action plans, the first research question has reflected this aspect. Final research questions are as follows:

The revised main research question of this study is: 'to what extent do institutional, socioeconomic, and environmental factors, as potential drivers and barriers of the development of climate change action plans, relate to the level of integration of mitigation and adaptation policies of cities in Latin America and the Caribbean?'

Sub research questions are: 'which institutional, socioeconomic and environmental factors are related to the integration of mitigation and adaptation when developing climate action plans?', 'what is the current level of integration of mitigation and adaptation in climate change plans of LAC cities? and 'how do institutional, socioeconomic and environmental factors relate to the level of integration of mitigation and adaptation plans?'

3.2. Research approach and techniques

Desk research is the research strategy applied for this study. This approach was done by conducting quantitative analysis, working with the existing secondary quantitative and quantified qualitative data, to yield the relationships between institutional, socioeconomic and environmental factors and the level of the integration of mitigation and adaptation action plans.

According to Van Thiel (2014), desk research with secondary analysis enables comparison of wide-ranging numerical indicators from different groups and different time. In addition, secondary analysis is appropriate for deductive research that defines main concepts, continues to suitable data collection and yields findings as results. This study aims to draw the relationship between the two concepts of the research question with various indicators from a number of cities.

3.3. Operationalization

The two main concepts are: potential drivers and barriers of the development of climate change plans; and the integration of mitigation and adaptation action plans. Based on these concepts, three variables and their indicators are selected for independent variables while one dependent variable will be measured by several indicators.

Table 3: Operationalization

Independent Variables				
Concept	**Variables**	**Category of indicators**	**Indicators**	**Type of Data**
Potential drivers and barriers of the development of climate change plans *Definition : "Barriers are hindrance that can be overcome and are not insurmountable." and "Drivers are understood as activities, processes or patterns that produce positive incentives for climate action." (Reckien, et al., 2015, p. 2)	Institutional Factors	National climate policy/strategy/plan	• Adoption of national climate change strategy (Reckien, et al., 2015) • Both M+A addressed in national climate policy (Duguma, et al., 2014) • Common climate strategy/action for both M+A included in national climate policy (Duguma, et al., 2014) • Submission of NAMA (Nationally Appropriate Mitigation Actions) or REDD+ R-PP (Readiness Preparation Proposal) and/or NAPs* to the UNFCCC (Duguma, et al., 2014)	Qualitative
		Institutional capacity (Corfee-Morlot, et al., 2009; Duguma, et al., 2014; Grafakos, et al., 2018; Fuhr, Hickmann and Kern, 2018)	• Governance structure: climate related agency or department - National and city levels** • Establishment of an expert body or committee - National and city levels** • Common climate fund - National level • Programs and projects: joint program or subnational joint projects - National level	Qualitative
		Networks (Reckien, et al., 2015; Grafakos, et al., 2018)	• Global wide - 100 resilient cities*** - C40 - ICLEI - Global Covenant of Mayors • Regionwide*** - Mercociudades (Sud-America) - FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas) - AL-LAs (Alianza Euro-Latinoamericana de cooperación entre ciudades) - UCCI (Unión de Ciudades Capitales Iberoamericanas)	Qualitative
		• Donor agency contribution to the development of plan****		Qualitative
	Socioeconomic Factors	Population (Reckien, et al., 2015)	• Population size • Population growth rate • Population density	Quantitative
		• City-level GDP per capita (Corfee-Morlot, et al., 2009; Duguma, et al., 2014; Reckien, et al., 2015)		Quantitative
		• Gini coefficient****		Quantitative
		• Unemployment rate (Reckien, et al., 2015)		Quantitative

		• Environmentally-concerned civil society (Fuhr, Hickmann and Kern, 2018)		Qualitative
	Environmental Factors	• City-level CO2 emissions per capita****		Quantitative
		Geographical conditions (Reckien, et al., 2015)	• Proximity to coast • Coastal city • Altitude above sea level • Distance from equator	Quantitative Qualitative
		Meteorological conditions (Reckien, et al., 2015)	• Temperature - Average temperature of warmest month - Average temperature of coldest month • Precipitation - Total amount of rainfall - Number of rainy days	Quantitative
Dependent Variable				
Concept	**Variable**	**Indicators for calculating the variable**		**Type of Data**
		Category	**Indicators**	
The integration of mitigation and adaptation action plans *Definition : "Actions that integrate efforts to mitigate the causes of climate change (mitigation) and adapt to changing climatic conditions (adaptation), for a global transition to a low-emissions economy and a resilient world." (Grafakos, et al., 2018, p. 102)	Integration Index: The level of integration of mitigation and adaptation action plans (Grafakos, et al., Under review)	Analysis on current and future GHG emissions and CC impacts	• GHG emissions Profile • GHG Emissions Forecast • Vulnerability Profile • Future Climate Projections • Uncertainty of climate impacts • Cost estimates of damages of climate impacts • Climate Hazards (detailed)	Qualitative
		Envisioning and Planning	Target setting: • GHG emissions reduction targets • GHG emissions reduction sectoral targets • Adaptation objectives	Qualitative
			Prioritization: • Cost estimates of actions • Benefit estimates of actions • Consideration of M+A interrelationships • Sustainability benefits	Qualitative
			Communication: • Common public education and outreach	Qualitative
		Implementation and Monitoring Strategy	Financing: • Common Funding Body or Budget (public) • Financing commitment for both M+A (public or private)	Qualitative
			Implementation: • Mainstreaming potential of both M+A • Common Policy or Regulatory Framework • Common coordination/implementation body • Common partnership • Common Monitoring procedure/ framework	Qualitative

* NAPA (National Adaptation Programs of Actions) is replaced by NAPs (National Adaptation Plans) because none of countries of target cities is classified in the least developed countries according to the classification of countries by UN-DESA (World Population Prospects: The 2017 Revision)

** City-level is added.

*** Indicators are adopted from a report of (ICLEI, 2015, p. 29) in line with the network indicators from the literature of (Reckien, et al., 2015).

**** New indicators are added in the context of the region and in line with the indicators from the literature review.

3.4. Sample size and selection

This study focuses on climate action plans from 44 cities in the LAC region which populations account for around 28 percent of the total population of the entire area. Criteria for the selection of cities are as follows:

1) Cities of a certain level of population size, specifically those with more than one million inhabitants

Demographic information is acquired from UN Department of Economic and Social Affairs (UN-DESA) Population Division (2016).

2) Cities which have already developed policies that include separated mitigation or adaptation, or integrated (combined) action plans

The scope of climate action plans for the selected cities is not limited to stand-alone climate change plans but also included plans that are incorporated actions in other type of documents such as a development plan or a strategic plan. Therefore, the types of climate action plans considered in this study are:

a) stand-alone mitigation or adaptation or integrated action plans;
b) sustainable development plan or environmental plan which mainly describes climate change issues in the introduction;
c) development plan or strategic plan or territorial plan which includes action plans that specifically contained the words 'climate change' or 'climate resilience' or 'sustainable energy' or 'renewable energy.'

If the city has developed several types of plans that contain climate change action plans, the priority is given on a), and then b) and c) in that order.

The plans which only includes the development of climate change plans or the education about climate change actions are excluded from this study. In addition, sectoral plans are likewise excluded as those plans may have a specific purpose focusing on sectoral issues rather than climate change. Sustainable or renewable energy plans as well as those with indicators of reduction in GHG emissions are included in the list. Moreover, for cities which have plans at both city-level and metropolitan area-level, the metropolitan area plans are prioritized. The adoption of the plan was not considered, so a draft or a document in the approval process might also be included in this research.

Given the above considerations, there are 67 cities with more than one million inhabitants in the region. The population of these cities account for approximately 35 % of the total population of LAC. One of those cities, San Juan, the capital city of Puerto Rico, is excluded from the sample of this study because Puerto Rico is a territory of the USA in North America. As a result, 44 out of the 67 cities have been found to have climate action plans: mitigation, adaptation or integrated action plans (see Annex 1). In terms of demography, the total population of the 44 cities in 16 countries accounts for around 28% of the total population of the LAC region. Of this, 32 out of 44 cities have integrated climate change action plans. Based on the World Urbanization Prospects by UN-DESA (2015), four megacities (Buenos Aires, Mexico City, Rio de Janeiro, and Sao Paulo) and two potential megacities (Bogota and Lima) are included in the selected cities as starred in Figure 7. Among them, Mexico City and Sao Paulo ranked the 4th largest cities in the world in 2018 (UN-DESA, 2018).

Figure 7: Map of target cities

Table 4: List of target cities

REGION	COUNTRY (16)	CITY (44)
CARIBBEAN	Cuba	Havana
	Dominican Republic	Santo Domingo
CENTRAL AMERICA	Costa Rica	San Jose
	Honduras	Tegucigalpa
	Mexico	Aguascalientes, Mexico City, Cuernavaca, Guadalajara, Leon de los Aldamas, Merida, Puebla, Queretaro, Tijuana, Toluca de Lerdo, Torreon
	Panama	Panama City
SOUTH AMERICA	Argentina	Buenos Aires, Mendoza, Rosario
	Bolivia	Cochabamba, La Paz, Santa Cruz de la Sierra
	Brazil	Belo Horizonte, Brasilia, Curitiba, Florianopolis, Fortaleza, Goiania, Vitoria, Joao Pessoa, Rio de Janeiro, Salvador, Sao Paulo
	Chile	Santiago
	Colombia	Bogota, Bucaramanga, Cali, Cartagena, Medellin
	Ecuador	Quito
	Paraguay	Asuncion
	Peru	Lima
	Uruguay	Montevideo
	Venezuela	Caracas

3.5. Validity and reliability

Since the main source of data is secondary data produced by reliable entities such as governments, multilateral banks, development cooperation agencies and well-recognized research entities, a significant level of reliability and external validity can be preserved. As the use of dataset improves the validity of analysis (Van Thiel, 2014), more importance was given to the dataset over a combination of individual data from different sources. Quantitative analysis is conducted, so an in-depth study is not applied because determining the causality between variables is not the purpose of this study, so internal validity is still weak. An additional in-depth study is also not plausible considering the time limitation. Instead, recommendations for further in-depth research of cities in the LAC region will be provided in the end based on the results from this study.

3.6. Data collection methods

The data source for both dependent and independent variables is secondary empirical data and the data collection method is web-based desk research. Relevant variables are basic characteristics of national and local governance, location characteristics, and components of climate policies. None of them are subjective indicators, such as perception on mitigation or adaptation, which would require a conduct of a survey. Moreover, most of these data can be found in reliable online sources, such as official websites of national and local governments or international organizations. Considering this data collection availability online, as well as the time constraints and resource limitations, the web-based desk research is the most efficient and appropriate means to collect data with the number of variables required for the study.

For selected target cities, a dataset was formed with indicators of independent variables and indicators to calculate a dependent variable 'integration index', as well as characteristics of relevant policies. Data for independent variables are obtained from official websites of national and local governments, bilateral or multilateral development cooperation agencies and well-recognized research institutions. A full-list of data source is given in Annex 2.

With regard to the dependent variable, 'integration index' is calculated based on the evaluation framework of Grafakos, et al. (Under review). The sub-variables of the framework are scored based on the content analysis of climate action plans in policy documents and the integration index is the sum of total values of variables. The guideline for analyzing urban climate action plans basically targets integrated climate plans. However, this study includes separate mitigation or adaptation action plans along with integrated climate plans as the action plan has at least one of components related to variables of the evaluation framework. All policy documents are obtained from local governments' official websites. If a city had announced via its official website or newspapers that the development of policies including climate change action plans are in process, they were contacted to determine if the policy document has been already completed or if not, when is the expected date that the documentation will be finalized, and the policy established.

3.7. Data analysis methods

According to Van Thiel (2014), inferential statistics can be used for deductive research to examine the relationships and to determine if the data are measured minimally at the ordinal level. In addition, Van Thiel (2014) notes that the regression analysis is utilized to establish relation between independent and dependent variables. Therefore, this type of statistical modeling is the appropriate method to analyze the relation between potential driving and constraining factors and the level of integration of climate plans.

For independent variables, a number of institutional, socioeconomic and environmental indicators of cities are adopted from the literature. Several relevant indicators are not available for all target cities since the availability of urban data is relatively limited compared with national level data, therefore they are excluded or replaced with proxy variables. If applicable, variables are also extended to a different scope such as regional networks.

Table 5: Potential drivers and barriers identified from the literature and factors tested in this study

	INSTITUTIONAL	SOCIOECONOMIC	ENVIRONMENTAL
INTEGRATION OF MITIGATION AND ADAPTATION (Duguma, et al., 2014; Grafakos, et al., 2018)	• Relevant policies: common climate policy, common strategy/action plan in the policy, submission of NAMA and/or NAP • Common institutional arrangements: common committee/implementing body • Common national climate fund • Joint project/programs • Municipal financial and governance capability • Stakeholder engagement • Political leadership • Networking	• Economic development	• Physical limits: land use, availability of freshwater • Local conditions: traffic pattern and distribution, built environment, land-use zoning, hotspots • Infrastructure system
MITIGATION OR ADAPTATION (Corfee-morlot, et al., 2009; Reckien, et al., 2015, Fuhr, Hickmann and Kern, 2018)	• Climate-related governing structure • Expert body or commission • Funding • Relevant jurisdiction • Support from central governments • Relevant national/regional policies • Inter-municipal action • Adoption of national climate strategies • Member of global city networks: climate alliance, C40, Covenant of Mayors, ICLEI • Capacity under high problem pressure • Local democracy • Enabling policy framework • Local leadership	• Population: age, size, density • GDP per capita • Unemployment rate • Smart city index • Environmentally-concerned civil society • Green industry	• Coastal zone, proximity to coast • Low elevation coastal zone • Altitude above sea level • Hours of sunshine • Average temperature of warmest and coldest month • Total amount of rainfall • Proportion/availability of green space
FACTORS TESTED IN THIS STUDY	• Adoption of national climate strategies • Common climate policy* • Common strategy/action plans within the same policy* • Submission of NAMA/REDD+ and/or NAPs** • Governance structure* • Establishment of expert body or committee* • Common climate fund** • Joint programs and projects** • Networks***: global (100 resilient cities****, C40, ICLEI, Global Covenant of	• Population: size***, growth rate****, density*** • GDP per capita*** • Gini coefficient**** • Unemployment rate*** • Environmentally-concerned civil society***	• City level CO2 emissions per capita**** • Geographical factors***: proximity to coast, altitude above sea level, distance from equator • Meteorological factors***: average temperature of warmest and coldest month, total amount

	Mayors), regional**** (Mercociudades, FLACMA, AL-LAs, UCCI) • Donor agency contribution to the development of plan****	of rainfall, number of rainy days

* National and city level respectively
** National level only
*** City level only
**** Newly added in this study

The dependent variable, the level of integration of mitigation and adaptation, is represented by the 'integration index', which is the sum of scores of variables from the evaluation framework developed by Grafakos, et al. (Under review). The evaluation framework is composed of 3 stages of planning including 22 qualitative variables that compose the integration index (see Table 6).

Table 6: Evaluation framework for the level of integration of mitigation and adaptation action plans

STAGE OF PLANNING	COMPONENT	VARIABLES (22)	SCORING
IDENTIFYING AND UNDERSTANDING	Scientific knowledge and information	GHG emissions profile	• Scale: 0-1 - Identified (1) or not identified (0) in the plan
		GHG emissions forecast	• Scale: 0-2 - Forecast beyond 2020 (2), up to 2020 (1) or not included in the plan (0)
		Vulnerability profile	• Scale: 0-2 - Supported by quantitative data (2), identified in the plan but w/o quantitative data (1) or not identified (0)
		Future climate projections	• Scale: 0-2 - Projection beyond 2030 (2), up to 2030 (1) or not included in the plan (0)
		Uncertainty of climate impacts	• Scale: 0-1 - Addressed (1) or not addressed (0) in the plan
		Cost estimates of damages of climate impacts	• Scale: 0-1 - Included (1) or not included (0) in the plan
		Climate hazards (detailed)	• Scale: 0-1 - Included (1) or not included (0) in the plan
ENVISIONING AND PLANNING	Target setting	GHG emissions reduction targets (overall)	• Scale: 0-2 - Target by 2050 (2), by 2020 (1) or not included in the plan (0)
		GHG emissions reduction targets (by sector)	• Scale: 0-1 - Included (1) or not included (0) in the plan
		Adaptation objectives	• Scale: 0-2 - Long term (2), short term (1) or not included in the plan (0)
	Prioritization	Cost estimates of actions	• Scale: 0-2 - Both M+A (2), either M or A (1) or not included in the plan (0)
		Benefit estimates of actions	• Scale: 0-2 - Both M+A (2), either M or A (1) or not included in the plan (0)
		Consideration of M+A interrelationships*	• Scale: 0-2 - Both synergies and conflicts (2), either synergies or conflicts (1) or not included in the plan (0)
		Sustainability benefits	• Scale: 0-1 - Included (1) or not included (0) in the plan

	Communication	Common public education and outreach*	• Scale: 0-1 - Included (1) or not included (0) in the plan
IMPLEMENTATION AND MONITORING	Financing	Common public funding body or budget (national/city level)*	• Scale: 0-1 - Included (1) or not included (0) in the plan
		Public or private financing commitment	• Scale: 0-1 - Included (1) or not included (0) in the plan
	Implementation	Mainstreaming potential of both M+A*	• Scale: 0-2 - Both M+A (2), either M or A (1) or not included in the plan (0)
		Common policy or regulatory framework*	• Scale: 0-2 - Both M+A (2), either M or A (1) or not included in the plan (0)
		Common coordination/ implementation body*	• Scale: 0-1 - Included (1) or not included (0) in the plan
		Partnerships	• Scale: 0-2 - Both M+A (2), either M or A (1) or not included in the plan (0)
	Monitoring	Common monitoring procedure/framework*	• Scale: 0-2 - Both M+A (2), either M or A (1) or not included in the plan (0)
TOTAL SCORE (INTEGRATION INDEX)			**Maximum 34**

Source: adopted from (Grafakos, et al., Under review)
* Variables commonly relevant to mitigation and adaptation

The correlation analysis has been used to compute the level of significance of independent variables (institutional, socioeconomic and environmental factors) related to the dependent variable (the level of integration of climate plans 'integration index'). Insignificant indicators had been excluded before the next stage of regression analysis.

Atlas.ti was utilized for coding city-level policy documents, and SPSS (Statistical Package for the Social Sciences) and Microsoft Excel were utilized to process the data for the correlation and regression analyses.

Chapter 4. Research Findings and Analysis

4.1. Overview of target cities

The 44 target cities are located in 16 countries, which belong to three income categories: 2 high-income countries, 12 upper-middle-income countries and 2 lower-middle-income countries according to the classification of UN-DESA (2017b). In terms of the number of target cities, cities located in Brazil and Mexico already account for half of the total target cities at 22 and followed by Colombia with 5 cities.

Chart 1: Cities by region (left) and by income group (right)
(Number of cities and proportion %)

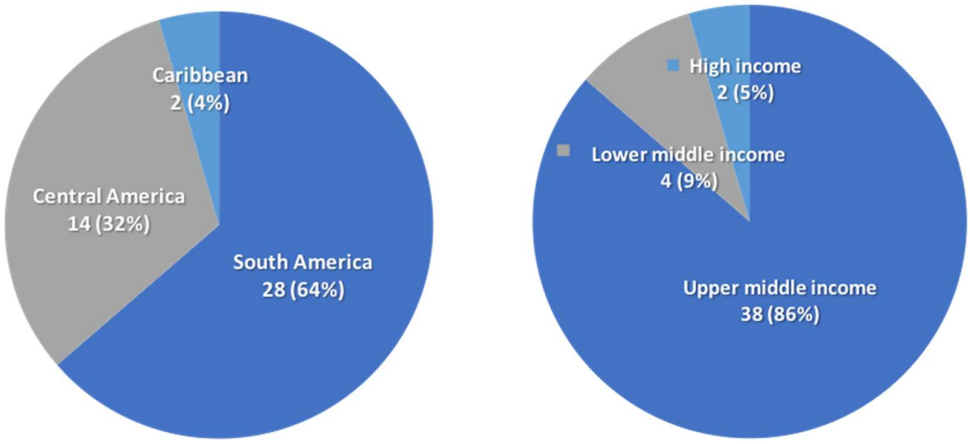


Chart 2: Number of target cities by country

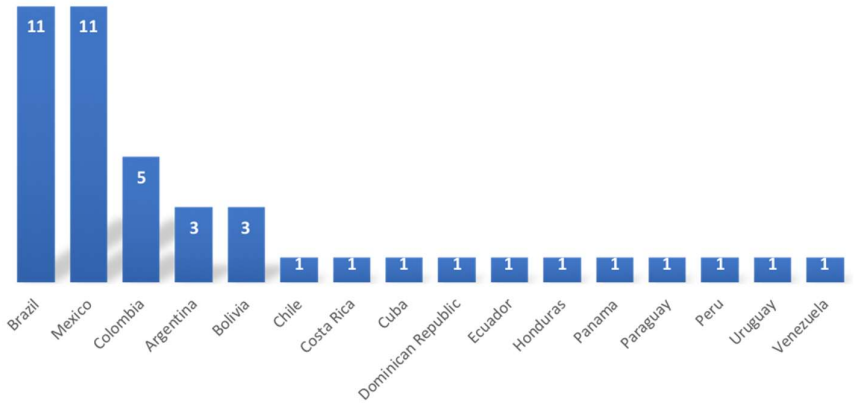


Table 7: Overview of target cities

POPULATION	▪ Population size (thousand inhabitants) o Range of population: 1,006 to 21,297 o Average of population: 4,075 ▪ Population density (inhabitants/km2) o Range of population density: 2,700 to 17,700 o Average of population density: 6,518
COUNTRIES BY INCOME GROUP	▪ High-income country (2): Chile and Uruguay ▪ Upper-middle-income country (12): Argentina, Brazil, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Mexico, Panama, Paraguay, Peru and Venezuela ▪ Lower-middle-income (2): Bolivia and Honduras
CITY-LEVEL GDP PER CAPITA (US$)	▪ Range: 7,470 to 33,830 ▪ Average: 19,550

Across the 44 target cities, 73% of the cities have integrated plans with both mitigation and adaptation actions, while 20% have mitigation actions and the last 7% have adaptation actions. Overall, there are fewer plans with adaptation actions than those with mitigation actions. In addition, in terms of type of policy, in addition, more than half of the target cities have mainstreamed climate change action plans into high-level or sectoral policies such as a local development plan (see Chart 4). In detail, 41% of the cities have developed a climate change plan, 25% incorporated climate-related actions in a sustainable development plan and 21% in a city development plan followed by strategic plan, climate change strategy, territorial development plan and environment plan.

Besides, Santiago, capital city of Chile, used the term ´adaptation to climate change´, instead of 'mitigation and adaptation', to refer to both mitigation and adaptation.

Chart 3: Cities by type of plan, out of 67 cities
(Number of cities and proportion %)

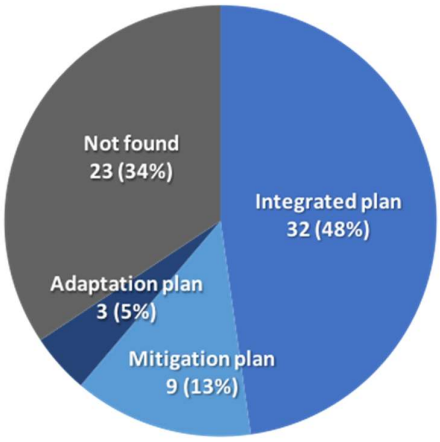


Chart 4: Type of plan by separated/integrated (left) and by policies (right), out of 44 cities
(Number of cities and proportion %)

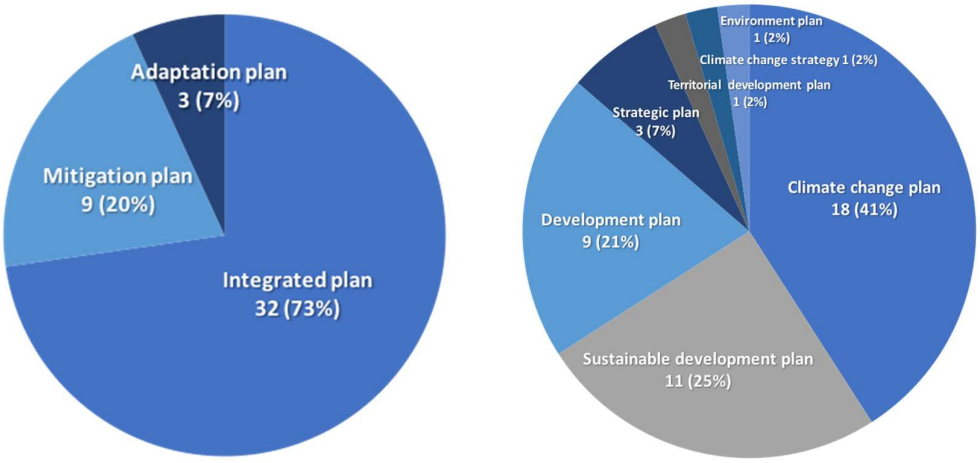


Figure 8: Distribution map of mitigation, adaptation and integrated plans of target cities

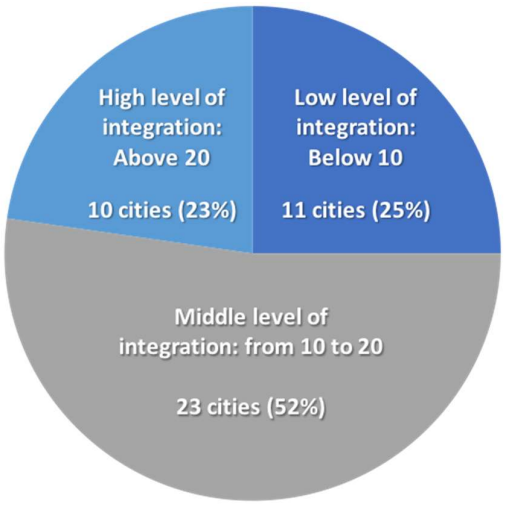
4.2. The level of integration of mitigation and adaptation action plans

4.2.1. Integration index

The analytical framework introduced by Grafakos, et al. (Under review) is adopted in this study to evaluate and quantify the level of integration. Hereby referred as the ´integration index´, it is a composite index based on an assessment of climate action plans at the city level. In line with this, policy documents of climate-related action plans from 44 cities have been reviewed for the evaluation regarding the level of integration. The policy documents reviewed include separate analytical working paper of the GHG emissions and vulnerability of the city if the report has been written as a preparation stage for developing climate-related action plans and provides scientific background and information. Therefore, the analysis report was reviewed and reflected in the integration index along with a main policy document and it affects mainly the score on variables of the first stage of planning 'identifying and understanding'. This is the case for two cities, namely the Mendoza metropolitan area, Argentina and Santo Domingo, Dominican Republic.

According to the integration index based on the evaluation framework of Grafakos, et al. (Under review), the average of total integration index of 44 cities is 14.77, middle-level of integration. The results in detail show that out of 44 cities, 23 cities (52%) show a middle-level of integration (score 10 to 20) while 11 cities (25%) fall under low-level of integration (score below 10) and the rest 10 cities (23%) show high-level of integration (score above 20).

Chart 5: The level of integration
(Number of cities and proportion %)



In terms of the type of policies, 10 cities with a climate change plan and 11 cities with a sustainable development plan have developed policies with support from donor agencies. They show higher scores than those with other kinds of action plans. This might imply that these cities considered GHG emissions and climate change impacts as important factors starting at the beginning stage of the development of policies according to the donor agencies' integrated approaches to climate change in their methodology.

Bogota, the capital city of Colombia, shows the highest level of integration in the target cities with a score 28 out of total score 34, followed by Mendoza, Argentina, which scored 25. The top 10 cities' action plans are all integrated plans which include both mitigation and adaptation action plans. Except for Mexico City, the rest of the cities in the top 10 have developed climate change action plans or sustainable action plans with support from donor agencies (see Annex 4).

Furthermore, the result also showed that the average of integration index of 32 cities that have integrated climate plans is 17.09, while that of all 44 target cities is 14.77. The city with the lowest score, Mérida, Mexico, which garnered a score of 4, has developed an urban development plan that includes a mitigation action of low-emission transport.

4.2.2. Interrelationships

Based on Chapter 2. Literature review, interrelationship is a key concept for the integration of mitigation and adaptation. Out of 44 cities, 13 cities stated the existence of interrelationships between mitigation and adaptation in 27 climate-related actions. Actions aiming at adaptation driven with mitigation co-benefits account for 48% (13 actions) while the statement of synergies between mitigation and adaptation is found in 9 actions (33%) and the rest 5 actions (19%) mention mitigation driven with adaptation co-benefits. None of statement on conflicts between mitigation and adaptation is found. In terms of sectors, 8 actions (30%) of urban greening show interrelationships between mitigation and adaptation, followed by biodiversity (6 actions, 22%), water (5 actions, 18%), built environment, energy, agriculture, carbon reduction incentives and land use.

Chart 6: Actions by type of interrelationships (left) and sectors (right)
(Number of actions with interrelationships and proportion %)

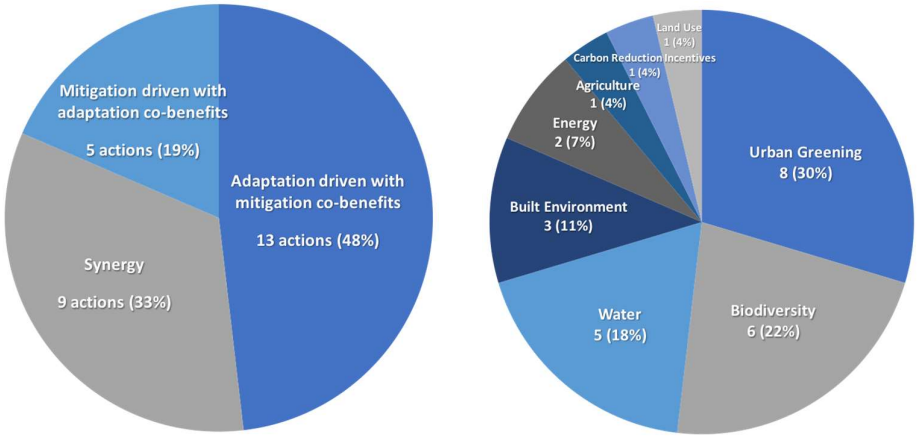


Table 8: Cities with the stated interrelationships in action plans

CITY	COUNTRY	NO. OF ACTIONS WITH STATED INTERRELATIONSHIPS (SECTOR)	RANK OF INTEGRATION INDEX
CALI	Colombia	7 (Biodiversity, water, built environment)	5
MEXICO CITY	Mexico	4 (Urban greening, water, agriculture)	2
CARTAGENA	Colombia	3 (Urban greening)	10
BOGOTA	Colombia	2 (Urban greening, water)	1
LA PAZ	Bolivia	2 (Urban greening, energy)	15
QUITO	Ecuador	2 (Built environment, carbon reduction incentives)	13
BUENOS AIRES	Argentina	1 (Urban greening)	9
ROSARIO	Argentina	1 (Built environment)	39
GOIANIA	Brazil	1 (Water)	32
SAO PAULO	Brazil	1 (Land use)	28
SANTIAGO	Chile	1 (Energy)	19
SANTO DOMINGO	Dominican Republic	1 (Urban greening)	15
MONTEVIDEO	Uruguay	1 (Biodiversity)	5
TOTAL		***27***	

4.3. Potential driving and constraining factors of the level of integration of mitigation and adaptation action plans

4.3.1. Correlation analysis

Correlation analysis draws associations between the level of integration of mitigation and adaptation plans and potential drivers and barriers that may influence the development of plans of the selected Latin American cities. Among the tested 27 factors (38 factors including sub-indicators), 5 institutional factors are identified significantly ($p < 0.05$) related to the level of the integration of mitigation and adaptation (represented by 'integration index'): 3 drivers and 2 barriers, all from institutional factors. To be specific, factors with positive relation include: regional network 'FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)'; another regional network 'UCCI (Unión de Ciudades Capitales Iberoamericanas); and 'the contribution of donor agencies to the development of climate action plans'. On the other hand, identified factors with negative relation are: 'national common climate fund'; and the global network 'Urban LEDS (Low Emissions Development Strategy)'. Among them, 'national climate fund' and 'contribution of donor agencies to the development of climate action plans' are identified as the most influential constraining and driving factors of the level of integration of mitigation and adaptation showing a strong correlation, -0.416 and 0.489 ($p < 0.01$), respectively (see Table 9).

With regard to the driving factors, both regional networks FLACMA (http://www.flacma.lat/) and UCCI (http://ciudadesiberoamericanas.org/) were established in early 1980s. Both networks have developed steady and strong relationships between member cities and municipalities for a significant time of period with a common purpose of the development of the region. Moreover, FLACMA, in particular, has recently restructured the organization in line with global SDGs, which may affect the incorporation of mitigation and adaptation actions in their strategies and action plans. In this sense, strong relationships between member cities and a common integrative approach to climate change and sustainable development might positively influence the level of integration of mitigation and adaptation action plans.

Table 9: Potential drivers and barriers of the level of the integration of mitigation and adaptation plans

			Index (all)	Index (common)	Integrated Plan	M plan	A plan	9	11	20	23	25	26	32	39	40	41
Dependent Variable	Integration index_all variables	Pearson Correlation	.														
		Sig. (2-tailed)	.														
	Integration index_common variables	Pearson Correlation	**.890****	.													
		Sig. (2-tailed)	0.000	.													
Type of Plan (integration)	Integrated plan	Pearson Correlation	**.572****	**.641****	.												
		Sig. (2-tailed)	0.000	0.000	.												
	Mitigation plan	Pearson Correlation	**-.603****	**-.597****	**-.828****	.											
		Sig. (2-tailed)	0.000	0.000	0.000	.											
	Adaptation plan	Pearson Correlation	-0.045	-0.176	**-.442****	-0.137	.										
		Sig. (2-tailed)	0.771	0.252	0.003	0.375	.										
Institutional Factor	9. National_common climate fund	Pearson Correlation	**-.416****	**-.347***	**-.466****	**.329***	0.296	.									
		Sig. (2-tailed)	0.005	0.021	0.001	0.029	0.051	.									
	11. City_adoption of national climate change strategy/action plan	Pearson Correlation	0.266	**.303***	0.176	-0.146	-0.078	-0.141	.								
		Sig. (2-tailed)	0.081	0.046	0.252	0.344	0.615	0.360	.								
	20. Network-global_Urban LEDS	Pearson Correlation	**-.299***	**-.321***	**-.339***	**.428****	-0.086	**.346***	0.014	.							
		Sig. (2-tailed)	0.048	0.033	0.024	0.004	0.581	0.021	0.926	.							
	23. Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)	Pearson Correlation	**.383***	**.391****	0.243	-0.201	-0.107	**-.363***	-0.247	-0.126	.						
		Sig. (2-tailed)	0.010	0.009	0.111	0.190	0.487	0.016	0.106	0.416	.						
	25. Network_regional_UCCI (Unión de Ciudades Capitales Iberoamericanas)	Pearson Correlation	**.309***	0.246	0.067	-0.055	-0.029	**-.349***	0.176	-0.089	**.501****	.					
		Sig. (2-tailed)	0.041	0.108	0.667	0.722	0.849	0.020	0.252	0.568	0.001	.					
	26. Donor agency contribution to the development of plan	Pearson Correlation	**.489****	**.359***	0.232	**-.305***	0.078	-0.224	0.184	-0.014	-0.018	0.011	.				
		Sig. (2-tailed)	0.001	0.017	0.129	0.044	0.615	0.143	0.231	0.926	0.907	0.945	.				
Socioeconomic Factor	32. Gini Coefficient	Pearson Correlation	-0.142	-0.221	**-.363***	0.184	**.339***	**.346***	-0.173	**.407****	-0.012	-0.034	0.178	.			
		Sig. (2-tailed)	0.371	0.159	0.018	0.244	0.028	0.025	0.273	0.007	0.938	0.830	0.261	.			
Environmental Factor	39. Average temperature of warmest month	Pearson Correlation	-0.260	**-.375***	-0.291	0.212	0.175	0.247	-0.280	0.095	**-.430****	-0.214	0.049	0.110	.		
		Sig. (2-tailed)	0.089	0.012	0.055	0.167	0.256	0.107	0.065	0.540	0.004	0.163	0.753	0.488	.		
	40. Average temperature of coldest month	Pearson Correlation	-0.216	**-.314***	**-.413****	0.294	0.261	0.207	-0.036	0.140	-0.255	-0.076	0.085	**.365***	**.616****	.	
		Sig. (2-tailed)	0.158	0.038	0.005	0.053	0.087	0.177	0.818	0.364	0.094	0.625	0.584	0.017	0.000	.	
	41. Total amount of rainfall	Pearson Correlation	-0.066	-0.169	-0.297	0.130	**.317***	0.190	-0.135	0.205	0.031	-0.038	0.162	**.556****	**.347***	**.627****	.
		Sig. (2-tailed)	0.673	0.272	0.050	0.402	0.036	0.216	0.381	0.181	0.841	0.805	0.294	0.000	0.021	0.000	.

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

As Annex 4. The top 10 ranking of integration index shows, the highly-ranked cities have developed their climate change action plans with the assistance of international development cooperation. Especially, IDB (the Inter-American Development Bank), a representative multilateral bank in LAC, has been implementing a sustainable urban development program CES (Ciudades Emergentes y Sustentables, in English 'Emerging and Sustainable Cities Program') in the region since 2011. The CES program applies a methodology of 5 steps across the development and execution of action plans including diagnostic analysis of climate change addressing mitigation and adaptation together, which represents the integrative approach to climate change (see Annex 5). 9 out of 44 target cities of this study (Mendoza-Argentina, Cochabamba-Bolivia, Florianopolis-Brazil, Vitoria-Brazil, Joao Pessoa-Brazil, San Jose - Costa Rica, Tegucigalpa-Honduras, Panama City-Panama, Asuncion-Paraguay) have developed sustainable development action plans including climate-related actions under the CES program. The average of the integration index of those 9 cities is 20.78, a high-level integration. In addition to CES, Mexico implemented the program PACMUN (Plan de Acción Climática Municipal, in English 'The Climate Action Plan for Municipalities Programme') with support from ICLEI and funded by DFID to promote a policy framework on mitigation and adaptation actions at the local level. This program is also expected to encourage the integration of mitigation and adaptation action plans. 4 cities (Aguascalientes, Cuernavaca, Puebla and Toluca de Lerdo) of the target cities have developed climate action plans under this program.

On the other hand, 'national common climate fund' is identified as a significant potential barrier to the integration of mitigation and adaptation. Brazil and Mexico established national climate fund in 2009 (regulated in 2010) and 2013 (regulated in 2015) respectively[1]. However, the Brazilian programs of the national climate fund include more mitigation sub-programs than adaptation even though the fund ultimately aims to promote both mitigation and adaptation actions (see Table 10). In addition, 60% of Brazilian climate fund was replenished with revenue from tax on oil companies and only 15% of the fund was allocated for adaptation in 2011 (Ludeña and Netto, 2011). In this context, the Brazilian national climate fund might influence the development of mitigation driven climate change action plans. The Mexican climate fund, for its part, supports joint projects of mitigation and adaptation along with separate mitigation and adaptation actions. However, the fund has been a recent creation and several cities had already developed climate action plans before the establishment of the Mexican national climate fund. This would indicate that the Mexico climate fund does not affect the current level of integration as much as Brazilian climate fund does.

[1] Climate action plans developed before the establishment of national climate fund are given a value '0' that means 'no existence of national climate fund' in the dataset for correlation analysis.

Table 10: Brazil and Mexico national climate fund

COUNTRY	NAME OF CLIMATE FUND	ENTITIES	PROGRAMS
BRAZIL	National Fund on Climate Change (or Climate Fund, in Portuguese 'Fundo Clima')	Minitstry of Environment and The Brazilian Development Bank (in Portuguese 'Banco Nacional de Desenvolvimento Econômico e Social', BNDES)	• Urban Mobility • Sustainable Cities and Climate Change • Efficient Machinery and Equipment • Renewable Energies • Solid Waste • Charcoal • Combating Desertification • Native Forests • Management and Carbon Services • Innovative Projects
MEXICO	Climate Change Fund (in Spanish 'Fondo para el Cambio Climático')	Secretary of Environment and Natural Resources (SEMARNAT) and National Finance-Development Banking (in Spanish 'Nacional Financiera, Banca de Desarrollo', NAFIN)	• Adaptation actions • Joint project for mitigation and adaptation • Mitigation actions • Education program • Research and evaluations of national climate change system • Project for investigation, technology development, innovation and technology transfer

Source: ECLAC, GIZ and ipea (2016), BNDES official website (accessed 16-08-2018), and SEMARNAT (2016)

With regard to another barrier Urban LEDS (Urban Low Emissions Development Strategy, http://urbanleds.iclei.org/index.php?id=61), implemented by ICLEI and UN-Habitat, encourages cities to integrate low emissions and green economy strategies into city development plans with the building city networks of the program. Since this program aims to promote mainly mitigation strategies, this inclined approach may hinder from integrating mitigation and adaptation actions. During the Urban LEDS phase I (2012-2015), 4 Brazilian cities out of 44 target cities of this study were included: Belo Horizonte, Curitiba, Fortaleza and Rio de Janeiro. These cities show an average of integration index 8.5, a low-level of integration. However, in the next phase of Urban LEDS, the concept of adaptation co-benefits has been recently adopted in the purpose of the program besides of low emissions. Therefore, it may support or less prevent from integrating mitigation and adaptation actions afterwards.

As the result of correlation analysis shows (see Table 8), there is a strong relationship between integrated climate plans and the integration index, which means that climate plans with integrated climate actions are highly likely to show the high level of integration of mitigation and adaptation action plans. For integrated plans, 4 factors - 'national common climate fund', 'global network Urban LEDS', 'Gini coefficient' and 'average temperature of coldest month' - are identified as potential barriers. Among them, two factors 'national common climate fund' and 'average temperature of the coldest month' shows a strong negative correlation ($p < 0.01$). For mitigation plan, 2 drivers 'national common climate fund' and 'global network Urban LEDS' and 1 barrier 'contribution of donor agency' are identified. This result is a reverse to that of the level of integration: 'national common climate fund' and 'global network Urban LEDS' as barriers and 'contribution of donor agency' as a driver. For adaptation plan, 2 potential drivers 'Gini coefficient' and 'annual amount of rainfall' are drawn from the correlation analysis.

In addition, the result of correlation analysis between factors and the integration index were calculated with common feature variables (see Table 6). This analysis produced 3 potential drivers and 4 barriers: 'adoption of national climate policy/strategy/action plan', member of 'FLACMA', 'contribution of donor agency to the development of climate action plan' as the drivers; and 'national common climate fund', 'global network Urban LEDS', 'average temperature of the warmest month' and 'average temperature of the coldest month' as the barriers. The notable difference from the result of correlation analysis between factors and the integration index of all variables is that internal-institutional factor 'adoption of national climate policy' and environmental factors 'average temperatures of each warmest and coldest months' are additionally identified as driving and constraining factors respectively. Besides, donor agencies' intervention of the planning of climate action plans is the most significant driver for the level of integration (integration index).

Overall, most of the driving and constraining factors for the level of integration of mitigation and adaptation are institutional factors. Particularly, 'national common climate fund' and 'global network Urban LEDS' are identified as constraining factors for the level of integration and development of integrated plans, and simultaneously driving factors for mitigation plans. Table 9 illustrates the significant factors and the full table of the result of correlation analysis of all indicators is attached in Annex 6.

4.3.2. Regression analyses with significant factors

A multiple regression analysis is conducted to test a model to see mathematical expression of the relation between factors (independent variables) and the level of integration (dependent variable) (Van Thiel, 2014). In terms of the selection of independent variables of the model, when the criterion '*p-value* < 0.01' is applied, 2 predictors meet the condition: national common climate fund and donor agencies' contribution to the plan. To test more predictors as possible, '*p-value* < 0.05' is considered for modeling, therefore 5 predictors are included in the test. Those predictors are significant factors (*p-value* < 0.05) drawn from the correlation analysis of the level of integration (integration index-all variables): national common climate fund, global network Urban LEDS, regional networks FLACMA and UCCI respectively, and donor agencies' contribution to the development of climate action plans.

The result of multiple regression analysis with *enter method* shows that the model explains 47.3% (R square=0.473) of the cases and can be considered as a model of good-fit based on F-value (6.823 > 1) and significance *p* (0.000125 < 0.001). One predictor 'donor agency contribution to the development of action plans' is identified as a unique significant predictor of the model (see Box 1) showing a positive relationship (β=0.467, $p < 0.001$) with the level of integration. When the city develops climate action plans with support from donor agencies (assigned value '1'), integration index (the level of integration of mitigation and adaptation) may increase 6.203 (*B*).

Box 1: Result of multiple regression (Method: Enter)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.688[a]	.473	.404	5.178	.473	6.823	5	38	.000

a. Predictors: (Constant), Donor agency contribution to the development of plans, Network_regional_Unión de Ciudades Capitales Iberoamericanas (UCCI), Network-global_Urban LEDS, Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas), National_common climate fund

ANOVA[a]

>1 ↑

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	914.786	5	182.957	6.823	.000[b]
	Residual	1018.941	38	26.814		
	Total	1933.727	43			

→ 0.000125 ($p < 0.001$)

a. Dependent Variable: Integration index_all variables

b. Predictors: (Constant), Donor agency contribution to the development of plans, Network_regional_Unión de Ciudades Capitales Iberoamericanas (UCCI), Network-global_Urban LEDS, Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas), National_common climate fund

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	11.259	1.803		6.245	.000	7.610	14.909		
	National_common climate fund	-1.315	1.883	-.099	-.698	.489	-5.127	2.497	.693	1.443
	Network-global_Urban LEDS	-4.935	2.904	-.214	-1.699	.097	-10.815	.945	.874	1.144
	Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)	5.249	2.712	.272	1.936	.060	-.241	10.739	.704	1.421
	Network_regional_Unión de Ciudades Capitales Iberoamericanas (UCCI)	1.557	1.896	.114	.821	.417	-2.282	5.396	.715	1.399
	Donor agency contribution to the development of plans	6.203	1.618	.467	3.833	.000	2.927	9.479	.933	1.072

a. Dependent Variable: Integration index_all variables

As this study does not find the causality, *stepwise method* is also applied to test a model (Field, 2013). The result of multiple regression analysis with a stepwise[2] method shows that the prediction of model is correct in 45.3% (R square=0.453) of the cases and can be considered as a model of good-fit (F-value 11.029 > 1 and significance $p < 0.001$). There are three predictors identified as significantly contributing to the model ($p < 0.05$): 'donor agency contribution to the development of action plans', 'regional network FLACMA' and 'global network Urban LEDS' (see Box 2). Donor agency contribution shows a positive relationship (β=0.492, $p < 0.001$) with the level of integration while the other two predictors have negative relationships. Therefore, the possibility of increase in the level of integration rises when receiving donor agencies' assistance in developing policies, having a membership of FLAMA

[2] Regression analyses with forward and backward stepwise methods yield the same model in this test.

and not participating in Urban LEDS. The remarkable results include that these three predictors are all external institutional factors.

Box 2: Result of multiple regression (Method: Stepwise)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics			
					R Square Change	F Change	df1	df2	Sig. F Change
1	.489[a]	.239	.221	5.919	.239	13.191	1	42	.001
2	.627[b]	.393	.363	5.352	.154	10.384	1	41	.002
3	.673[c]	.453	.412	5.144	.060	4.379	1	40	.043

a. Predictors: (Constant), Donor agency contribution to the development of plans

b. Predictors: (Constant), Donor agency contribution to the development of plans, Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)

c. Predictors: (Constant), Donor agency contribution to the development of plans, Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas), Network-global_Urban LEDS

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	462.166	1	462.166	13.191	.001[b]
	Residual	1471.561	42	35.037		
	Total	1933.727	43			
2	Regression	759.541	2	379.771	13.261	.000[c]
	Residual	1174.186	41	28.639		
	Total	1933.727	43			
3	Regression	875.395	3	291.798	11.029	.000[d]
	Residual	1058.332	40	26.458		
	Total	1933.727	43			

a. Dependent Variable: Integration index_all variables

b. Predictors: (Constant), Donor agency contribution to the development of plans

c. Predictors: (Constant), Donor agency contribution to the development of plans, Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)

d. Predictors: (Constant), Donor agency contribution to the development of plans, Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas), Network-global_Urban LEDS

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	11.381	1.292		8.811	.000	8.774	13.988		
	Donor agency contribution to the development of plans	6.489	1.787	.489	3.632	.001	2.883	10.094	1.000	1.000
2	(Constant)	10.299	1.215		8.475	.000	7.845	12.753		
	Donor agency contribution to the development of plans	6.583	1.615	.496	4.075	.000	3.320	9.845	1.000	1.000
	Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)	7.577	2.351	.392	3.222	.002	2.828	12.325	1.000	1.000
3	(Constant)	10.926	1.206		9.061	.000	8.489	13.363		
	Donor agency contribution to the development of plans	6.528	1.553	.492	4.204	.000	3.389	9.667	.999	1.001
	Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)	6.976	2.278	.361	3.062	.004	2.372	11.581	.984	1.016
	Network-global_Urban LEDS	-5.690	2.719	-.247	-2.093	.043	-11.186	-.194	.984	1.016

a. Dependent Variable: Integration index_all variables

One of notable output is that 'national common climate fund' shows an insignificant relationship with the level of integration similarly in two models of enter and stepwise methods even though it is detected as a highly significant factor from the correlation analysis. In addition, even though socioeconomic and environmental factors are identified as potentially influential factors on the development of climate plans based on the literature review, most of them are resulted to insignificant (p-value > 0.05) when it comes to the level of integration. This might be due to the possibility that the tested factors have low explanatory power in average or the adopted factors from the literatures might not be appropriate in the context of target cities in LAC region. Moreover, interdependency between factors is not considered in this study.

Chapter 5. Conclusion and recommendations

The study was conducted based on content analysis of the literature and policy documents, along with statistical analysis of the relationships between selected institutional, socioeconomic and environmental factors of the development of climate change plans and the level of integration of mitigation and adaptation action plans from 44 cities in Latin America and the Caribbean (LAC). This study does not aim to explain the causality between factors and the level of integration of climate action plans, therefore the factors identified as significant in the correlation analysis are considered *'potential'* drivers or barriers of the level of integration. Research on the causality is suggested in the end of this chapter along with the other recommendations for further research.

To answer the first research sub-question, *'which institutional, socioeconomic and environmental factors are related to the integration of mitigation and adaptation when developing climate action plans?'*, relevant literatures were reviewed in chapter 2 to identify factors that may influence the integration of climate action plans. Since few academic articles (Duguma, et al., 2014; Grafakos, et al., 2018) address relevant factors to the integration of mitigation and adaptation, the factors identified as related to the development of climate policies and action plans are also selected for the study. Therefore, 20 main indicators (42 when including sub-indicators) are selected. Among these indicators, more than half are institutional, while the rest are environmental and socioeconomic factors, based on the relative importance of institutional factors for developing and implementing climate plans as identified in the literature. (Duguma, et al., 2014; Aylett, 2015; Reckien, et al., 2015; Grafakos, et al., 2018)

The second sub-question *'what is the current level of integration of mitigation and adaptation in climate change plans of LAC cities?'* can be answered by integration index of target cities that were calculated based on the evaluation framework of Grafakos, et al. (Under review). The average integration index of 44 cities is 14.77, a middle-level of integration. The range of integration index of target cities is extensive, varying from 4 to 28. In detail, out of 44 cities, 23 cities show a middle-level of integration (score 10 to 20) while 11 cities fall under low-level of integration (score below 10) and the rest 10 cities show a high-level of integration (score above 20). Bogota, the capital city of Colombia, is scored the highest level of integration while Merida, Mexico obtained the lowest score on the level of integration.

In order to answer the third sub-question, *'how do institutional, socioeconomic and environmental factors relate to the level of integration of mitigation and adaptation plans?'*, correlation and regression analyses were conducted utilizing the data drawn from the first and second sub-questions, which are the selected factors and the integration index of target cities. Five significant factors were identified in the correlation analysis: 3 factors with a positive correlation (regional networks 'FLACMA' and 'UCCI', and contribution of donor agencies to developing action plans); and 2 factors with a negative correlation (global network 'Urban LEDS' and national climate fund). The rest of selected factors were revealed as insignificant to the level of integration of mitigation and adaptation action plans of target cities.

As a result, the responses to these three sub-questions have led to resolving the main research question, *'to what extent do institutional, socioeconomic, and environmental factors, as potential drivers and barriers of the development of climate change action plans, relate to the level of integration of mitigation and adaptation action plans of cities in Latin America and the Caribbean?'* Overall, among tested factors, those with a significant level of relationship

with the level of integration are all from institutional factors (See Table 11) despite distinctive regional characteristics of socioeconomic (e.g. economic inequality) and environmental conditions (e.g. coastal cities) in the LAC region as addressed in Chapter 2. As a result, 3 potential driving factors and 2 constraining factors are identified. The three potential driving factors are: *regional networks (1) Federation of Latin American Cities, Municipalities and Associations (FLACMA)*; *(2) Union of Ibero-American Capital Cities (UCCI)*; and *(3) contributions of donor agencies* to developing climate-related action plans. On the other hand, the potential constraining factors are: *(1) national common climate fund*; and *(2) global network Urban Low Emissions Development Strategy (Urban LEDS)*. The remarkable results include that external institutional factors, such as global and regional networks and the contribution of donor agencies for developing action plans, are identified as significant for the level of integration of mitigation and adaptation, while most of the internal institutional factors related to the institutional capacity, such as the establishment of a climate change committee or technical working group and climate-related entity in local governments, are identified as non-significant. As can be seen in the regression analysis, the possibility of increase in the level of integration rises when receiving donor agencies' assistance in developing action plans, having a membership of FLAMA and not participating in Urban LEDS. Among all factors, *donor agencies' contribution to the development of action plans* is identified with the strongest relationship, which means that the factor seems more likely to contribute to the level of integration of mitigation and adaptation action plans.

Table 11: Summary of potential drivers and barriers to the level of integration of mitigation and adaptation

INTEGRATION INDEX	POTENTIAL DRIVERS AND BARRIERS (p <0.05, r >+.30 or <-.30)
WITH ALL VARIABLES	• Drivers (3): all institutional factors - Regional network 'FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)' - Regional network 'UCCI (Unión de Ciudades Capitales Iberoamericanas) - **Contribution of donor agencies to the development of climate action plans*** • Barriers (2): all institutional factors - **National common climate fund*** - Global network 'Urban LEDS'
WITH COMMON VARIABLES	• Drivers (3): all institutional factors - Adoption of national climate policy in the local climate action plans - **Regional network 'FLACMA'*** - Contribution of donor agencies to the development of climate action plans • Barriers (4): 2 institutional factors and 2 environmental factors - National common climate fund - Global network 'Urban LEDS' - Average temperature of the warmest month - Average temperature of the coldest month

* p <0.01

As aforementioned in Chapter 1 and 2, there are hardly the academic literatures about driving and constraining factors of the integration of mitigation and adaptation. Duguma, et al. (2014) deal with enabling factors for integrating mitigation and adaptation at the national level and do not consider constraining factors. The study of European cities by Reckien, et al. (2015) includes both driving and constraining factors not for the integration of mitigation and adaptation but for the development of separated mitigation or adaptation plans. Grafakos, et al. (2018) address an extensive selection of factors for integrating mitigation and adaptation in the planning for climate change at the city level. However, the study is not regional-specific, and

the level of relationships are not considered. In this regard, this study is the first one that addresses potential driving and constraining factors associated with the level of the integration of mitigation and adaptation in local climate change action plans, particularly from cities in LAC.

As addressed in Chapter 2. Literature Review, the research of Duguma, et al. (2014) is one of few academic literatures on studying the enabling factors of the integration of mitigation and adaptation. Therefore, those factors are adopted in this study of LAC cities, and the result shows that only 'national common climate fund' out of four enabling factors was identified as significant. Moreover, unlike the study of Duguma, et al. (2014), it was revealed as a constraining factor to the development of integrated climate plans as well as to the level of integration. The mitigation-centered climate fund of Brazil might be one of reasons. However, the relation between the existence of climate fund and the level of integration may change in the future because recently Mexico established an integrative climate fund and Colombia established a sustainable development fund.

In the study of European cities (Reckien, et al., 2015), institutional, socioeconomic and environmental factors are all significant to the development of separated climate plans, and especially climate networks are an effective measure to support both mitigation and adaptation action plans. With this regard, one similar finding is observed in this study of LAC cities that networks related to climate change or sustainable development are identified as significant to the level of integration of mitigation and adaptation. Global network Urban LEDS and two regional networks FLAMA and UCCI, which were included additionally in this study, are identified as significant, as a barrier and drivers respectively. However, in terms of global network Covenant of Mayors identified by Reckien, et al. (2015) as a significant influence on both mitigation and adaptation, it was identified as insignificant to any types of climate plans nor to the level of integration in the tested LAC cities (see Table 12).

Table 12: Summary of potential drivers and barriers to integrated and separate mitigation and adaptation plans

TYPE OF PLAN	POTENTIAL DRIVERS AND BARRIERS (P <0.05, R >+.30 OR <-.30)	(RECKIEN, ET AL., 2015) (P <0.05, R >+.20 OR <-.20)
INTEGRATED PLAN	• Barriers - Institutional: National common climate fund*, Global network Urban LEDS - Socioeconomic: Gini coefficient - Environmental: Average temperature of coldest month*	N/A
MITIGATION PLAN	• Drivers: all institutional factors - National common climate fund, Global network Urban LEDS* • Barriers: institutional factors - Contribution of donor agency	• Drivers - Institutional: Global networks (CoM* and Climate Alliance*) - Socioeconomic: Population size*, GDP per capita* • Barriers - Socioeconomic: Unemployment rate*
ADAPTATION PLAN	• Drivers - Socioeconomic: Gini coefficient - Environmental: Annual amount of rainfall	• Drivers - Institutional: Global networks (CoM*) - Socioeconomic: Population size* • Barriers - Socioeconomic: Smart cities rank

* p <0.01

Furthermore, in the world-wide study of Aylett (2015), internal institutional factors, such as a common working group that supports climate policies, are considered as influential for the planning and implementing adaptation plans or integrated climate plans. However, those factors, except for common climate fund, are identified as insignificant in this study of LAC cities in terms of both the integration of climate plans and their level of integration. On the other hand, the proportion of integrated climate plans and separated plans of the target cities are observed similar to the global survey of Aylett (2015), which is that integrated climate plans are substantially more than separated mitigation or adaptation plans.

On the other hand, the availability of data relevant to factors from the literature review is limited in target cities. With regard to this aspect, the need for improving the database related to climate change has increased in the LAC region. ECLAC has been trying to disseminate the framework for the development of environment statistics (FDES 2013) in the region (Quiroga, 2018). However, the database is still limited to the national level and does not provide city-level data.

Recommendations for further study

This study provides cities in the LAC region with the first insight of the current level of integration of mitigation and adaptation and potential driving and constraining factors for it. However, correlation and regression analysis conducted in this study cannot determine the causal relations between factors and the level of integration of mitigation and adaptation. Therefore, further research is recommended to study the identified significant factors to probe its associations with the level of integration or to investigate the role of factors.

In line with the results of this study, the following researches are suggested to further investigate the urban climate action plans:

- In-depth research with interviews and survey to explain the causality of the relationships identified in this study: negative relationships (national common climate fund and global network) and positive relationships (regional networks and the contribution of donor agencies to the development of action plans). This study may likewise identify which variables of the evaluation framework are significant contributors to the integration index;
- Case studies to understand the main factors of the integration of mitigation and adaptation in countries that have national climate change policies with components (strategy or plan) of the implementation of integrated climate action plans at the local level. e.g. Chile;
- Research on the implementation of integrated plans to determine how the integrated plans have been implemented or are likely to be implemented; and what factors enable or constrain the implementation of the integrated plans;
- Research on the mainstreaming of climate policies, especially integrated climate action plans, into the national and local sustainable development plans;
- Research on the level of local governments' dependency on assistance from donor countries and international organizations and their roles in the development of mid- and long-term sustainable development plans or other climate-related plans; and
- Comparison of the level of integration between cities in other continents and its potential driving and constraining factors.

Bibliography

Aylett, A., 2015. Institutionalizing the urban governance of climate change adaptation: Results of an international survey. *Urban Clim*ate, 14 pp. 4-16. Available at: http://dx.doi.org/10.1016/j.uclim.2015.06.005 .

Baftijari, I., Caragounis, R., Dobruna, A., Emini, A., et al., 2007. Inclusive and sustainable urban planning: a guide for municipalities_Volume 4. Nairobi: UN-Habitat.

Bárcena, A., Samaniego, J., Galindo, L. M., Ferrer, J., et al., 2017. La economía del cambio climático en américa latina y el caribe: síntesis 2016: una visión gráfica. Santiago de Chile: United nations economic commission for Latin America and the Caribbean. Available at: https://repositorio.cepal.org/bitstream/handle/11362/42228/1/S1701215_es.pdf [Accessed 13-04-2018].

Bulkeley, H. and Betsill, M. 2005. Rethinking sustainable cities: Multilevel governance and the 'urban' politics of climate change. *Environmental Politics,* 14 (1), pp. 42-63.

Bulkeley, H., Schroeder, H., Janda, K., Zhao, J., et al., 2011. Cities and climate change: Responding to an urgent agenda. Chapter 5. The role of institutions, governance, and urban planning for mitigation and adaptation. Herndon, VA: World Bank.

Buob, S. and Stephan, G. 2011. To mitigate or to adapt: How to confront global climate change. *European Journal of Political Economy,* 27 pp. 1-16. Available at: http://dx.doi.org/10.1016/j.ejpoleco.2010.05.001 [Accessed 05-04-2018].

Carlino, H., Pérez, S., Moneo, M., Moreno, A., et al., 2016. Análisis inicial de las implicaciones del Acuerdo de París en la mitigación y la adaptación al cambio climático de América Latina y el Caribe. Panama City: UNEP. Available at: http://www.pnuma.org/cambio_climatico/publicaciones/Acuerdo-de-Par%C3%ADs-Mitigaci%C3%B3n-y-Adaptaci%C3%B3n-en-ALC-Estudio_2.pdf [Accessed 13-04-2018].

Corfee-Morlot, J., Kamal-Chaoui, L., Donovan, M. G., Cochran, I., et al., 2009. Cities, climate change and multilevel governance. OECD environment working papers No.14, OECD. Available at: http://www.oecd-ilibrary.org/environment/cities-climate-change-and-multilevel-governance_220062444715 [Accessed 05-04-2018].

Davidson, F., 1996. Planning for performance: Requirements for sustainable development. *Habitat International,* 30 pp. 445-462.

Di Gregorio, M., Ridho, D. N., Paavola, J., Sari, I. M., et al., 2017. Climate policy integration in the land use sector: Mitigation, adaptation and sustainable development linkages. *Environmental Science & Policy,* 67 pp. 35-43. Available at: http://dx.doi.org/10.1016/j.envsci.2016.11.004 .

Duguma, L. A., Wambugu, S. W., Minang, P. A. and van Noordwijk, M. 2014. A systematic analysis of enabling conditions for synergy between climate change mitigation and adaptation measures in developing countries. *Environmental Science & Policy,* 42 pp.

138-148. Available at: http://dx.doi.org/10.1016/j.envsci.2014.06.003 [Accessed 30-03-2018].

Eckstein, D., Kŭnzel, V. and Schäfer, L., 2017. Global climate risk index 2018: Who suffers most from extreme weather events? Weather-related loss events in 2016 and 1997 to 2016. Germanwatch e.V. Available at: https://germanwatch.org/en/download/20432.pdf [Accessed 19-01-2018].

ECLAC, 2013. Respuestas urbanas al cambio climático en América Latina. Santiago de Chile: United Nations Economic Commission for Latin America and the Caribbean. Available at: https://repositorio.cepal.org/bitstream/handle/11362/36622/1/S2013813_es.pdf [Accessed 02-04-2018].

ECLAC, 2015. La economía del cambio climático en América Latina y el Caribe: Paradojas y desafíos del desarrollo sostenible. Santiago de Chile: United Nations Economic Commission for Latin America and the Caribbean.

ECLAC, GIZ and ipea 2016. Avaliação do fundo clima. United Nations Economic Commission for Latin America and the Caribbean. Available at: https://repositorio.cepal.org/bitstream/handle/11362/40843/1/S1601337_pt.pdf .

Feld, B. and Galiani, S. 2015. Climate change in Latin America and the Caribbean: Policy options and research priorities. *Latin American Economic Review,* 24 (14), pp. 1-39. Available at: https://doi.org/10.1007/s40503-015-0028-4 [Accessed 03-04-2018].

Field, A., 2013. Discovering statistics using IBM SPSS statistics. 4. SAGE Publications.

Fuhr, H., Hickmann, T. and Kern, K. 2018. The role of cities in multi-level climate governance: Local climate policies and the 1.5 C target. *Current Opinion in Environmental Sustainability,* 30 pp. 1-6. Available at: http://dx.doi.org/10.1016/j.cosust.2017.10.006 .

Grafakos, S., Pacteau, C., Delgado, M., Landauer, M., et al., 2018. Integrating mitigation and adaptation: Opportunities and challenges, climate change and cities. 2018. Second assessment report of the urban climate change research network. Cambridge University Press.

Grafakos, S., Trigg, K., Landauer, M., Chelleri, L., et al., Under review. Analytical framework to evaluate the level of integration of climate adaptation and mitigation in cities. *Climatic Change*.

Hallegatte, S., Bangalore, M., Bonzanigo, L., Fay, M., et al., 2016. Shock waves: Managing the impacts of climate change on poverty. World Bank. Available at: https://elibrary.worldbank.org/doi/pdf/10.1596/978-1-4648-0673-5?download=true [Accessed 05-04-2018].

Hardoy, J. and Lankao, P. R. 2011. Latin American cities and climate change: challenges and options to mitigation and adaptation responses. *Current Opinion in Environmental Sustainability,* 3 pp. 158–163. Available at: http://dx.doi.org/10.1016/j.cosust.2011.01.004 [Accessed 05-04-2018].

Hardoy, J. and Pandiella, G. 2009. Urban poverty and vulnerability to climate change in Latin America. *Environment & Urbanization,* 21 (1), pp. 203–224. Available at: http://journals.sagepub.com/doi/10.1177/0956247809103019 [Accessed 16-04-2018].

Huh, T., Park, Y. and Yang, J. Y. 2017. Multilateral governance for climate change adaptation in S. Korea: The mechanisms of formulating adaptation policies. *Sustainability,* 9 (1364), Available at: http://www.mdpi.com/2071-1050/9/8/1364 [Accessed 17-04-2018].

IBRD-WB, 2010. World development report 2010: Development and climate change. Washington DC: World Bank. Available at: https://elibrary.worldbank.org/doi/abs/10.1596/978-0-8213-7987-5 [Accessed 07-04-2018].

ICLEI, 2015. carbon *n*® Climate registry: 5-year overview report (2010-2015). Available at: http://e-lib.iclei.org/wp-content/uploads/2015/12/cCR2015_5Year_Report.pdf .

IFC, 2016. Climate-smart investment potential in Latin America: A trillion-dollar opportunity. Washington, DC: International Finance Corporation (IFC). Available at: https://www.ifc.org/wps/wcm/connect/0d9f8fbf-2738-4432-843c-05184b9546d8/LAC+1Trillion+6-13-16+web+FINAL.pdf?MOD=AJPERES [Accessed 09-04-2018].

IPCC, 2007. IPCC climate change 2007: Impacts, adaptation and vulnerability. Contribution of Working Group II to the fourth assessment report of the intergovenmental panel on climate change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press.

IPCC, 2014a. Climate change 2014: Impacts, adaptation, and vulnerability. Part B: Regional aspects. contribution of Working Group II to the fifth assessment report of the intergovernmental panel on climate change. IPCC. Available at: http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-PartB_FINAL.pdf .

IPCC, 2014b. Climate change 2014: Synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. Geneva, Switzerland: IPCC. Available at: http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf .

IPCC, 2017. Forty-sixth session of the IPCC: Approved outlines of the Working Group contributions to the sixth assessment report. Montreal: IPCC. Available at: http://www.ipcc.ch/ .

Klein, R. J. T., Schipper, E. L. F. and Dessai, S. 2005. Integrating mitigation and adaptation into climate and development policy: three research questions. *Environmental Science & Policy,* pp. 579–588. Available at: http://linkinghub.elsevier.com/retrieve/pii/S1462901105001073 [Accessed 07-04-2018].

Landauer, M., Juhola, S. and Klein, J. 2018. The role of scale in integrating climate change adaptation and mitigation in cities. *Journal of Environmental Planning and Management,* Available at: https://doi.org/10.1080/09640568.2018.1430022 .

Landauer, M., Juhola, S. and Soderholm, M. 2015. Inter-relationships between adaptation and mitigation: a systematic literature review. *Climatic Change,* 131 pp. 505–517. Available at: http://link.springer.com/10.1007/s10584-015-1395-1 .

Laukkonen, J., Kim Blanco, P., Lenhart, J., Keiner, M., et al., 2009. Combining climate change adaptation and mitigation measures at the local level. *Habitat International,* 33 pp. 287-292. Available at: http://dx.doi.org/10.1016/j.habitatint.2008.10.003 [Accessed 10-04-2018].

Lee, T. and Painter, M. 2015. Comprehensive local climate policy: The role of urban governance. *Urban Climate,* 14 pp. 566–577. Available at: http://dx.doi.org/10.1016/j.uclim.2015.09.003 .

Ludeña, C. and Netto, M. 2011. Brazil: Mitigation and adaptation to climate change, Theoretical framework for the elaboration of IDB's strategy in Brazil. Available at: https://publications.iadb.org/bitstream/handle/11319/6041/Brasil%20-%20IDB-TN-622%20-%20Sept%2014.pdf?sequence=1 .

NASA EOSDIS SEDAC, 2016. Gridded population of the world (GPW), v4, UN-Adjusted population count 2015. Available at: http://sedac.ciesin.columbia.edu/data/collection/gpw-v4 .

OECD, 2009. Integrating climate change adaptation into development co-operation: Policy guidance. OECD. Available at: https://www.oecd-ilibrary.org/docserver/9789264054950-en.pdf?expires=1522878644&id=id&accname=ocid194328&checksum=507DED6B9E14299AFB5F7292B7E15CDA [Accessed 14-04-2018].

OECD, 2010. Cities and climate change. OECD Publishing. Available at: http://dx.doi.org/10.1787/9789264091375-en [Accessed 03-04-2018].

OECD, 2016. 2020 Projections of climate finance towards the USD 100 billion goal: Technical note. OECD. Available at: http://www.oecd.org/environment/cc/Projecting%20Climate%20Change%202020%20WEB.pdf [Accessed 07-04-2018].

Porteron, S., Leonardsen, J., Hahn, F., Attström, K., et al., 2018. Urban climate action impacts framework: A framework for describing and measuring the wider impacts of urban climate action. C40. Available at: https://c40-production-images.s3.amazonaws.com/other_uploads/images/1605_C40_UCAIF_report_V3.original.pdf?1518203136 [Accessed 11-04-2018].

Quiroga, R. M., 2018. Estadísticas e indicadores de cambio climático: perspectiva regional ALC. Eclac, Available at: http://euroclimaplus.org/images/Noticias/FIIAPP/Sesion8-CEPAL.pdf .

Raupach, M. R., Marland, G., Ciais, P., Le Quéré, C., et al., 2007. Global and regional drivers of accelerating CO2 emissions. *Proceedings of the National Academy of Sciences of the United States (PNAS),* 104 (24), pp. 10288–10293. Available at: http://www.pnas.org/content/pnas/104/24/10288.full.pdf [Accessed 03-04-2018].

Reckien, D., Flacke, J., Olazabal, M. and Heidrich, O. 2015. The influence of drivers and barriers on urban adaptation and mitigation plans—An empirical analysis of European cities. *Plos One,* 10 (8), Available at: http://dx.plos.org/10.1371/journal.pone.0135597 [Accessed 10-03-2018].

Romero, P. L., Hughes, S., Qin, H., Hardoy, J., et al., 2014. Scale, urban risk and adaptation capacity in neighborhoods of Latin American cities. *Habitat International,* 42 pp. 224-235. Available at: http://dx.doi.org/10.1016/j.habitatint.2013.12.008; [Accessed 19-01-2018].

Satterthwaite, D., 2008. Cities' contribution to global warming: notes on the allocation of greenhouse gas emissions. *Environment & Urbanization,* 20 (2), pp. 539–549. Available at: http://journals.sagepub.com/doi/10.1177/0956247808096127 [Accessed 11-04-2018].

Satterthwaite, D., Huq, S., Pelling, M., Reid, H., et al., 2007. Adapting to climate change in urban areas: The possibilities and constraints in low- and middle-income nations. London: International Institute for Environment and Development (IIED). Available at: http://pubs.iied.org/pdfs/10549IIED.pdf [Accessed 03-04-2018].

SEMARNAT, 2016. Fondo para el cambio climático: Mexico. ECLAC. Available at: https://www.cepal.org/sites/default/files/events/files/fondo_para_el_cambio_climatico_2016_mexico.pdf .

Skok, J. E., 1990. Theory of strategic action for public policy. *American Review of Public Administration,* 20 (2), pp. 77-93. Available at: http://journals.sagepub.com/doi/pdf/10.1177/027507409002000202.

Solecki, W., Seto, K. C., Balk, D., Bigio, A., et al., 2015. A conceptual framework for an urban areas typology to integrate climate change mitigation and adaptation. *Urban Climate,* 14 pp. 116-137. Available at: http://dx.doi.org/10.1016/j.uclim.2015.07.001 .

Spikin, A. S. and Hernández, J. R. 2016. Climate change in Latin America: Inequality, conflict, and social movements of adaptation. *Latin American Perspectives,* 43 (4), pp. 4–11. Available at: http://journals.sagepub.com/doi/10.1177/0094582X16644916 [Accessed 14-04-2018].

Staden, M. v. and Musco, F., 2010. Local governments and climate change: Sustainable energy planning and implementation in small and medium sized communities. Springer Science & Business Media. [Accessed 11-04-2018].

Swart, R. and Raes, F. 2007. Making integration of adaptation and mitigation work: mainstreaming into sustainable development policies? *Climate Policy,* 7 pp. 288-303. Available at: http://www.tandfonline.com/doi/abs/10.1080/14693062.2007.9685657 .

Thornbush, M., Golubchikov, O. and Bouzarovski, S. 2013. Sustainable cities targeted by combined mitigation–adaptation efforts for future-proofing. *Sustainable Cities and Society,* 9 pp. 1-9. Available at: http://dx.doi.org/10.1016/j.scs.2013.01.003 .

UN-DESA, 2015. World Urbanization Prospects: The 2014 Revision. New York: United Nations, Department of Economic and Social Affairs, Population Division.

UN-DESA, 2016. The world's cities in 2016: Data booklet. ST/ESA/SER.A/392, United Nations. Available at: http://www.un.org/en/development/desa/population/publications/pdf/urbanization/the_worlds_cities_in_2016_data_booklet.pdf [Accessed 05-04-2018].

UN-DESA, 2017a. 2016 Demographic yearbook. United Nations. Available at: https://unstats.un.org/unsd/demographic-social/products/dyb/dybsets/2016.pdf .

UN-DESA, 2017b. Classification of countries by region, income group and sub-region of the world. *World Population Prospects: The 2017 Revision,* Available at: https://esa.un.org/unpd/wpp/General/Files/Definition_of_Regions.pdf .

UN-DESA, 2018a. Methodology: Definition issues, World Urbanization Prospects 2018. Available at: https://esa.un.org/unpd/wup/General/DefinitionIssues.aspx .

UN-DESA, 2018b. World Urbanization Prospects: The 2018 Revision. Key facts. New York: United Nations.

UN-Habitat, 2012. The State of Latin American and Caribbean Cities 2012: Towards a new urban transition. UN-Habitat. Available at: https://unhabitat.org/books/state-of-latin-american-and-caribbean-cities-2/ [Accessed 27-03-2018].

UN-Habitat, 2015. Guiding principles for city climate action planning. HS/086/15E), Nairobi, Kenya: UN-Habitat. Available at: https://unhabitat.org/books/guiding-principles-for-climate-city-planning-action/ [Accessed 07-04-2018].

Van Thiel, S., 2014. Research methods in public administration and public management: An Introduction. Routledge.

Yanow, D., 1996. How does a policy mean? Interpreting policy and organizational actions. Washington, D.C.: Georgetown University Press.

Annex 1: List of target cities and policy documents

Internet search keywords for policy documents are in three languages, Spanish, Portuguese and French: climate change action plan (in Spanish 'plan de acción para cambio climático'/in Portuguese 'plano de mudança climática'/in French 'le changement climatique'), adaptation (adaptación/adaptação/adaptation), mitigation (mitigación/mitigação/atténuation), energy (energia/energia/énergie), sustainable development plan (plan de desarrollo sostenible or sustentable/ plano de desenvolvimento sustentável/plan de développement durable) and strategic plan (plan estratégico/plano estratégico/plan stratégique).

NO.	COUNTRY	CITY	TITLE OF POLICY DOCUMENT
1	Argentina	Buenos Aires	Plan de Acción Frente al Cambio Climático (PACC) 2020 (EN) Action Plan against Climate Change 2020
2	Argentina	Mendoza	Plan de Acción Área Metropolitana de Mendoza Sostenible (EN) Action Plan Sustainable Metropolitan Area Mendoza
3	Argentina	Rosario	Plan Ambiental Rosario (EN) Rosario Environmental Plan
4	Bolivia	Cochabamba	Plan de Acción Área Metropolitana de Cochabamba Sostenible (EN) Action Plan Sustainable Metropolitan Area Cochabamba
5	Bolivia	La Paz	Plan Estratégico Institucional del Gobierno Autónomo Municipal de La Paz (PEI 2016 - 2020) (EN) Instituional Strategic Plan of the Autonomous Municipal Government of La Paz 2016-2020
6	Bolivia	Santa Cruz de la Sierra	Plan Estratégico Institucional (PEI 2016-2020) (EN) Institutionsl Strategic Plan 2016-2020
7	Brazil	Belo Horizonte	Plano Plurianual de Ação Governamental (PPAG) 2018-2021 (EN) Multiannual Governmental Action Plan 2018-2021
8	Brazil	Brasília	Plano Plurianual (PPA) 2016-2019 (EN) Multiannual Plan 2016-2019
9	Brazil	Curitiba	Curitiba Ações Estratégicas: Clima e Resiliência (EN) Curitiba Strategic Actions: Climate and Resilience
10	Brazil	Florianópolis	Plano de Ação Florianópolis Sustentável (EN) Action Plan Sustainable Florianopolis
11	Brazil	Fortaleza	Planos de Ação e Metas Para a Redução de Gases do Efeito Estufa (EN) Action Plan and Greenhouse Gases Reduction Goals
12	Brazil	Goiânia	Goiânia Sustentável: Plano de Ação (EN) Sustainable Goiania: Action Plan
13	Brazil	Vitória	Plano de Ação Vitória Sustentável (EN) Action Plan Sustainable Vitoria
14	Brazil	Joao Pessoa	Plano de Ação Joao Pessoa Sustentável (EN) Action Plan Sustainable Joao Pessoa
15	Brazil	Rio de Janeiro	Plano de Ação para Redução de Emissões do Município do Rio de Janeiro (EN) Action Plan for Reduction of Emissions of Rio de Janeiro
16	Brazil	Salvador	Planejamento Estratégico 2017-2020 (EN) Strategic Planning 2017-2020
17	Brazil	São Paulo	Diretrizes para o Plano de Ação da Cidade de São Paulo para Mitigação e Adaptação Às Mudanças Climáticas (EN) Guidelines for the Action Plan of São Paulo for Mitigation and Adaptation to Climate Change
18	Chile	Santiago	Plan de Adaptación al Cambio Climático para la Región Metropolitana de Santiago de Chile (EN) Climate Change Adaptation Plan for the Metropolitan Region of Santiago de Chile
19	Colombia	Bogotá	Plan Distrital de Gestión del Riesgo y Cambio Climático para Bogotá D.C. 2015-2050 (EN) Risk Management and Climate Change Plan for Bogota D.C. 2015-2050
20	Colombia	Bucaramanga	Plan de Desarrollo Gobierno de las Ciudadanas y los Ciudadanos 2016 – 2019 (EN) Governmental Development Plan for Citizens 2016-2019
21	Colombia	Cali	Plan Integral de Mitigación y Adaptación al Cambio Climático para Santiago de Cali

			(EN) Integral Plan of Mitigation and Adaptation to Climate Change for Santiago de Cali
22	Colombia	Cartagena	Plan 4C: Cartagena de Indias Competitiva y Compatible con el Clima (EN) Plan 4C: Cartagena de Indias, Competitive and Compatible with the Climate
23	Colombia	Medellín	Plan de Desarrollo 2016 - 2019, Medellín Cuenta con Vos (EN) Development Plan 2016-2019
24	Costa Rica	San José	San José Capital: de la Acción Local a la Sostenibilidad Metropolitana (EN) Local Action to the Metropolitan Sustainability
25	Cuba	Havana	Plan Especial de Desarrollo Integral hasta 2030 (EN) Integral Development Plan by 2030
26	Dominican Republic	Santo Domingo	Plan de Ordenamiento Territorial del Distrito Nacional (POT) Capital 2030 (EN) Territorial Plan of the National District: Capital 2030
27	Ecuador	Quito	Plan de Acción Climático de Quito 2015-2025 (EN) Climate Action Plan of Quito 2015-2025
28	Honduras	Tegucigalpa	Tegucigalpa y Comayagüela: Capital Sostenible, Segura y Abierta al Público (EN) Tegucigalpa and Comayaguela: Sustainable, Secure and Open to the Public Capital City
29	Mexico	Aguascalientes	Plan de Acción Climática Municipal (PACMUN) (EN) Municipal Climate Action Plan
30	Mexico	Mexico City	Programa de Acción Climática de la Ciudad de México 2014-2020 (EN) Climate Action Program for Mexico City 2014-2020
31	Mexico	Cuernavaca	Plan de Acción Climática Municipal del H. Ayuntamiento de Cuernavaca (EN) Cuernavaca Municipal Climate Action Plan
32	Mexico	Guadalajara	Plan Municipal de Desarrollo Visión 2030 Y Plan de Gestión Institucional 2012-2015 para El Municipio de Guadalajara por el Plan Municipal de Desarrollo Guadalajara 500/Visión 2042 (EN) Municipal Development Plan 'Visión 2030´and Institutional Operation Plan 2012-2015 of the municipality of Guadalajara for the Municipal Development Plan 'Guadalajara 500/Vision 2042'
33	Mexico	León de los Aldama	Programa Municipal de Cambio Climático (EN) Municipal Climate Change Program
34	Mexico	Mérida	Programa Municipal de Desarrollo Urbano de Mérida (EN) Urban Development Program of Merida
35	Mexico	Puebla	Plan de Acción Climática del Municipio de Puebla (EN) Puebla Climate Action Plan
36	Mexico	Querétaro	Propuesta de Plan Municipal de Atención al Cambio Climático 2017-2018 (EN) Proposal of the Municipal Climate Change Plan 2017-2018
37	Mexico	Tijuana	Plan Municipal de Desarrollo 2017-2019 (EN) Municipal Development Plan 2017-2019
38	Mexico	Toluca de Lerdo	Plan de Acción Climático Municipal Toluca (EN) Toluca Municipal Climate Action Plan
39	Mexico	Torreón	Plan Estratégico para Torreón con Enfoque Metropolitano 2040 (EN) Torreon Strategic Plan with Focus on Metropolitan Area 2040
40	Panama	Panama City	Plan de Acción Panamá Metropolitana Sostenible, Humana y Global (EN) Action Plan of the Sustainable, Humane and Global Panama Metropolitan Area
41	Paraguay	Asunción	Plan de Acción Área Metropolitana de Asunción Sostenible (EN) Metropolitan Action Plan of Sustainable Asuncion
42	Peru	Lima	Estrategia de Adaptación y Acciones de Mitigación de la Provincia de Lima al Cambio Climático (EN) Mitigation and Adaptation Strategy to Climate Change
43	Uruguay	Montevideo	Plan Climático de la Región Metropolitana de Uruguay (EN) Climate Plan of the Metropolitan region in Uruguay
44	Venezuela	Caracas	Avances del Plan Estratégico Caracas Metropolitana 2020 (EN) Progress of the Metropolitan Caracas Strategic Plan 2020

Annex 2: List of data source

VARIABLE	CATEGORY	INDICATOR	SOURCE	REMARKS
DEPENDENT	Integration index	(22 indicators)	City climate change action plans found in local governments' official websites	As of July, 2018 * Indicators are scored based on the content analysis of policy documents. Sum of total values of indicators is to be an integration index.
INDEPENDENT	Institutional	Both M+A addressed in national climate policy	National climate policies from 16 target countries	
INDEPENDENT	Institutional	Common climate strategy/action for both M+A included in national	National climate policies from 16 target countries	
INDEPENDENT	Institutional	Submission of NAMA/REDD+ R-PP and/or NAPs		
		Submission of NAMA	UNFCCC	
		Submission of REDD+ R-PP	UNFCCC	
		Submission of NAPs (National Adaptation Plans)	UNFCCC	
INDEPENDENT	Institutional	National committee addressing M+A together	Central governments' official websites or policy documents	
INDEPENDENT	Institutional	National governance structure: climate related institution, agency, department	Central governments' official websites or policy documents	
INDEPENDENT	Institutional	National Common climate fund	Central governments' official websites or policy documents	
INDEPENDENT	Institutional	Previously executed or ongoing joint M+A project/program	ODI-Climate Funds Update	As of 28.02.2018 * Most countries have had joint projects except for Venezuela
INDEPENDENT	Institutional	Adoption of national climate change strategy	Policy documents of target cities	
INDEPENDENT	Institutional	City-level governance structure: climate related agency or department	Municipality official website or policy documents	* Existence of climate change or environment or sustainable development department
INDEPENDENT	Institutional	City-level: establishment of expert body or committee	Municipality official website or policy documents	
		Number of city networks		* Number of membered global and regional city networks
INDEPENDENT	Institutional	Member of global city network		* Score '1' if a member of at least one global network
		100 resilient cities	Official website of 100 resilient cities	As of June, 2018
		C40	Official website of C40	As of June, 2018
		ICLEI	Official website of ICLEI	As of June, 2018
		Global Covenant of Mayors	Official website of Global Covenant of Mayors	As of June, 2018

		Urban LEDS	Official website of Urban LEDS	As of June, 2018
INDEPENDENT	Institutional	Member of regional city network		* Score '1' if a member of at least one regional network
		Mercociudades	Official website of Mercociudades	As of July, 2018
		FLACMA	Official website of FLACMA	As of July, 2018
		AL-LAs.	Official website of AL-Las	As of July, 2018
		UCCI	Official website of UCCI	As of July, 2018
INDEPENDENT	Institutional	Donor agency contribution to developing plan	Policy documents of target cities	
INDEPENDENT	Socioeconomic	Environmentally-concerned civil society	Registry list from central or local government official websites	* Brazil: Association of civil society
INDEPENDENT	Socioeconomic	Population size	UN-DESA: The World's Cities in 2016	2016
INDEPENDENT	Socioeconomic	Population growth	UN-DESA: The World's Cities in 2016	2000-2016
INDEPENDENT	Socioeconomic	Population density	Demographia 2018	2016
INDEPENDENT	Socioeconomic	City-level GDP per capita	Urban World, McKinsey & Company	2015
INDEPENDENT	Socioeconomic	Gini Coefficient	* UN-HABITAT: World cities report 2016, UN-HABITAT CPI, Atlas Brasil	
INDEPENDENT	Socioeconomic	Unemployment	Policy documents, Urban Dashboard by IDB, UN-HABITAT CPI	
INDEPENDENT	Environmental	City-level CO2 emission per capita	CDP, policy documents, Urban Dashboard by IDB, UN-HABITAT CPI	
INDEPENDENT	Environmental	Proximity to coast	Google map	
INDEPENDENT	Environmental	Distance to equator	Google map	
INDEPENDENT	Environmental	Altitude above sea level	Google earth and information of meteorological station	
INDEPENDENT	Environmental	Average temperature of warmest month	WMO World Weather Information Service (30-year period, 1981–2010)	* National meteorological office : AR (Rosario), BO
INDEPENDENT	Environmental	Average temperature of coldest month		
INDEPENDENT	Environmental	Total amount of rainfall		
INDEPENDENT	Environmental	Number of rainy days		

Annex 3: Atlas.ti code list

ATLAS.ti Report
Integration of M and A_67 cities_LAC
Code groups (selection)
Report created by Hyejung Kim on Aug 19, 2018

1_Identifying and understanding-Scientific knowledge

7 Members:
- Climate Hazards (detailed)
- Cost estimates of damages of climate impacts
- Future Climate Projections
- GHG Emissions Forecast
- GHG emissions Profile
- Uncertainty of climate impacts
- Vulnerability Profile

2_Envisioning and planning_(1)Target setting

3 Members:
- Adaptation objectives
- GHG emissions reduction sectoral target
- GHG emissions reduction target

2_Envisioning and planning_(2)Prioritization of actions

5 Members:
- Benefit estimates of actions
- Common public education and outreach
- Consideration of M+A interrelationships
- Cost estimates of actions
- Sustainability benefits

3_Implementation and monitoring_(1)Financing

2 Members:
- Common funding body or budget (public)
- Financing commitment (public or private)

3_Implementation and monitoring_(2)Implementation

4 Members:
- Common coordination/implementation body
- Common policy or regulatory framework
- Mainstreaming potential of M+A actions
- Partnerships

3_Implementation and monitoring_(3)Monitoring

1 Members:
- Common monitoring procedure/framework

Annex 4: Top 10 cities by the level of integration of mitigation and adaptation plans

RANK	CITY	COUNTRY	INTEGRATION INDEX-all variables	INTEGRATION INDEX-common variables	TYPE OF POLICY	CONTRIBUTION OF DONOR AGENCY
1	Bogota	Colombia	28	13 (rank 1)	Climate change plan	Yes (UN org.: UNDP and UN-HABITAT)
2	Mendoza	Argentina	25	9 (7)	Sustainable development plan	Yes (IDB)
2	Mexico City	Mexico	25	12 (2)	Climate change plan	No
2	Asuncion	Paraguay	25	8 (11)	Sustainable development plan	Yes (IDB)
5	Florianopolis	Brazil	24	9 (7)	Sustainable development plan	Yes (IDB)
5	Cali	Colombia	24	11 (4)	Climate change plan	Yes (CIAT)
5	Panama City	Panama	24	8 (11)	Sustainable development plan	Yes (IDB)
5	Montevideo	Uruguay	24	11 (4)	Climate change plan	Yes (UN org.: UNDP)
9	Buenos Aires	Argentina	23	12 (2)	Climate change plan	No
10	Cartagena	Colombia	22	10 (6)	Climate change plan	Yes (DFID, DGIS)

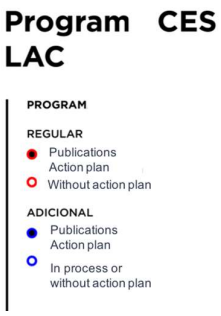
Annex 5: (I)CES program by IDB

Methodology of CES

PHASES		ACTIVITIES	DELIVERABLES
CORE OF THE METHODOLOGY : DEVELOPMENT OF THE ACTION PLAN - 1 YEAR	Preparation	• Initiate data collection • Form work teams • Identify stakeholders • Hire technical experts	• List of stakeholders and initial view of strengths and problem areas
	1. Diagnostic analysis	• First mission • City overview • Complete indicators • Traffic light exercise • Baseline studies	• Set of indicators with traffic light analysis, comparisons with other cities and baseline studies
	2. Prioritization	• Applying filters: - Public opinion, economic cost, climate change specialists - Critical areas for the city's sustainability	• List of prioritized areas and sectors
	3. Action plan	• Formulating action plans for identified strategies • Initial study • Create detailed action plan • Validate action plan	• High level action plan
PRE-INVESTMENT + MONITORING: ACTION PLAN EXECUTION – 3 YEARS	4. Pre-investment	• Financing studies in prioritized sectors: feasibility, economic, engineering and environmental • Prepare vertical cooperation agreement	• Set of actions with basic descriptions
	5. Monitoring	• Design and implementation of a monitoring system • Indicators for prioritized areas • Citizen perception • Topics of interest	• Monitoring system
	Investment	• Action plan execution • Projects ready for bidding and financing	• New public services and infrastructures

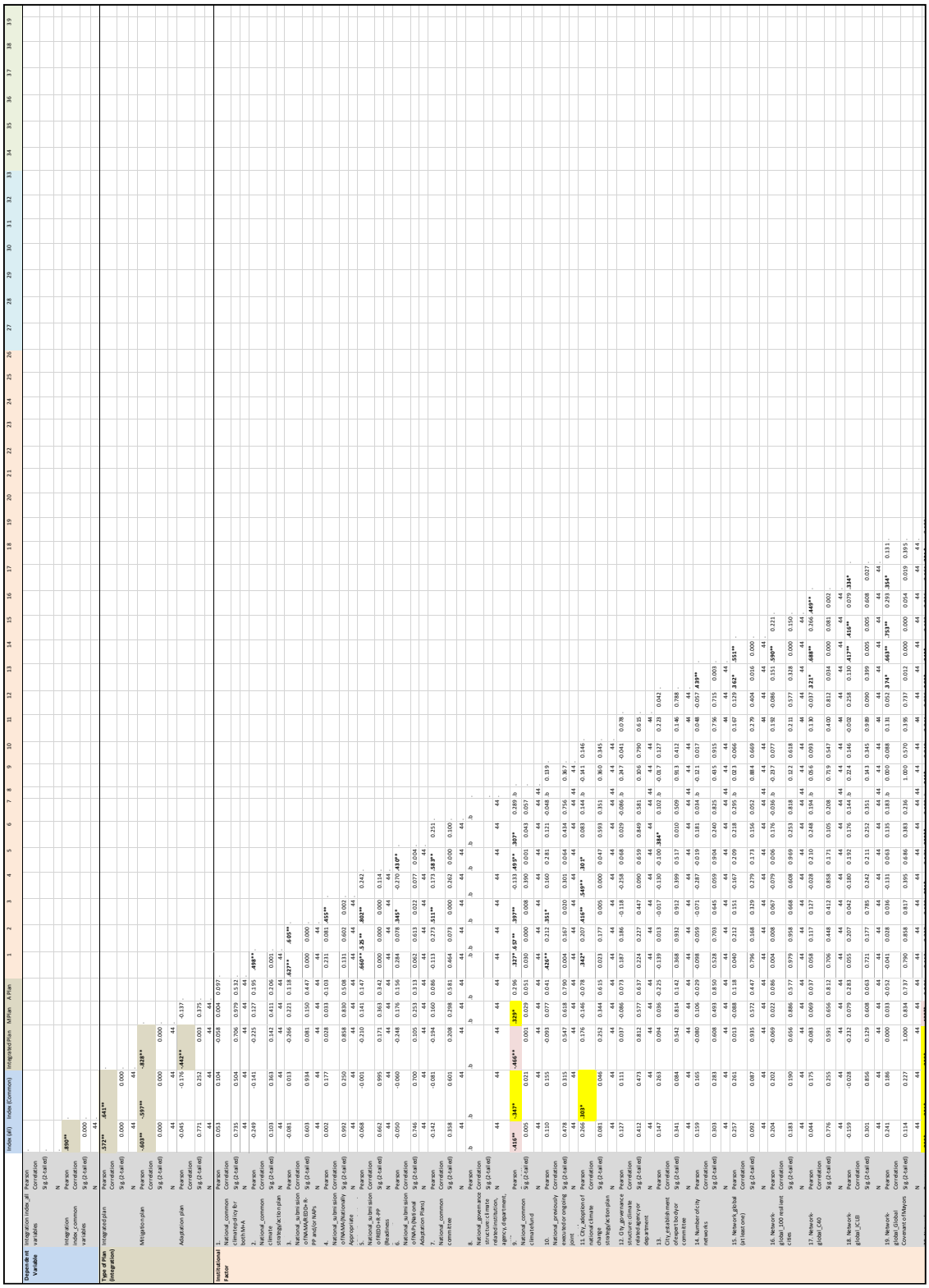
Source: CES official website (https://www.iadb.org/es/ciudades)

Map of target cities of CES program



Source: CES official website (https://www.iadb.org/es/ciudades), status as of 2017

Annex 6: Result of correlation analysis (all variables)



	20. Network-global_Urban LEDS	Pearson Correlation	-.299*	-.321*	-.339*	.428**	-0.086	0.113	0.227	0.138	-.331*	0.171	.399**	0.100	.b	.346*	0.048	0.014	0.086	.380*	.343*	0.138	0.036	0.161	.331*	0.183	.
		Sig. (2-tailed)	0.048	0.033	0.024	0.004	0.581	0.464	0.138	0.373	0.028	0.266	0.007	0.518		0.021	0.756	0.926	0.581	0.011	0.023	0.373	0.818	0.295	0.028	0.236	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	21. Network_regional (at least one)	Pearson Correlation	0.175	0.056	0.020	-0.016	-0.009	-0.245	-0.182	-0.297	-.555**	-.370*	0.141	-0.216	.b	-0.160	-0.104	-0.226	-0.185	.370*	.609**	0.236	0.225	.309*	0.067	.394**	0.216	.
		Sig. (2-tailed)	0.255	0.720	0.898	0.915	0.955	0.110	0.236	0.050	0.000	0.013	0.361	0.159		0.298	0.501	0.139	0.230	0.013	0.000	0.122	0.141	0.041	0.667	0.008	0.159	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	22. Network_regional_Mercociudades (Sud America)	Pearson Correlation	-0.055	-0.140	0.000	0.056	-0.090	-0.215	-0.144	-.435**	-.683**	-.325*	.327*	-.316*	.b	0.000	-0.152	-.319*	0.090	.370*	.477**	0.186	0.169	0.204	0.046	0.262	.316*	.683**	.
		Sig. (2-tailed)	0.724	0.363	1.000	0.716	0.561	0.161	0.352	0.003	0.000	0.031	0.030	0.037		1.000	0.323	0.035	0.561	0.013	0.001	0.226	0.273	0.184	0.769	0.085	0.037	0.000	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	23. Network_regional_FLACMA (Federación Latinoamericana de Ciudades, Municipios y Asociaciones Municipalistas)	Pearson Correlation	.383*	.391**	0.243	-0.201	-0.107	-0.066	-.413**	-0.189	-0.151	-0.101	-0.179	-0.105	.b	-.363*	0.061	-0.247	-0.155	-0.061	.462**	0.173	0.127	0.203	0.151	0.229	-0.126	0.271	0.000	.
		Sig. (2-tailed)	0.010	0.009	0.111	0.190	0.487	0.668	0.005	0.218	0.329	0.516	0.244	0.499		0.016	0.696	0.106	0.314	0.693	0.002	0.262	0.412	0.187	0.329	0.134	0.416	0.075	1.000	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	24. Network_regional_AL-LAs (Alianza Euro-Latinoamericana de cooperación entre	Pearson Correlation	0.024	0.077	-0.152	0.242	-0.118	0.156	0.182	0.189	0.042	0.088	0.038	-0.079	.b	-0.023	0.066	0.206	0.118	0.270	.575**	0.189	.396**	.431**	0.206	0.251	0.295	0.297	0.186	0.008	.
		Sig. (2-tailed)	0.876	0.617	0.324	0.114	0.447	0.313	0.238	0.219	0.785	0.572	0.808	0.612		0.884	0.669	0.179	0.447	0.076	0.000	0.219	0.008	0.003	0.179	0.100	0.052	0.050	0.226	0.958	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	25. Network_regional_UCCI (Unión de Ciudades Capitales Iberoamericanas)	Pearson Correlation	.309*	0.246	0.067	-0.055	-0.029	-0.157	-0.119	-0.038	0.011	-0.238	-0.246	-0.074	.b	-.349*	-0.192	0.176	-.341*	0.194	.515**	0.218	0.292	0.248	-0.104	.350*	-0.089	.542**	0.047	.501**	0.293	.
		Sig. (2-tailed)	0.041	0.108	0.667	0.722	0.849	0.308	0.443	0.808	0.945	0.120	0.107	0.634		0.020	0.211	0.252	0.024	0.207	0.000	0.156	0.055	0.105	0.501	0.020	0.568	0.000	0.764	0.001	0.054	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	26. Donor agency contribution to the development of plan	Pearson Correlation	.489**	.359*	0.232	-.305*	0.078	0.088	-0.015	0.206	0.089	0.025	0.104	0.014	.b	-0.224	0.160	0.184	-0.258	0.055	-0.222	0.206	-0.079	-.334*	-0.180	-0.026	-0.014	0.031	-0.137	-0.018	-.331*	0.011	.
		Sig. (2-tailed)	0.001	0.017	0.129	0.044	0.615	0.570	0.922	0.179	0.566	0.874	0.501	0.926		0.143	0.301	0.231	0.090	0.724	0.148	0.179	0.608	0.027	0.242	0.866	0.926	0.841	0.377	0.907	0.028	0.945	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
Socioeconomic Factor	27. Environmentally-concerned civil society in the city	Pearson Correlation	0.073	0.051	0.241	-0.199	-0.106	-0.169	0.034	-0.205	0.021	-0.256	-.473**	-0.149	.b	-0.161	-0.072	0.097	-0.128	0.033	0.220	0.117	0.093	0.156	-0.021	0.272	-0.056	0.184	0.000	0.187	0.044	.374*	-0.097	.
		Sig. (2-tailed)	0.639	0.744	0.116	0.195	0.492	0.273	0.827	0.182	0.890	0.094	0.001	0.334		0.295	0.643	0.533	0.409	0.833	0.152	0.449	0.548	0.311	0.890	0.074	0.719	0.232	1.000	0.223	0.777	0.012	0.533	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	28. Population size	Pearson Correlation	0.104	0.263	0.020	0.051	-0.117	-0.036	0.103	0.033	-0.074	0.088	0.171	0.150	.b	0.150	0.036	0.093	0.044	.518**	.512**	0.216	0.157	.692**	.324*	0.277	0.161	.310*	0.201	0.109	.367*	0.294	-.342*	0.183	.
		Sig. (2-tailed)	0.500	0.085	0.896	0.744	0.449	0.819	0.507	0.834	0.633	0.571	0.267	0.330		0.332	0.817	0.550	0.778	0.000	0.000	0.159	0.308	0.000	0.032	0.069	0.298	0.041	0.191	0.482	0.014	0.052	0.023	0.234	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	29. Population growth rate	Pearson Correlation	0.193	0.116	0.134	-0.152	0.008	.471**	-0.070	-0.034	-0.032	0.145	0.044	-0.243	.b	0.000	.308*	0.110	.413**	-0.197	-.324*	-0.295	-0.249	-0.174	-0.097	-0.262	-0.117	-0.147	-0.049	0.004	-0.271	-.318*	0.071	-0.141	-0.239	.
		Sig. (2-tailed)	0.210	0.452	0.387	0.323	0.960	0.001	0.653	0.829	0.835	0.347	0.777	0.112		1.000	0.042	0.477	0.005	0.199	0.032	0.052	0.104	0.258	0.530	0.086	0.449	0.340	0.751	0.981	0.076	0.036	0.646	0.362	0.118	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	30. Population density	Pearson Correlation	0.254	0.259	0.003	-0.034	0.050	0.075	-.383*	0.134	.337*	0.116	.322*	0.138	.b	-.345*	-0.134	.404**	0.079	0.141	0.159	0.084	0.184	.319*	0.020	0.190	-0.123	0.018	-0.153	0.064	0.187	0.168	-0.047	-0.207	0.214	0.070	.
		Sig. (2-tailed)	0.096	0.089	0.985	0.825	0.749	0.629	0.010	0.386	0.025	0.452	0.033	0.373		0.022	0.384	0.007	0.611	0.360	0.304	0.588	0.233	0.035	0.899	0.216	0.428	0.909	0.322	0.680	0.225	0.276	0.763	0.178	0.163	0.651	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	31. City-level GDP per capita	Pearson Correlation	0.166	0.174	0.279	-0.128	-0.288	-.390**	-0.042	-0.102	-0.098	-0.126	-0.092	0.244	.b	-0.210	-0.274	0.065	-0.235	.304*	.341*	0.219	0.292	0.208	-0.205	.342*	-0.119	.321*	0.136	0.168	0.124	.438**	-0.152	0.242	0.258	-.461**	-0.063	.
		Sig. (2-tailed)	0.282	0.258	0.067	0.408	0.058	0.009	0.787	0.512	0.526	0.416	0.554	0.111		0.172	0.072	0.674	0.125	0.045	0.023	0.153	0.054	0.175	0.182	0.023	0.441	0.034	0.378	0.275	0.424	0.003	0.325	0.113	0.091	0.002	0.685	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	.
	32. Gini Coefficient	Pearson Correlation	-0.142	-0.221	-.363*	0.184	.339*	.358*	0.199	0.221	-.510**	0.180	.700**	-0.033	.b	.346*	0.227	-0.173	-0.060	0.213	0.194	0.216	0.136	0.075	0.276	0.116	.407**	.378*	.349*	-0.012	-0.048	-0.034	0.178	-0.253	0.071	0.075	-0.059	-0.261	.
		Sig. (2-tailed)	0.371	0.159	0.018	0.244	0.028	0.020	0.207	0.160	0.001	0.255	0.000	0.836		0.025	0.148	0.273	0.707	0.176	0.219	0.170	0.391	0.637	0.077	0.465	0.007	0.014	0.023	0.938	0.765	0.830	0.261	0.105	0.656	0.637	0.710	0.095	.
		N	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	.
	33. Unemployment rate	Pearson Correlation	0.188	0.079	-0.092	-0.066	0.258	-0.062	-.488**	-0.076	-0.171	-0.086	.495**	-0.053	.b	-0.249	-0.130	0.038	-0.117	0.223	0.239	0.107	.377*	0.053	-0.098	0.271	0.051	.331*	0.271	0.127	-0.046	0.190	0.091	-0.163	0.004	-0.076	.559**	0.063	.407**	.
		Sig. (2-tailed)	0.233	0.620	0.561	0.678	0.099	0.697	0.001	0.631	0.279	0.590	0.001	0.740		0.111	0.414	0.811	0.461	0.156	0.127	0.498	0.014	0.741	0.538	0.083	0.747	0.032	0.082	0.424	0.771	0.229	0.567	0.302	0.979	0.632	0.000	0.692	0.008	.
		N	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	41	.
Environmental Factor	34. CO2 emission per capita	Pearson Correlation	0.068	0.000	0.139	-0.028	-0.188	-.576**	0.004	-0.250	-0.113	-0.255	-0.275	0.289	.b	-0.165	-.319*	0.053	-0.085	0.061	0.118	.346*	0.151	-0.136	-0.008	0.265	-0.010	0.082	0.019	-0.079	-0.094	0.192	0.054	0.110	-0.047	-.461**	-0.214	.570**	-.338*	-0.170	.
		Sig. (2-tailed)	0.676	1.000	0.392	0.864	0.245	0.000	0.980	0.120	0.486	0.113	0.085	0.070		0.308	0.045	0.745	0.602	0.709	0.470	0.029	0.352	0.401	0.961	0.098	0.951	0.616	0.907	0.630	0.563	0.235	0.743	0.498	0.774	0.003	0.185	0.000	0.033	0.294	.
		N	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	.
	35. Proximity to the coast	Pearson Correlation	-0.058	-0.069	0.162	-0.050	-0.207	0.069	-0.209	-0.214	-0.212	-0.045	-0.058	-0.210	.b	-0.034	0.125	-0.069	0.186	-0.001	-0.130	-0.202	-0.286	-0.207	-0.019	-0.272	-0.138	0.051	0.196	0.172	-0.129	-0.063	-0.150	0.072	-0.096	.439**	-0.225	-0.087	0.032	-0.139	-0.168	.
		Sig. (2-tailed)	0.706	0.655	0.293	0.749	0.177	0.658	0.174	0.163	0.166	0.769	0.711	0.170		0.829	0.418	0.655	0.227	0.992	0.402	0.189	0.060	0.178	0.903	0.074	0.371	0.741	0.202	0.265	0.404	0.682	0.330	0.641	0.533	0.003	0.143	0.576	0.839	0.380	0.300	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	42	42	40	.
	36. Coastal city	Pearson Correlation	0.060	-0.002	-0.239	0.137	0.202	0.091	0.182	0.297	-0.031	0.021	0.159	0.046	.b	0.062	0.104	-0.067	-0.202	0.027	-0.027	0.030	0.137	-0.090	-0.262	0.056	0.123	0.152	0.000	-0.129	0.103	0.159	0.262	-.311*	-0.095	-0.158	0.029	-0.008	0.241	0.250	0.007	-.577**	.
		Sig. (2-tailed)	0.698	0.988	0.118	0.374	0.188	0.558	0.236	0.050	0.841	0.892	0.301	0.765		0.688	0.501	0.667	0.188	0.862	0.859	0.845	0.374	0.563	0.086	0.716	0.425	0.323	1.000	0.403	0.505	0.301	0.086	0.040	0.538	0.304	0.850	0.960	0.124	0.110	0.965	0.000	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	42	42	40	44	.
	37. Distance from equator	Pearson Correlation	0.025	0.064	0.159	-0.031	-0.229	-.377*	0.046	-0.262	-0.013	-.365*	-0.245	-0.095	.b	0.054	0.144	-0.126	-0.097	0.254	-0.007	-0.078	0.017	-0.066	-0.183	-0.001	-0.035	0.008	0.280	-0.168	-0.119	-0.092	0.023	.315*	0.095	-0.205	-.537**	0.226	-0.226	-0.307	0.200	0.034	-0.113	.
		Sig. (2-tailed)	0.873	0.687	0.315	0.846	0.144	0.014	0.770	0.093	0.934	0.017	0.118	0.552		0.734	0.361	0.425	0.542	0.104	0.964	0.621	0.916	0.677	0.247	0.997	0.828	0.959	0.072	0.287	0.452	0.563	0.884	0.042	0.551	0.193	0.000	0.149	0.160	0.051	0.222	0.833	0.476	.
		N	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	40	41	39	42	42	.
	38. Altitude above sea level	Pearson Correlation	0.145	0.249	0.276	-0.201	-0.167	0.221	-0.069	-0.103	0.201	0.060	-0.241	-0.229	.b	-0.151	0.008	0.203	0.101	-0.241	-0.005	-0.018	-0.147	0.106	0.288	-0.072	-0.164	-0.169	-0.277	.319*	0.073	0.022	-0.098	0.263	0.032	0.122	0.113	-0.184	-0.145	-0.207	-0.272	0.275	-.589**	-0.275	.
		Sig. (2-tailed)	0.347	0.103	0.069	0.191	0.278	0.150	0.658	0.506	0.191	0.698	0.114	0.134		0.329	0.957	0.187	0.513	0.114	0.976	0.907	0.342	0.494	0.058	0.643	0.287	0.273	0.069	0.035	0.636	0.886	0.525	0.085	0.835	0.430	0.466	0.231	0.358	0.187	0.090	0.071	0.000	0.078	.
		N	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	40	40	38	42	42	40	.
	39. Average temperature of warmest month	Pearson Correlation	-0.260	-.375*	-0.291	0.212	0.175	-0.176	0.049	0.038	-0.181	-0.066	0.083	0.167	.b	0.247	-0.051	-0.280	0.001	-0.017	-0.228	-0.108	0.023	-0.290	-.323*	-0.091	0.095	-0.037	0.130	-.430**	-0.187	-0.214	0.049	-0.224	-0.178	-0.023	-0.219	-0.043	0.110	0.105	0.262	-0.122	.405**	0.188	-.839**	.
		Sig. (2-tailed)	0.089	0.012	0.055	0.167	0.256	0.253	0.750	0.807	0.241	0.668	0.594	0.277		0.107	0.741	0.065	0.993	0.914	0.136	0.485	0.884	0.057	0.033	0.557	0.540	0.811	0.400	0.004	0.224	0.163	0.753	0.145	0.247	0.883	0.153	0.782	0.488	0.510	0.102	0.431	0.006	0.234	0.000	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	42	42	40	44	44	42	42	.
	40. Average temperature of coldest month	Pearson Correlation	-0.216	-.314*	-.413**	0.294	0.261	0.208	0.039	.348*	-0.069	0.252	.354*	0.244	.b	0.207	-0.104	-0.036	0.031	-0.128	-0.160	0.045	0.069	-0.199	-0.130	0.025	0.140	-0.051	-0.146	-0.255	-0.054	-0.076	0.085	-.422**	-0.178	0.055	0.264	-0.225	.365*	.407**	-0.010	-0.233	.466**	-.579**	-.487**	.616**	.
		Sig. (2-tailed)	0.158	0.038	0.005	0.053	0.087	0.175	0.800	0.020	0.658	0.099	0.018	0.110		0.177	0.501	0.818	0.842	0.409	0.299	0.773	0.656	0.195	0.399	0.871	0.364	0.744	0.346	0.094	0.727	0.625	0.584	0.004	0.247	0.722	0.084	0.143	0.017	0.007	0.952	0.127	0.001	0.000	0.001	0.000	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	42	42	40	44	44	42	42	44	.
	41. Total amount of rainfall	Pearson Correlation	-0.066	-0.169	-0.297	0.130	.317*	0.118	0.035	0.272	-.368*	0.189	.476**	0.199	.b	0.190	0.052	-0.135	-0.022	0.016	0.162	.323*	0.250	0.001	0.159	0.196	0.205	0.224	0.098	0.031	-0.030	-0.038	0.162	-0.230	-0.015	-0.050	0.045	0.048	.556**	.353*	0.025	-0.073	.318*	-.365*	-.366*	.347*	.627**	.
		Sig. (2-tailed)	0.673	0.272	0.050	0.402	0.036	0.445	0.821	0.074	0.014	0.220	0.001	0.196		0.216	0.737	0.381	0.889	0.919	0.295	0.033	0.101	0.995	0.303	0.203	0.181	0.143	0.526	0.841	0.845	0.805	0.294	0.132	0.921	0.749	0.774	0.756	0.000	0.022	0.879	0.636	0.035	0.018	0.017	0.021	0.000	.
		N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	42	42	40	44	44	42	42	44	44	.
	42. Number of rainy days	Pearson Correlation	0.068	0.035	-0.130	-0.007	0.238	0.206	-0.072	0.185	-0.273	0.221	.584**	0.092	.b	0.010	-0.087	0.061	0.271	0.056	0.287	0.299	0.267	.325*	.323*	0.224	0.160	0.245	0.162	0.105	0.221	-0.043	-0.036	-0.304	0.130	0.059	.531**	-0.086	.451**	.437**	-0.171	-0.088	0.136	-.666**	0.031	-0.149	.407**	.735**	.
		Sig. (2-tailed)	0.670	0.827	0.413	0.967	0.129	0.190	0.652	0.242	0.080	0.160	0.000	0.562		0.949	0.583	0.702	0.083	0.723	0.066	0.054	0.087	0.036	0.037	0.154	0.311	0.118	0.306	0.507	0.160	0.788	0.820	0.050	0.413	0.709	0.000	0.588	0.003	0.005	0.306	0.580	0.391	0.000	0.849	0.346	0.008	0.000	.
		N	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	42	40	40	38	42	42	40	40	42	42	42	.

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

b. National-level governance structure: Cannot be computed because at least one of the variables is constant.

Annex 7: IHS copyright form

In order to allow the IHS Research Committee to select and publish the best UMD theses, participants need to sign and hand in this copy right form to the course bureau together with their final thesis.

Criteria for publishing:

A summary of 300 to 500 words should be included in the thesis.

The number of pages for the thesis is about 60.

The thesis should be edited.

Please be aware of the length restrictions of the thesis. The Research Committee may choose not to publish very long and badly written theses.

By signing this form you are indicating that you are the sole author(s) of the work and that you have the right to transfer copyright to IHS, except for items cited or quoted in your work that are clearly indicated.

I grant IHS, or its successors, all copyrights to the work listed above, so that IHS may publish the work in *The IHS thesis series*, on the IHS web site, in an electronic publication or in any other medium.

IHS is granted the right to approve reprinting.

The author(s) retain the rights to create derivative works and to distribute the work cited above within the institution that employs the author.

Please note that IHS copyrighted material from *The IHS thesis series* may be reproduced, up to ten copies for educational (excluding course packs purchased by students), non-commercial purposes, providing full acknowledgements and a copyright notice appear on all reproductions.

Thank you for your contribution to IHS.

Date : _____

Your Name(s) : _____

Your Signature(s) : _____

Please direct this form and all questions regarding this form or IHS copyright policy to:

The Chairman, IHS Research Committee Burg. Oudlaan 50, T-Building 14th floor, 3062 PA Rotterdam, The Netherlands	j.edelenbos@ihs.nl Tel. +31 10 4089851