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Title: **Influence of contextual and governance factors
on vertical integration of urban adaptation
strategies in NDCs**

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Title

**Influence of contextual and governance factors on vertical
integration of urban adaptation strategies in NDCs**

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Summary

As a part of growing concern, several significant decisions have been accepted by world leaders beneath the United Nations Framework Convention on Climate Change (UNFCCC) in the recent decades. In France, parties of the world came to a consent known as ‘Paris agreement’ to minimize the causes and effects of climate change in 12th December 2015 which has been ratified by enough member states within next year. The agreement with ‘common global target’ determined mitigation attributes to confine global temperature increase to 1.5 degree Celsius and develop the capacity to adapt climate change effects and become more resilient. Countries have devoted to support this global agenda through Nationally Determined Contributions (NDCs) and review it in every five years. Along with mitigation measures, parties are intended to introduce adaptation strategies, plans, actions in response to climate change effects. However, within this global platform of opportunities, member states are promised to exchange knowledge, information, technology, skill and financial resources to implement NDC actions. The inclusion of adaptation strategies and prioritize are very perplexing because they are localized and contextual. Therefore, both in academic field and policy implication, it is important to explore the context that are instigating countries to adopt adaptation actions as well as assess the opportunities and challenges of integrating local actions vertically at the national level.

To reduce the gap in this newly emerged academic field of NDCs, present research contributed by analyzing 52 NDCs which concentrated mainly in urban adaptation measures. The study identified the level of vertical integration of urban adaptations of the NDCs, evaluated the influence of contextual factors in integrating actions as well as assessed the drivers and constraints of the governance system in determining vertical integrations level by following both qualitative and quantitative study. The study reveals that among the three level of vertical integration, only 13 are highly integrated while most of the NDCs (38) are moderately integrated. Income level, urbanization rate and vulnerability level as contextual factors have significant influence in determining vertical integration level of urban adaptations. The factors are also strongly correlated to each other as both income level and urbanization increase the level of vulnerability. However, governance factors play an essential role in integrating urban adaptations in NDCs. Study depicts that, countries with high level of vertical integration have better performance in governing issues such as information sharing between national and local level, participation of actors, collaboration between national and sub-national level, national and local adaptation plan, expressing about funding source and capacity etc. It is also mentionable that income level as a context significantly influences governance system as well as the vertical integration of urban adaptations of a country.

As first submitted NDCs, the countries showed their commitments, devotion as much as possible through actions, strategies, and plan. Yet, there are information gaps in understanding the existing capacities and effort in implementation potentialities. Therefore, based on findings few guidelines have been provided in conclusion to make NDCs more robust, effective and understandable for the next review. It is expected that the goal of exchanging experience, knowledge and sharing capacity, resources within NDCs will be smoother and effective by following the guidelines.

Keywords

Climate change, NDC, Adaptation actions, Income level, Vulnerability, Urbanization rate, governance factors

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Abbreviations

CRI	Global Climate Risk Index
CIA	Central Intelligence Agency
CAF	Cancun Adaptation Framework
CTCN	Climate Technology Centre and Network
CNA	Capacity Need Assessment
COP	Conference of the Parties
FNA	Financial Need Assessment
GCF	Green Climate Fund
IPCC	Intergovernmental Panel for Climate Change
NDC	Nationally Determined Contribution
NAP	National Adaptation Plan
NAPA	National Adaptation Program of Actions
UNDP	United Nations Development Program
UNISDR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlement Program

Glossary of Terms

Adaptation

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate harm or exploit beneficial opportunities. In natural systems, human intervention may facilitate adjustment to expected climate and its effects. (IPCC, 2014)

Adaptation actions

The array of strategies and measures that are available and appropriate for addressing adaptation needs. They include a wide range of **actions** that can be categorized as structural, institutional, or social. (IPCC, 2014)

Climate change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions, and persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC, 2014)

Exposure: The extent to which human society and its supporting sectors are stressed by the future changing climate conditions (ND-GAIN, 2015).

Resilience

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate and recover from the effects of a hazard in a timely and efficient manner. (World Bank, 2012)

Sensitivity: The degree to which people and the sectors they depend upon are affected by climate-related perturbations. The factors increasing sensitivity include the degree of dependency on sectors that are climate-sensitive and proportion of populations sensitive to climate hazard due to factors such as topography and demography (ND-GAIN, 2015).

Vertical Integration

In the context of incorporating adaptation in national policy, vertical integration is the process of creating intentional and strategic linkages between national and sub-national adaptation planning, implementation and monitoring and evaluation (NAP, 2016)

Vulnerability

The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt. (IPCC, 2014)

Table of Contents

Summary.....	iii
Keywords	iii
Acknowledgements	iv
Abbreviations	v
Glossary of Terms.....	vi
Table of Contents	vii
List of Boxes.....	ix
List of Figures.....	ix
List of Tables	x
Chapter 1: Introduction	1
1.1 Background of the research	1
1.2. Problem Statement.....	2
1.3. Research Objectives	2
1.4. Research questions	3
1.4.1 Sub-questions	3
1.5. Significance of the study	4
1.6. Scope of the study.....	4
1.7. Limitations.....	4
1.8. Organization of the chapters	5
Chapter 2: Literature Review	6
2.1. Introduction	6
2.2. Integration of urban adaptations in climate policy	7
2.2.1. Tensions and dilemmas around adaptation.....	7
2.2.1.1 <i>Climate change adaptation complexities due to dealing a societal problem in a scientific way..</i>	7
2.2.1.2 <i>Multi-Dimensional and distressing characteristics of climate change.....</i>	8
2.2.1.3 <i>Multifaceted characteristics of adaptation governance</i>	8
2.2.2 Vertical Integration of local (urban) climate policy	9
2.2.2.1. <i>Sustainable development and environmental policy integration</i>	9
2.2.2.2. <i>Vertical integration as core portfolio to achieve environment goal.....</i>	10
2.2.2.3. <i>Vertical integration is the network of actors, administration and policy within spatial scale ..</i>	10
2.3. Evidence of adaptation integration in urban climate policies.....	11
2.4. Contextual factors that influence vertical integration of adaptation strategies.....	12
2.5. Influences of governance factors in vertical integration of urban adaptations	14
2.5.1 Data/Information barriers.....	15
2.5.2 Institutional arrangements.....	15
2.5.3 Level of Capacity	16
2.6. Vertical integration of urban adaptation strategy in NDCs	17
2.7. Research gap.....	17
2.8. Conceptual Framework.....	18
Chapter 3: Research Design and Methods	19
3.1. Introduction	19
3.2. Revised Research Questions.....	19
3.2.1. Revised Sub-questions	19
3.3. Research Approach and Design.....	19

3.4. Research Strategies.....	20
3.5. Operationalization: Variables and indicators.....	21
3.5.1. Outlining contextual factors.....	21
3.5.2. Describing Governance factors.....	21
3.6. Data type and Data collection method.....	22
3.6.1. Data on the level of vertical integration of urban adaptation (Dependent variable).....	22
3.6.2. Data on Contextual factors (Independent variables).....	23
3.6.3. Data on governance factors (Independent variables).....	5
3.7. Sample size and selection.....	5
3.8. Validity and reliability.....	6
3.9. Data analysis methods.....	6
Chapter 4: Research Findings	9
4.1. Introduction.....	9
4.2. Level of vertical integration of urban adaptations (findings on research question 1).....	9
4.3. Influence of contextual factors on vertical integration level of urban adaptation strategies	16
4.3.1. Vertical integration of urban adaptations and influence of income, urbanization rate and vulnerability.....	21
4.4. Influence of governance factors on vertical integration of urban adaptations (Answer to question 3).....	26
4.5. Vertical integration with information availability.....	26
4.5.1. Data Availability at national and local level.....	27
4.5.2. Adaptations actions for the poor and vulnerable group as well as the integration of local knowledge in NDCs.....	28
4.5.3. Vertical integration and information sharing between national and sub-national level.....	29
4.6. Institutional arrangement and vertical integration of urban adaptations.....	32
4.6.1. Participation of actors.....	32
4.6.2. National and local adaptation policy, plan or framework of NDCs.....	33
4.6.3. Collaboration between national and sub-national level and vertical integration of urban adaptations.....	35
4.6.4. Existing policy, law, regulations and vertical integration of urban adaptations.....	36
4.7. Level of capacity and vertical integration of urban adaptations.....	37
4.7.1. The skill of actors (vulnerability mapping, expertise in projections, model making etc., professional training) in response to climate change.....	38
4.7.2. Initiatives in response to adaptations (to develop capacity, techniques, and technology) and financial ability in different levels of vertical integration).....	39
Chapter 5: Conclusions and recommendations	42
5.1. Conclusion.....	42
5.1.1. High level of vertical integration requires sector specific, unambiguous urban adaptation actions..	42
5.1.2. Income level, urbanization rate and vulnerability highly influence each other and level of vertical integration.....	42
5.1.3. Income level influence governance system negatively which in turn affects vertical integration of urban adaptations.....	43
5.1.4 Governance factors highly influence vertical integration level of urban adaptations.....	43
5.2. Recommendations.....	43
5.2.1. General recommendations.....	44
5.2.2. Specific recommendations.....	44
5.3. Scope for the future research.....	45
Bibliography.....	46
Annex 1:.....	57
Annex 2.....	59
Annex 3:.....	65

Annex 4: IHS copyright form	90
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List of Boxes

Box 1	16
Box 2	26
Box 3	28
Box 4	29
Box 5	32
Box 6	33
Box 7	34
Box 8	36
Box 9	37
Box 10	39
Box 11	40
Box 12	41

List of Maps

Map 1: Countries with different level of vertical integration.....	15
Map 2: Urbanization rate and vulnerability of different countries	18
Map 3: Climate change vulnerability of countries with various income level	19
Map 4: Income level of studied countries.....	22
Map 5: Urbanization rate of studied countries.....	23
Map 6: Vulnerability profile of the studied countries.....	24

List of Figures

Figure 1: Conceptual Framework	18
Figure 2: Level of vertical integration within urban content (After UN-Habitat, 2017).....	23
Figure 3: NDCs with urban content (After UN-Habitat, 2017).....	4
Figure 4: Selection of sample	5
Figure 5: Data analysis process.....	8
Figure 6: Countries (%) with vertical integration level of urban adaptation	10
Figure 7: Vertical integration of countries within continents	10
Figure 8: Income level of NDC countries with urban adaptation strategies	17
Figure 9: Vulnerability and urbanization rate of different income level countries.....	17
Figure 10: Correlation of urbanization rate and vulnerability	18
Figure 11: Vulnerability increase with an urbanization rate	19
Figure 12: Relation between income and vulnerability level.....	20
Figure 13: Vulnerability of countries with income and vertical integration level	25

Figure 14: Data availability at national and local level (total percentage).....	27
Figure 15: National and local data source of NDCs within the vertical integration.....	27
Figure 16: Information sharing between national and local level with different level of vertical integration	30
Figure 17: Comparative data on overall information (Data availability and information sharing)	31
Figure 18: Participation of actors within vertical integration level	33
Figure 19: National and local adaption policy, plan or framework with vertical integration level	34
Figure 20: Collaboration between national and sub-national level with vertical integration level	35
Figure 21: Existing policy, law, regulations with the vertical level of integration	37
Figure 22: Initiatives in response to adaptations with different level of vertical integration	39
Figure 23: Data on information sharing within case number	58
Figure 24: Data of initiatives and explicit information on financial ability within case number	58
Figure 25: Percentage of initiatives of adaptation actions within vertical integration level	58

List of Tables

Table 1: Variables and indicators.....	24
Table 2: Summary of some countries with urban climate actions and level of vertical integration.....	11
Table 3: Correlation of vulnerability and urbanization rate	57
Table 4: Correlational analysis of income and vulnerability level.....	57
Table 5: Correlational analysis of vertical integration level and vulnerability.....	57
Table 6: Scaling criteria	59
Table 7: Guidelines for difference factors/indicators of governance factors	63

Chapter 1: Introduction

1.1 Background of the research

Based on scientific research it is evident that mainly anthropogenic activities influence climate change and its significant risk on human, non-human life and environment are increasing day by day (IPCC, 2014; IPCC, 2007). Study found that, about 97% climate scientist are now agreed that due to human activity climate over the world are changing (Doran and Zimmerman, 2009) with growing risk of global warming, sea level rise, high frequency and intensity of extreme events such as hurricanes, rainfall, floods etc. (IPCC, 2013; Solomon et al., 2007). The aggregate frequency of climate change-induced disasters, risks and a high level of uncertainty to predict them has made the issue a matter of global concern. The circumstance further complicated by varying degree of socio-economic and environmental context where climate change effects are being observed and this two are ‘inextricably intertwined’ (Parry et al., 1998; Lorenzoni, 2000). For reducing the adverse climate change impacts, ‘manifestation of climate change’ in response to socio-economic activities is already in the pipeline (IPCC, 2014). The degree to which future climate change effects will be experienced mostly depend on mitigation measures at present or ‘how much greenhouse gases are allowed to rise’ as well as long-term adaptive behavior and ‘iterative learning’ (UNISDR, 2015). Worldwide policymakers are now introducing policy, plan, and strategies at a different level to minimize the extreme effects of climate change. According to the IPCC assessment report (IPCC, 2013, 2007), greenhouse gas should cut down drastically to regulate ongoing global warming and its effects. For long, international and national climate policies were more attentive in reducing greenhouse gases through mitigation measures, especially in developed countries. As the effects of climate change are being observed around the world, along with mitigation the report also suggested for embracing adaptation strategies with prime importance to climate context (Masson et al., 2014). Urban areas are the residing place for more than half of the world population and a significant center of assets, economic growth, innovation, and development. Climate change issues are mostly related with urban areas in both ways, as a source of large-scale emission and center of effects where the extensive level of loss may occur in terms of life, destruction of assets and environment. For instance, development of ‘heat island’ (UHI), may lead to many deaths (Gabriel and Endlicher, 2011; Johnson and Wilson, 2009) or prolonged urban flood can destroy public and private property, resources. Based on local context such as city location, geographical characteristics, interactions among different level of governance, socio-economic criteria etc. specific adaptive measures are crucial to face each type of climate impact on cities (Masson et al., 2014).

Though human being has a long history of adaptation to his/her environment for the need of survival, climate change has brought new and distinctive challenges towards lives, livelihoods (Doherty et al., 2016) and natural flow of development. In the growing risks and forthcoming insecurity, concentration has been shifted toward climate change adaptation in the past two decades. The term ‘adaptation’ was introduced first in the 1990s but it achieved momentum by the definition and features discussed in the fourth assessment report of IPCC (Glick et al., 2009). IPCC defined adaptation as a process of adjustment in an environmental or man-made structure in response to change or anticipated ‘climatic stimuli’ and their impacts which can lessen damage or create positive opportunities (IPCC, 2007). Under growing concern over the world, participants of UNFCCC in COP 21 decided to set a global goal on adaptation for developing adaptive capability, reinforcing resilience and minimizing vulnerability in response to climate change (UNFCCC, 2015). However, several challenges and questions have arisen related to the unpredictability of long-term climate change impact. For example, what kind of

adaptation measures will be fruitful; will it cost effective or loss project or how to justify the strategies and to what way address critical vulnerabilities- which are still ambiguous (Doherty et al., 2016). All these questions regarding adaption bring the opportunity for academic research to analyze more cases of different countries with a variety of background, vulnerability context and examine adaptation strategies.

To minimize the causes and results of climate change, nations over the world negotiated almost two decades beneath the United Nations Framework Convention on Climate Change (UNFCCC). As an outcome of the Kyoto Protocol (since December 1997), 194 United Nations member states came to an agreement in 12th of December 2015 in France. The agreement is known as 'Paris agreement' which ratified by sufficient member states within next one year on 4 November 2016 ((UN Habitat, 2017). The consent with 'common global target' focused on mitigation aspects to restrain the global temperature increase in this century 'below 2 degree Celsius above pre-industrial levels' and pursue attempts to confine the temperature rise even further to 1.5 degree Celsius as well as develop the capability to adapt in response to climate change effects (UNFCCC, 2015). According to the Paris agreement, countries have committed to support the goal through Nationally Determined Contributions (NDCs). It will identify the key challenges of considering mitigation measures and introduce strategies to adapt to effects. The Paris Agreement devoted its Article 7 totally to the provision of adaptation with a 'global goal on adaptation' which includes three objectives such as 'extend adaptive capacity', 'strengthen resilience' and 'reduce vulnerability' to climate change (Craft and Fisher, 2018). Within this global platform of promise, member states further decided to share information, technologies, and resources to confront climate change impacts (UN-Habitat, 2017). The countries have already submitted their first NDCs and an initial report by UN-Habitat (2017) indicates that most of them (113 out 164) have a strong or moderate focus on urban content especially in Africa and Asia. Out of 113 'urban content' about half (58) of NDCs concentrated on adaptation. NDCs are newly introduced internationally and committed to review the policy every five years as well as increase their contribution to the global agenda of minimizing climate change effects. Hence, the area has a wider space for further research, especially in terms of adaptation. It will be academically significant and practically helpful for policy making if diversity of adaptation context, barriers, and opportunities of governance system can be revealed by analyzing NDCs.

Therefore, the purposes of the present research are; first, to identify the level of vertical integration of urban adaption of NDCs; next, to assess significant contexts (urbanization rate, income level, vulnerability level) that are driving countries for integrating urban adaptation strategies vertically; then, to analyse influence of governance factors which create opportunities or challenges in incorporating urban adaptation; and finally, to understand the gap of NDCs and provide some guidelines to improve the way of presenting explicit or clear data, make it strong and effective for next review.

1.2. Problem Statement

Assessing the influence of contextual and governance factors on the vertical integration of urban adaptation strategies in NDCs.

1.3. Research Objectives

The main aim of the research is to assess the influences of various factors in the vertical integration of urban adaptation strategies in NDCs. However, the specific objectives are,

- To know the level of vertical integration of adaptation policies, strategies, and actions in NDCs
The objective has been achieved through analyzing NDCs with the support of UN-Habitat (2017) report which already identified three different clusters regarding vertical integration of NDCs.
- To understand the influences of the contextual factors in integrating urban adaptation vertically by NDCs
This objective has shown internal relation and influence among contextual factors through Pearson correlation (urbanization rate, income level, vulnerability) as well as their effects on the level of vertical integration of adaptation within descriptive statistics and qualitative data from NDCs.
- To analyze governance factors as driver or constraint in the vertical integration of urban adaptation
The objective has been met by analyzing the influence of various governance factors such as information, institutional arrangement, and capacity on the level of vertical integration through descriptive statistics and qualitative analysis.
- To provide guidelines for the improvement of NDC content
After accomplishment of data analysis, the recommendation has been delivered according to the existing gap and information lacking to improve the structure and explicit way of presenting information regarding various issues of the next NDCs.

1.4. Research questions

What are the contextual and governance factors that influence the level of vertical integration of urban adaptation strategies in NDCs?

1.4.1 Sub-questions

1. What is the level of vertical integration of urban adaptation policies, actions and strategies in NDCs?
The outcomes of this question have shown the level of vertical integration of urban adaptation strategies by analyzing the reflection of urban content in the NDCs and the level of vertical integration has been defined as high, medium and low (see operationalization).
2. What are the major contextual factors that influence the level of vertical integration of urban adaptation in NDCs?
The answer of this question reveals internal correlation among the contextual factors (urbanization rate and vulnerability level as well as income level and vulnerability level) and their influence in determining the level of vertical integration in the NDCs.
3. Which governance factors drive or constraint vertical integration of urban adaptation strategies in NDCs?
By answering the question, significant governance factors (information, institutional and level of capacity) have been explored and their contribution to the vertical integration of urban adaptations have also been evaluated.

1.5. Significance of the study

Worldwide there is a growing concern on adaptation response to tackle present climate vulnerability and variability as well as to be ready for future climate impacts. As the adverse effects of climate change are being observed locally, along with mitigation world leaders and policymakers are emphasizing the significance of incorporating adaptation locally, nationally and internationally (OECD, 2015). Efforts to heighten adaptation measures and enlarge resilience are a key target of introducing climate policy in different scale including actors and worldwide network. However, it is difficult to approve specific framework or ‘one single model’ for adaptation as variation and dimension of climate change vulnerability are contextual and local. Moreover, it is very difficult to make certain projections on future climate change and its probable effects which made adaptation practices more uncertain and challenging. Therefore, world leaders, policymakers, are looking for practical evidence experienced by different nations as well as interested to exchange information, knowledge, and capacity within the common platform of global agreement. From this point of view, it is very much significant to understand the context that drives countries for capturing adaptation policies; the barriers and opportunities of a governance system that influence vertical integration of policies, strategies, and actions. NDCs are a very new area for research as they only submitted the first policy paper and will review it in every five years which keep the space for further improvement and lesson to follow by others. Furthermore, policy formulation or proper planning is the primary step to walk on the way to sustainable development. The planning process will be smoother, and decision-making will be more robust if practical examples come from difficulties and success stories experienced by countries.

1.6. Scope of the study

By considering the importance of adaptation incorporation in policies globally and locally, the present research has conducted on the NDCs which have driven by adaptation strategies to determine their contribution to global target. The focus of the study is to understand how local actions are integrated into national policy, strategies, and actions (bottom up). The research evaluated contextual and governance factors as they affect the inclusion of vertical integration of adaptation. Firstly, urbanization rate, income level and vulnerability level as the local context have been analyzed as they influence each other and have direct effects in encompassing adaptation strategies. Secondly, factors of governance system such as information, institutional structure, capacity level have also been scrutinized to understand their effect on adaption integration vertically. Data for measuring contextual factors collected from reliable secondary sources while governance factors have been examined mainly from NDCs. For quantitative study, qualitative information on governance factors has been translated into numerical value (Likert scale) which also supported by qualitative information from NDCs. The research only focuses on the vertical integration of adaptations as NDCs represent the national contributions of the country which are vertically aligned. Therefore, the facts and factors related to horizontal integration have been excluded from the study.

1.7. Limitations

During research, all the problems have been resolved as much as possible but still, there are some limitation, as follows

- There is a lack of enough information to understand the ground of drivers and constraining factors as well as the absence of necessary data for measuring indicators
- Very few evidence and literature on contextual factors (especially urbanization rate) and their influence on vertical integration is a restriction to understand how they are correlated with each other and establish any hypothesis.

- Limited literature on vertical integration of adaptation strategies is a barrier for acquiring deep insights on how factor influences integrating process from local to national level.
- Multi-directional information in the NDCs without common consistency generated difficulties to evaluate them within common indicators.
- Scaling of governance factors is subjective and it's quite challenging to give it objectivity as no information has been found on qualitative scaling especially climate change governance and NDC issues.
- Correlation between independent and dependent variables did not show significant result due to mismatch of the sample within vertical integration. Hence, descriptive statistics have been employed to measure findings and supported by qualitative data from NDCs.

1.8. Organization of the chapters

In the present chapter, background, problem, research question and objective of the study have been discussed. Moreover, the significance of the study on the present academic field and policy context, scope and limitation have also been portrayed. In the next chapter, existing state of the art of the knowledge has been explored on present research through literature review to connect the concept of adaptation and vertical integration as well as how they are influenced by enabling or constraining factors have also been investigated. Chapter three clearly outlines the methodology of the research which discusses research design, the operationalization of variables and indicators, data on dependent and independent variables, sample size selection as well as validity and reliability of the research. The chapter also describes the detail data analysis method and challenges faced during analysis and how they have been overcome. The next chapter represents research findings on vertical integration, contextual factors, and governance factors. Analysis has been measured through correlation, descriptive statistics, and outcomes supported by the visual presentation of graphs, charts, maps as well as qualitative data from NDCs. The final chapter has made concluding remarks on the relation among all factors, identified existing gap of NDCs and provided few guidelines based on findings which have also been framed in a non-structured way (Table 7, Annex 2) to follow easily.

Chapter 2: Literature Review

2.1. Introduction

The Fifth Assessment Report of IPCC confirmed with scientific evidence about the climate change and its extensive aftermaths most of which are being observed recently in many parts of the world. Disaster and extreme events such as cyclones, floods, droughts, wildfire, irregular precipitation etc. are increasing at large scale by the effects of climate change which can harm both environment and society severely in the long run (Pietrapertosa et al, 2018). The amplified frequency of hydrometeorological and geophysical hazards elicited by climate change effects are damaging the ecosystem, destroying built environment and infrastructure and causing sufferings of people (Pietrapertosa et al, 2018; Daron, 2014; Pawson et al. 2011). Therefore, the situation demands strong local, regional and international integrated actions, concern and support. Since 1992, to limit the average global temperature and its inescapable impact United Nations Framework Convention on Climate Change – UNFCCC is highlighting the importance of captivating climate actions by countries over the world (Pietrapertosa et al, 2018). Activities and concern of UNFCCC have managed to bring enormous worldwide ‘commitment’ for reducing climate change impacts, but the improvements of the countries are still not adequate to meet ‘climate change challenges’ (Bruin, et al. 2009; Dewulf, 2013). Paris agreement in 2015 by world leaders in the Conference of the Parties (COP 21) has added a new dimension on the prevailing effort of UNFCCC as countries legally made agreement to include Nationally Determined Contributions (NDC) in response to climate change challenges. Now it has become the petition of time to incorporate a comprehensive portfolio of climate change measures including mitigation and adaptation in local to national level. For extended period mitigation has been most preferred option in climate policy as the focus was on reducing direct or indirect anthropogenic greenhouse gas emission (Pietrapertosa et al, 2018; Urwin and Jordan, 2008; Demeritt 2001; Jasanoff 2010) and keeping the temperature in a certain level. However, adaptation grasped the attention as the effects of climate change has already been observed at the local level. Since 2001, ‘Adaptation and Vulnerability’ in the Third Assessment Report of IPCC underlined ‘sensitivity, adaptive capacity and vulnerability’ of environmental, man-made systems to climate change and probable effects of susceptibility. As adaptation is ‘site-specific’ with varying ‘cross-sectoral’ aspects, it sturdily influenced by the local climate, environment, social, economic and political circumstances (Adger et al., 2005). It is further complicated by the high level of ambiguity and time-consuming framework of the intricate phenomena (Quay, 2010.) and their erratic outcomes on human activities as well as linked social and economic structure (Pietrapertosa et al, 2018)). To improve ‘climate resilience’ of vulnerable group, taming possible harms and create innovative prospects for advantage, it is crucial to integrate adaptation practices into decision making and policy formation by taking measures between various sectors (Niang- Diop and Bosch, 2005) at all scale of governance (Adger et al., 2005; Dupuis and Biesbroek, 2013).

To integrate adaptation strategies in policies in more fruitful ways, it is important to understand the characteristics of adaptation and its implication in policy and concept of vertical integration as a process of incorporating strategies from local to national level. Hence, present chapter deliberates adaptation in policy, tensions, doubts, and dilemma due to its dynamic qualities within climate change effects and uncertainties. Vertical integration as a part of climate policy assimilation, examples of worldwide urban adaptation incorporation has also been discussed here. Besides, the enabling and constraining aspects revealed by various literature has been presented with focusing and accumulating most dominants factors in urban adaptation amalgamation. Then, vertical integration of urban adaptation strategies has been connected

with the present research context (NDCs) by considering its importance. Finally, the research gap expresses the significance of the present study in the academic field with a noteworthy contribution to policy formation. A conceptual framework based on the concept and problem of the study has also been presented at the end.

2.2. Integration of urban adaptations in climate policy

With the growing concern on climate change effects, nowadays decision makers have acknowledged the significance of integrating climate policy in all sectors of public policy formulation which exposed different challenges and limitation within the existing structure. For long ‘climate policy integration’ has limited to mitigation strategies at the national and international level with tensions and arguments. However, adaption facets in policy assimilation focused at micro level were not addressed enough by academics or policymakers. As a result, barriers and opportunities in incorporating adaption from micro scale to macro scale or local level to national level remain concealed at a large extent. Recently, literature focused on the integration of adaptation and mitigation for sustainable development strategy in relevant European cities (EU, 2006) such as ‘Green Paper’ on adaptation published by European Commission in 2007 hunted to detect realistic means to assimilate adaptation into the present and new policy arenas (EU, 2007). Moreover, identifying conflicts and constraints of incorporating urban adaption in policy was recognized as one of the urgencies by Ministry of Environment of UK (DEFRA, 2006). However, it has become evident that contemporary climate policies need to be planned in the ways which will expediate adaptive responses. But, ‘climate policy integration’ (CPI) of adaptation are still limp due to the lack of well- established structure or consented approaches to achieve it (Urwin and Jordan, 2008) as well as its’ multi-dimensional characteristics and practical difficulties.

2.2.1. Tensions and dilemmas around adaptation

In policy and decision-making climate change adaptation is considered as ‘complex dilemma’ due to its intense uncertainties, involvement of differing stakeholders understanding and interest, dynamic social-environmental interfaces limited projection ability about future climate changes and associated natural and social responses to it (Lazarus, 2009; Levin et al., 2012; Head, 2014). There are also Influences of local context, effects, and solution at varying spatial scale (Head, 2014) affect adequacy and feasibility of solution which limits the space in the decision process. Moreover, multi-level stakeholder inclusion to reach in a consensus about strategies can also be challenging due to contradictory interest, local politics, varying level of expectancies from consultation, limited time and a shortage of cross-stakeholders interaction (Few et al., 2007). Therefore, for such continuous emerging adaptation process or ‘climate proofing’, there is still no fixed or approved method in policy scrutiny at specific or throughout the range of interlocking spatial scale (Urwin and Jordan, 2008).

2.2.1.1 Climate change adaptation complexities due to dealing a societal problem in a scientific way

To understand anthropogenic influence in climate change and possibility, rate and track of future or long-term climate change effects, only model projections, simulation of scenarios can be used (Demeritt 2001; Jasanoff 2010). Due to non-linear nature of projected climate change or extreme climatic events, adaptation decision making becomes ‘ontologically complex’ and ‘epistemologically distant’ (Carolan 2004; Esbjörn-Hargens 2010). Therefore, planning on adaptation is very much dependent on the reliability of knowledge, accuracy of anticipation (Biesbroek, 2014) and numerous socio-economic and environmental factors of local level with varying context. High level of intrinsic uncertainties in climate change projections identified as a barrier for adaptation strategies which also lead to arguments about the ‘legitimacy’ and

‘credibility’ of scientifically assembled knowledge (Hulme 2009; Weichselgartner and Kasperson 2010; Hoppe et al. 2013). Furthermore, due to the limits to scientific projections, flexibility and robustness should be considered to deal with ‘unknowable unknowns’ in counting adaptation strategies (Pawson et al. 2011; Termeer and Brink 2013).

2.2.1.2 Multi-Dimensional and distressing characteristics of climate change

Climate change is a socio-environmental obstruction which cannot be resolved only by science or technology because of its ‘wicked’ nature. There is no ‘one size fit’s model’ or agreed framework to propose a solution to climate change consequences because of its dynamic, multi-layered social, economic and cultural process (Biesbroek, 2014). To resolve such wicked problems decisions makers usually rely on political judgement or only scientific analysis (Rittel and Webber, 1973; Kwakkel et al., 2016) which may be politically and financially unattractive and socially unacceptable if discovered as sub-optimal from input resource or development prospects (Daron, 2014) and stakeholder’ fatigue’ (Conway and Mustelin, 2014). Actions regarding climate change impacts require understanding and defining the problem inherently as well as forming an uninterrupted spiral change (Brown et al. 2010). Because of the outcomes of each decision and fast-changing context, learning from previous solutions or mistakes through ‘trial and error’ or modifying implemented plan becomes almost impossible (Biesbroek, 2014). Hence, solution or answer of to any particular problem cannot be pre-assessed on the basis of ‘best’ or ‘optimal’ level rather the responses may be better, poor or worse in varying perspectives which made adaptation decisions extremely challenging (Weber and Khademian 2008; Lazarus 2009; Levin et al. 2012; Termeer et al. 2013)

2.2.1.3 Multifaceted characteristics of adaptation governance

Climate change affects cross conventional boundaries, influence standing institutional and functional configurations, procedures, policy arenas, linkages of various sub-division, scale and jurisdictions (Jochim and May 2010; Juhola and Westerhoff 2011). Adaptation governance includes ‘boundary spanning’ issues (Biesbroek, 2014), various actors or stakeholders and disagreement of functions and interest arises due to self-regulating inclinations of the prevailing organizational structure. It is further reinforced by mainstreaming approach in present vulnerable policies and exercises in relation to disintegrated or fragmented responsibilities and authority to occupy adaptation across sectors, macro to micro scale (Yamin 2005; Kok and de Coninck 2007). As a result, a new form of interdependencies and interconnections between sectors and organizations are constructed which regulate partnership, governance, instruments to address adaptation in a complicated, multifaceted institutional setting (Adger et al. 2009; Biesbroek, 2014).

2.2.1.4 Adaptation is an endless process to headway

Adaptation strategies emerge, changes or developed through coping with the problem. As there is no ‘perfect’ state of being adaptable with a problematic situation, it is a continuous process of transformation, modification or alteration without having a clear beginning or end line (Adger et al. 2009; Biesbroek, 2014). When the problem is exposed in an erratic and ‘situated fashion’, no single pathway can be defined to attain the normative goal of lucrative adaptation (Adger et al. 2005). Therefore, the concept of well-adapted, robustness in the decision, climate proofing can hardly definite by their meaning and application in practices. The contradiction arises as an adaptation by its nature means to take along changes while the conventional societal structure is notorious for their resistance to change. In absence of a goal, unknown or lack of self-explanatory causes to carry out changes and controversies among ideas or deep uncertainty (Duit and Galaz 2008) may push up chaos condition. Consequently, suggestions are given to

concentrate on short-term decisions by respecting long-term prospects (Underdal 2010), attempting to avoid maladaptive measures simultaneously (Barnett and O'Neill 2010) and to inhibit lock-ins in decision or policy making (Biesbroek, 2014).

2.2.2 Vertical Integration of local (urban) climate policy

2.2.2.1. Sustainable development and environmental policy integration

The concept of vertical integration in adaptation policies is not very widely used in literature. First, it was introduced through one dimension of environmental policy integration. One of the central qualities of 'sustainable development' is considered as having environmental goals through integration in the environment and non-environment policy areas as environmental sectors alone are unable to secure its fundamental aim. It is more logical and achievable if each sector incorporates environmental policy on their board both for sectoral development and for securing the environment. Within general environmental policy axioms of the 1980s and 1990s 'sustainable development' was the core concept and addition of environmental apprehension into other policy areas. It has been indicated as 'environmental integration', 'environmental policy integration', 'sectoral integration', or simply 'integrating the environment' (Lafferty and Hovden, 2003).

The idea of environmental policy integration was found before the 1980s in European Community which was not linked with environmental concern directly. First recognizable Environmental Action Plan approved in 1973 which introduced various pioneering rules involving the 'polluter-pays principle' and an initial structure of 'precautionary principle'. The initiative presented a more understandable comprehensive approach to environmental troubles by allowing environmental effects in non-environmental policy areas. Later, the approach used as the base for environmental policy integration and formulating successive action plan (Berger and Steurer, 2007). The World Conservation Strategy (WCS) first devised the phrase 'sustainable development' as a focal principle to integrate across the sectors and scale of governance for crafting 'cross-sectoral conservation policy'. However, up to the publication of 'Brundtland report' in 1987 Environmental policy integration regarded as pivotal in international policy-making (Lafferty and Hovden, 2003). Rio Declaration and Agenda 21 underscored on integrating environmental interest on a wider range of sectors, though Brundtland report effectually restrained EPI to encompassing it in economic decision formulating. Undeniably, the principle got different meaning and explanation in diverse policy and academic writings within international and European policy debates in case of directing sectoral policy 'cohesion' and 'balance' (Brown, 2009; Berger and Steurer, 2007). The focus was distinctive than the fundamental goal of reuniting economic and social urgencies regarding resource exhaustion and environmental degradation.

However, there is two type of environmental integration, horizontal and vertical. Horizontal policy integration (HEPI) refers to the degree to which 'central authority' (maybe a cabinet, government) has formed a wide-ranging cross-sectional strategy for EPI for considering overarching issues of environment in sustainable development. In defining holistic policy-making targets and process for the concerned political-administrative unit, horizontal integration includes the question of relative authority in association with environmental concern. Horizontal dimension of environmental policy integration involves: the presence of long-standing 'sustainable development' strategy; integrating process with central authority for guidance, harmonization and execution; well-defined descriptions of sectoral responsibilities for all-embracing aims; timeframes for targeted environmental policy; review and reporting of progress level regarding targets at both central and sectoral level (Lafferty and Hovden, 2003;

Urwin and Jordan, 2008). The interlinkages and network among subnational governments, agencies and other institutions or administrations generate ‘interaction effects’ (Young, 1996; Stokke, 2001, Oberthur and Gehring, 2006). This effect leads to the coherence of achieving sustainable goals of global climate change through connecting subnational actors and sectors to national level which is the form of vertical integration.

2.2.2.2. Vertical integration as core portfolio to achieve environment goal

Lafferty and Hovden (2003) argued that vertical environmental policy integration (VEPI) is the degree to which a certain segment of government undertakes and want to implement environmental goal as ‘core portfolio’ of purposes that the authoritative body practice regularly. VEPI encompasses the level to which sectoral governance is ‘greened’ or unified to environmental aims along with sectoral objectives to shape environmentally cautious decision-making ground where every section is independent to grow their own insight on the fact and its inference. In the paper, authors also mentioned some baseline measures on how sectors can integrate environmental facts on its actions such as preliminary mapping and identify prior environmental challenges related to the sector; forming ‘sectoral environmental action plan’ (SEAP); consistent ‘environmental impact assessment’ (EIA) and ‘strategic environmental assessment’ (SEA) for all kinds of sectoral policy-verdicts; indicator-based and measurable objectives postulation within timeframe and testifying the condition of environment-related policies regularly. It is also essential to emphasize that here ‘vertical’ means the distribution of functions which suggests organizational ‘up and down’ within sectoral responsibilities of ministries, interact and influence individual or corporate actors of a particular sector.

2.2.2.3. Vertical integration is the network of actors, administration and policy within spatial scale

Vertical alignment can be defined as linking (Brown, 2009) and harmonization of policies between the different scale of government for attaining the aim of ‘policy coherence’ (Berger and Steurer, 2007). Similarly, Young (2002) introduced the term macro, meso, and micro to explain policy forming actions at the various spatial scale of ‘ascendency’ (Urwin and Jordan, 2008). Connecting various authorities and diverse ‘transnational network’ by sharing one common aim of environmental concern and aligning efforts offer numerous advantages comprising effective resource distribution, information diffusion and transmission of ‘best practices’ (Broekhoff et al. 2015; Andonova et al. 2009). In the context of incorporating adaption in national policy, vertical integration is the “*process of creating intentional and strategic linkages between national and sub-national adaptation planning, implementation and monitoring & evaluation (M&E)*” (NAP, 2016, p. 3.). Here sub-national refers to the actors and procedures that sustain below the national level which may include multiple levels, macro to micro scale on country perspective.

Vertical integration is a two-way continuous process with multiple steps to reflect local ‘actualities’ in the national adaptation plan and allows this plan to be implementable in the subnational level. Along with institutional and financial capacity, identification of diversified sub-national vulnerability and pattern to climate change, responsibilities of actors at sub-national organizations and administrative bodies are the drivers for advancing adaption in vertical integration. Precise and open commitment from national actors to guide an ‘inclusive’ and ‘participatory’ process as well as a rolling discussion between national and local level actors in all phases are also considered as essential prerequisites for vertical integration of adaption.

2.3. Evidence of adaptation integration in urban climate policies

Adaptation in policy framework requires two core components such as existing and new policies. In European cases, as most of the existing policies were planned and effected before climate change, it was not considered as a vital political dispute. It may take the long way to comprehend the degree to which non-climatic policies assist or confine scope for merging adaptive responses (Urwin and Jordan, 2008). The literature showed that instead of formulating stand-alone adaptation plan in response to climate change, local or sub-national governments are more interested to integrate adaption plan into other types of plan in many cities. A survey was conducted on Urban Climate Adaptation in collaboration with JoAnn Carmin of MIT and ICLEI (Carmin et al., 2012a) which explored a global overview on existing status of adaptation planning and action in cities by focusing on how local government are institutionalizing adaptation in their existing arrangement and practices (Aylett, 2015). Response showed that in local level more than forty percent (43%) reported about integrating adaptation into their long-extend plans such as integrated development plan or community plan while one third opined (32%) about introducing wider sustainable development plans, and 32% said that they incorporated into standing sectoral plans, spatial development or transportation, for example.

On the other hand, nearly forty percent (39%) reported about ‘stand-alone plan’ specifically concentrated on both adaptation and mitigation while 28% mentioned about merely adaptation plan. By looking at the regional and sub-national level of Canadian cities, it can be said that they have plans specifically focusing on adaptation by integrating into municipality based long-range planning (at 57% for each). There is also some scheme concentrating on both adaptation and mitigation (14%). Nevertheless, very few respondents of African (11%) and the USA (17%) opined about the specific plan on adaptation. More than half (56%) mentioned incorporating adaptation strategies to achieve sustainable development goal in Africa. Apart from policy relevance, the apprehension is also connected to two broader premises in the climate change dispute. Firstly, recognizing the necessities to combine climate change into all section of policy making (i.e. CPI) (Nilsson and Nilsson, 2005) which viewed as a subcategory of the broader dogma of ‘environmental policy integration’ (EPI). It was initially propagated by the ‘Brundtland Commission’ in 1987 and at present extensively cherished in numerous permissible structures and policy dialog (Lenschow, 2002; Jordan and Lenschow, 2008). As most of the argument on CPI has been enclosed in relation to mitigation obligations, the policies were aligned to emission reductions at International, EU, and national level while by contrast adaptation options had a propensity for evolving intensely at more local level (Adger et al., 2005; Young, 2002).

Generally, it is presumed that adaptation should be commenced in the micro level by local organizations, government body where the bearings and interdependencies of climate change are faced and documented (Biesbroek et al., 2009; Measham et al., 2011). Vulnerability, the magnitude of climate change and cross-sectoral policies and design throughout different section such as public-private part, industrialization etc. requires collaboration within a different level and managing greater interest of nature or forest management, river basin or water management as well as spatial planning. From a survey with 200 cities of Europe it was found that most of the cities of United Kingdom, Netherlands and Germany have a greater concentration on mitigation strategies while Belgian cities are still backward in transforming national policy into local action (Heidrich et al., 2016). Conversely, adaptation measures are few and are not reviewed and updated regularly in many countries. Though, there are exceptions such as the United Kingdom and Ireland have active adaptation framework established through act and policy. Despite having variations in analysis, goals, and

timeframes, these two countries have distributed obligations in the national government, province and local agencies (Heidrich et al., 2013).

Recently, numerous of the studies focused on the adaptation integration in city level which is horizontal integration in cities within the same country or transnational cities. But, it is indispensable to know what contextual factors mainly drives urban adaptation incorporation vertically, how adaptations derived from local or micro level are presented in the national policy or what type of governance challenges are experienced by nations during vertical integration of urban adaptation strategies.

2.4. Contextual factors that influence vertical integration of adaptation strategies

The literature on contextual factors of vertical integration of adaptation in climate change science is limited. Some academic paper accepted contextual factors as ‘root cause’, barriers or influences for adaptation (Azhoni et al, 2016). Eisenack et al. (2014) underlined context as determinants to specify nature of adaptation where functions of actors are driven by given context, arise from ‘certain conditions or set of conditions’. Although abundant literature was not found which indicates the influence of urbanization rate and income level directly on vertical integration of adaptation, but few studies (Garschagen and Romero-Lankao, 2013) several reports, and evidence indicates these two factors are highly related with vulnerability level (ND-GAIN, 2017¹; World Bank, 2018²; UNISDR, 2018³; UN-Habitat, 2017).

High level of urbanization rate, income level and degree of vulnerability of countries act as major contextual factors to drive integration of adaptation strategies from local to national level. World Urbanization has been boosted from 29 percent to 49 percent between 1950 to 2005 and most of the urbanization process is now being observed in developing countries. (UN Habitat, 2017). Countries with rapid urbanization rate and ‘economic transformation’ generates significant challenges and sensitivity of climate change risk especially for low-income countries as they have low capacity to tackle negative changes. Contrary, it may also act as a driver for enhancing capacity, as policymakers become more concern about negative effects and adopt actions, strategies nationally in response to climate change risk (Garschagen and Romero-Lankao, 2013). Therefore, there is a connection between high urbanization rate, the income level of the countries and their vulnerability profile which altogether encourages the vertical integration of climate policies.

As mentioned before, currently high urbanization rate has shifted towards middle and low-income countries where marginalized and impoverished people move from economically depressed areas to urban areas in search of better life and livelihoods. Due to resource constraints and job opportunities, they move towards vulnerable areas and affected by disasters and climate change risks. Countries with huge urban population, lower income, limited resource and technological capacity, knowledge gap, minimal infrastructure (UN Habitat, 2017) highly suffer from slums, water-sanitation problem, urban health issues etc. in the face of climate change. This, in turn, constructs varying degree of vulnerability to climate change effects. Consequently, countries with above mentioned contextual aspects pay more attention

¹ <https://gain.nd.edu/our-work/country-index/rankings/>

² <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

³ <https://www.unisdr.org/we/inform/publications#r=?p=0®ion=3016>

to embrace adaptation strategies in their urban to national level policy. Report of UN Habitat (2017) mentioned that though there is no relation between the overall level of urbanization and prospect of urban reference in the NDCs, a correlation between the urbanization rate and ‘urban content’ has been exposed. It indicates that the countries with current higher urbanization rate have more tendencies to include more urban content in NDCs than which are already urbanized. The high rate of urbanization also encourages in technology transfers and knowledge sharing in response to climate change effects and incorporating urban adaptation measures. In low and middle-income countries fast rate of urban expansion upsurge demand for accommodation, infrastructural development, services which often beyond the capacity of the city to supply properly. As a result, stress is placed on existing resources, environment system, services and generate a potential threat to climate change (IIED, 2013). For survival, poor people in urban areas move towards environmentally hazardous areas (for example, slum) and become more prone to disaster. Consequently, adaptations are chosen to face climate change effects. Infrastructural weakness such as lack of proper housing, sanitation, the supply of pure water, drainage system pushes poor to health vulnerability (Romero-Lankao and Dodman, 2011). Increased level of vulnerability comes with rapid urbanization process in the developing world which bound them to adopt adaptation strategies by focusing on a particular sector such as urban housing, health, water issues etc. (UN Habitat, 2017),

The countries of developing economies have lower per capita emissions but is intensely concerned with urban adaptation. On the other hand, developed countries focused less on urban-related mitigation and adaptation strategies (UN Habitat, 2017). A study by UNFCCC (2007) on *Climate change: impacts, vulnerabilities, and adaptation in developing countries* reported that low or middle-income countries with varying geographic, social and economic condition require more attention in diversified adaptation measures. Low income, poverty causes low adaptive capacity in response to climate change impacts which drives them to pay more attention to integrate adaptation at the national level. According to Global Climate Risk Index (CRI) 2017, mainly least developed countries were most affected in extreme climate events as a result of climate change in the last 20 years which supports the reasons of considering adaptation strategies by middle and low- income countries (UN Habitat, 2017). For instance, countries of Africa are severely affected by climate disasters with four high ranking countries among the first ten worlds of world list in 2015– Mozambique (1st), Malawi (3rd), Ghana and Madagascar (joint 8th position) (CRI, 2017). All parties in national communications reported to the UNFCCC about their challenges regarding climate change effects. Countries with a high level of vulnerabilities in water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity and coastal zones are common where most negative impacts have been observed. In the climate related literature vulnerability has been viewed in terms of i) potential quantity of harm caused by particular climate-induced event or hazard to a system (Jones and Boer, 2003) or ii) as the condition that subsists within a system beforehand it meets hazards or calamities triggered by climate change (Allen, 2003). Vulnerability to the human system is governed by nature of the physical hazard(s) to which it is exposed, the frequency of occurring the hazard, the degree or human acquaintance to hazard and system’s sensitivity to the effects of the hazards (Brooks, 2003).

According to IPCC (2012) “Vulnerability is dynamic and context specific, determined by human behavior and societal organization, which influences, for example, the susceptibility of people (e.g., by marginalization) and their coping and adaptive capacities to hazards” (P.1050). Coping to climate change indicates the ability of any system to safeguard itself in the face of harmful consequence while adaptation involves long-term adjustment of the system itself

within the process of ‘learning, experimentation and change’ (Yohe and Tol, 2002; Pelling, 2010; Birkmann et al., 2013). Vulnerability and adaptation capacity differ with varying context and adaptation initiative depends on degree or level of vulnerability by focusing on risks, environmental and social stresses (Smit and Wandel, 2006). Various studies reported that global adaptation cost by 2030 to 2015 will increase two or three times higher than present along with increased level of vulnerability (Global Climate Risk Index, 2017; UNEP, 2016) which states a clear relation between vulnerability level and adopting adaptation strategies in response to climate change.

2.5. Influences of governance factors in vertical integration of urban adaptations

As a part of growing concern on climate change effects, incorporating adaptation in national policy is currently extensively admitted. During vertical integration, vulnerabilities are investigated, adaptation opportunities are recognized, and grounds are placed for implementation, monitoring, and evaluation of adaptation. In the planning process, including adaptation into prevailing strategies, rather than producing new, ‘stand-alone’ design on adaptation in association with information, knowledge, and experience unified over time and at diverse scale (NAP, 2016). For example, participants of UNFCCC have embraced five-year plan to assist countries in decision making on adaptation (SBSTA, 2005) while European Commission in EU has also delivered parallel policies for member countries (NAP, 2016) comprising ‘Green Paper on Adaptation’. Nevertheless, the advancement remained in the level of consent as the issues of identifying ‘what and how’ to adapt is still unclear. Prevailing academic literature recognized variety of factors ranging from ‘scientific uncertainty’, through to present status of technological advancement, accessibility to finance and resource, time limitation as some barriers for proposing operative adaptation plan (Smit and Pilifosova, 2001; Lorenzoni et al., 2000a, b; West and Gawith, 2005).

Furthermore, ‘policy context’ as a constraint (Burton et al., 2002; Lim et al., 2005) is also getting greater approval for considering one of the major pre-conditions for taking adaptation decisions in all level by policymakers and other social actors. For example, behavioral and cognitive aspects, human capital, political leadership or will (Wise et al., 2014) awareness level of public and policymakers as well as high level of stakeholder participation in decision-making act as driving forces for better integration of adaptation strategies (Hallegate, 2014). Consequently, from the local level to national, environment to non-environmental segment, public to private sector, political to non-political agendas, integration of adaptation strategies with the association of specialists, local authority, citizens, community and other related stakeholders has become a priority. (Pietrapertosa et al, 2018). On the contrary, Few et al. (2007) claimed that the inclusion of more stakeholders or participation from a different level in decision making may generate problem due to unequal social power aspect of the participatory procedure. Tension or conflict between principles of stakeholders may introduce complexities in the inclusion of adaptation strategies.

However, Andonova et al (2009) mentioned that ‘information sharing’, ‘capacity building’, and ‘rule setting’ are three categories of functions that influence the integration of climate policy in TCG network. C-40 cities for climate Leadership in their mission statement mentioned that knowledge sharing and information diffusion, resource allotment and distribution, functional connections with local partners, negotiations, establishing rules and standards are important for vertical alignments of climate policy. Nevertheless, Angelovski et al. (2014) stated some constraints in assimilating adaptation planning which can be categorized as political, institutional, economic and development issues. These types of barriers

may arise from institutional weakness, lack of coordination among administrative and environmental agencies, struggle for resources with other development focus including infrastructure, economic growth, business issues (Urwin and Jordan, 2008; Carmin et al., 2012a, b; Simon, 2012; Anguelovski et al., 2014).

Nonetheless, governance factors as barriers or drivers of adaptation incorporation can be analyzed from the different point of view or varying context. But, most of the existing literature and their direction of arguments pointed to some specific factors which are crucial in enabling vertical integration of adaptation strategies while the absence of such facilitating or conditional elements is regarded as barriers.

2.5.1 Data/Information barriers

To integrate or propose better adaptation policies it is crucial to have large number of reliable and valid information or data source or data collection process, past and present historical data on climate change, expert judgement, research and analytical capability, model simulation (Lempert and Collins, 2007; Mahmoud et al., 2009), update database on regular basis and future projection or scenario build upon the basis of available data (Groves et al., 2008; Lempert and Groves, 2010). Uncertainties and knowledge gap in future climate projection hinder decision making and plan for the future. Detail information for such data is more on hand and accessible in developed countries compared to developing nations (Bhave et al, 2016). Due to disagreements or clashes between national and sub-national administrative units with shared resources in data collection, ensuring better data quality or integrity, a wide range of data accessibility and effectual research and practice can be challenging (Bhave et al, 2016). Data availability, their analysis, and use upsurge knowledge of different stakeholders which help them to reach an agreement of decision-making process (Hallegatte, 2014). Data is also contemplated as ‘negotiation support’ that forces to build up dialogue and to reach an extensively acceptable consent among stakeholders. For a robust decision-making, capacity of learning and modify policies or strategies based on new information is a very crucial element which depends on data collection, research, development procedure with update information over time (Adenle, et al., 2015).

To minimize barriers of data source, information sharing is considered as the foremost resource channeled through the network with a common target of environmental concern. Exchange information may include scientific data of climate change, observation, changing trend, projection on effects, technological information etc. This process assumes a governance function when the knowledge shared is recognized as authoritative and directs network constituents (Adenle, et al., 2015; Andonova et al. 2009). National governments are also principal media of information that instigate policies and actions at lower jurisdictional levels. Local indigenous knowledge and experience merge with sub-national and national data set, documents, scientific model and projections through vertical integration can visualize a realistic representation of the present and future contexts as well as offer adaptation options in relation to future scenarios (Andonova et al. 2009).

2.5.2 Institutional arrangements

Institutional arrangements of a good governance system link national and sub-national planning process, assess existing planning platforms for prioritizing strategies, efficiently engage actors, create consciousness and understanding about adaptation at all levels (Angie, et al., 2016). The mechanism for harmonization and communication among different levels are arranged by intuitional setting (Andonova et al. 2009; Adenle, et al., 2015; Hallegatte, 2014). Institutional aptitude with a well-structured framework to assess adaptation strategies within the support of

laws and regulations, consistent updates of measures, incorporating update information within existing policies, skilled actors, modify plan and techniques (Anguelovski et al., 2014; Simon, 2012). For instance, the mandatory five years reassessment of Netherland's water policy forces involves different actors and decision makers to consider up to date relevant scientific knowledge and socio-economic progress in Dutch water policies. Without strong institutional elements, policies in the long-term planning process cannot act as a 'learning and acting' procedure that takes place over time (Hallegatte, 2014). Organizational resource constraints, short-term planning prospects, underdeveloped institutes, institutional division and conflicting timescale, insufficient inter-agency cooperation (Lehmann et al., 2015) disharmonies in communication and decision process are some of the severe institutional constraints in introducing new approaches in developing countries (Conway and Schipper, 2011; Daron, 2014).

Contrary, Lafferty and Meadowcroft (2000) mentioned that vertical policy integration is less prone to inter-departmental conflict, change in the overall distribution of sectoral 'winners and losers', adequate in achieving common targets of policy integration within a sustainable development framework. But, the achievement and effectiveness of integration majorly depend on the capability of providing an appropriate framework by the national government. However, rule setting and compliance enforcement inhabit in a hierarchical, sovereign power (Andonova et al. 2009) of a typical governance system. To evaluate rule setting and regulative linkages, it is important to concentrate on participation in monitoring, reporting, and verification through different levels (Hsu et al., 2016). In the vertical integration during incorporating adaptation planning, abreast and 'mutually supportive' dialogue is arranged among stakeholders at the national and sub-national levels.

2.5.3 Level of Capacity

Several kinds of literature mentioned capacity building as one of the major functional categories to linkage sub-national policies to the national level and increase 'policy coherence' (Hus et al, 2017; Andonova et al. 2009) in integrating mitigation. According to the literature, capacity includes human skill to understand and analyze climate risk and offer a probable solution while resource or financial capability includes funds to support actions. Level of technical capability and monetary or financial resources are frequently cited as crucial obstacles in planning and implementing local climate actions (Aylett 2015; Ryan 2014). Financial inability is another crucial barrier for countries to integrate urban adaptation strategies in policies. Lack of funding reduces institutional capacity and coordination, limit monitoring of social and environmental change, hamper the development of human capital through training or introducing contemporary management practices. (Conway and Mustelin, 2014; Shackleton et al., 2015; Smit and Pilifosova, 2001; Lorenzoni et al., 2000a). Financial constraint is a big issue for less developed or developing country when it comes to transactional cost, importing or develop technology (Hallegatte, 2014) in response to adaptation. However, capacity gap or inability at the local level bring challenges to vertical integration of adaptation measures despite having strong decentralized administration. Level of capacity regarding adaptation includes insight of climate change, human skill to vulnerability mapping and scenario design which may be absent at lower level (Angie, et al., 2016). Nonetheless, capacity development confirms that actors of various administrative sectors at various levels contain the knowledge and skills they need to employ in the planning process (Adenle, et al., 2015; Hallegatte, 2014) and they are able to incorporate 'new knowledge' in policy in response to change over time (Andonova et al. 2009).

2.6. Vertical integration of urban adaptation strategy in NDCs

Recently United Nations Framework Convention on Climate Change (UNFCCC, 2015) has provided participant countries a strong obligation on creating linkages between national and sub-national levels during planning, implementation, monitoring, and evaluation of integrating adaptation process in national policy. As a part of UNFCCC's continuous efforts to climate consensus, member parties agreed to contribute (Nationally Determined Contribution) on global aim to minimize climate change impacts through mitigation and adaptation strategies by Paris agreement in 2015. The concept of NDCs thus indicates countries' efforts to climate policy which will be revised every five years. According to the analysis of UN-Habitat (2017) on first submitted NDCs of the countries, out of 164 countries, 113 have absorbed urban issues in the policy while mainly low and middle-income countries from Africa and Asia concentrated more on adaptation. In most of the NDCs, there is an indication about factors that influence vertical integration of adaptation positively or negatively. But still, not much scientific or analytical work has been carried out to understand those factors and their function clearly. There are some available literature on the integration of urban mitigation (Hus et al, 2017; Andonova et al. 2009) actions which discussed three functional categories (information sharing, capacity building, and rule setting) to support the horizontal or vertical integration of mitigation. Yet, it is important to examine are the functions same for incorporating urban adaptations vertically in the case of NDCs or they differ. In the meantime, very few countries have been adopted national adaptation plans or 'NAP' to minimize impacts and improve resilience to climate change. The handbook on National adaptation plan specified three key factors for enabling vertical integration of adaptation such as institutional arrangement, information sharing and capacity development (NAP, 2016). However, there are differences between adaptation elements of NDCs and National adaptation plan. While NDCs connect or represent international legal binding to a country's contribution in response to climate change, national adaptation plan (NAP) is non-legal binding and domestic planning procedure (OECD, 2015). Nonetheless, NAP largely can influence or enrich NDCs' content through involving their identity, context, and needs.

Vertical integration is an iterative procedure and it is essential to ensure that the planning process at national and local levels are abreast and reciprocally supportive through dialogue among actors at various level. Good level of vertical integration includes capturing the adaptation process of the local level, continuous evaluation of action outcomes and learning as well as inform the learning to sub-national level (NAP, 2016). Combining adaptation strategies in national policy response need holistic evaluation to understand the challenges and opportunities of 'mainstreaming responses' to climate change both within and through standing 'urban system' (Aylett, 2015). As NDCs are introduced recently, there need more efforts to understand vulnerabilities, what type of experiences are faced to formulate climate policies, challenges and opportunities of policy-making as well in which sectors and how global cooperation or network should be developed.

2.7. Research gap

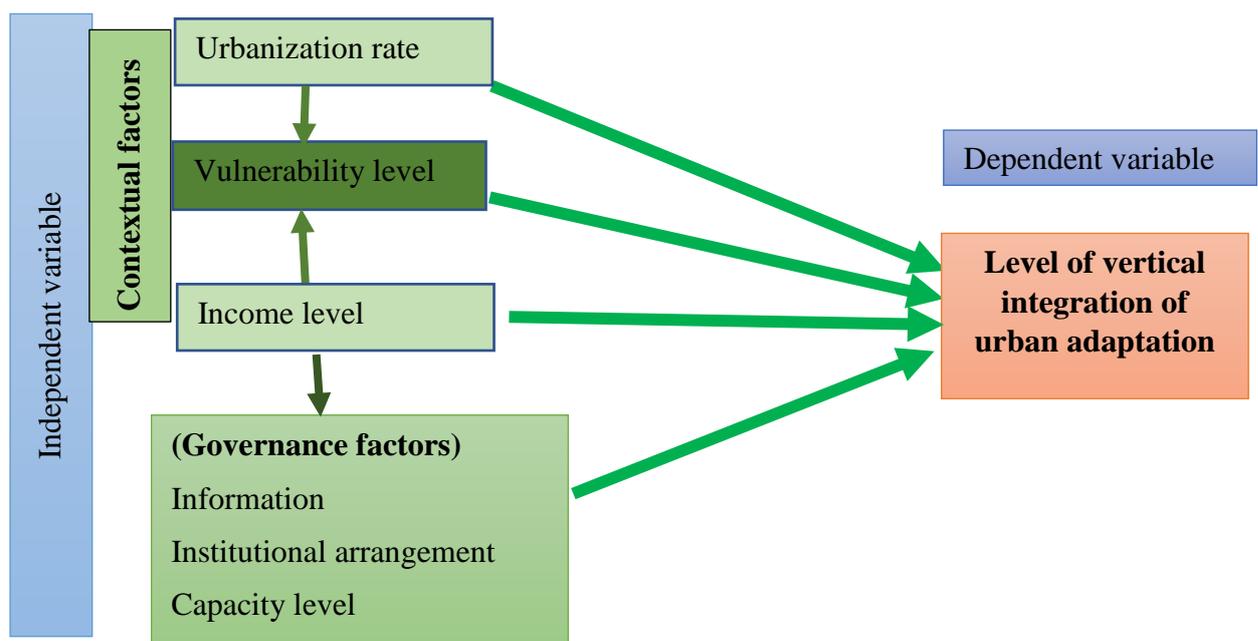
As NDCs are recently submitted, very few detail and analytical research are available on the content of these documents. Therefore, the present research can provide a strong platform to understand and analyze the contribution of significant contextual factors such as urbanization, income level and degree of vulnerability of the countries in adopting adaptation strategies vertically in climate policy. For dynamic characteristics and varying context, determining adaptation priorities and assess probable outcomes are very challenging. Countries with more urban content indicate a high urbanization rate and most of them are less developed and

developing countries of Africa and Asia. These countries are considered as extremely vulnerable for high urban population, its increasing rate and resource constraint. This data motivates to investigate further whether there is any relationship among urbanization, income, vulnerabilities and incorporating adaptation strategies. Additionally, the degree to which government can integrate urban adaptation in national policy largely depends upon on a number of factors or conditions related to information, institutional arrangements and capacity level in terms of finance and human resource. The diversified factors that influence such process is an area to make further exploration. On varying context, it is going to be very noteworthy to understand the type of opportunities and challenges have been faced by the countries to incorporate urban adaptations which may help others to formulate policies, strategies in response to climate change. Moreover, it is also substantial to know existing gaps in NDCs, where further improvement can be proposed for next review and in which sector (e.g. information, technological or financial) international support, cooperation should make on a priority basis.

2.8. Conceptual Framework

The conceptual framework is based on the above discussion which reflects contextual and governance factors have a significant influence on the level of vertical integration of adaptation strategies. Here, level of vertical integration of adaptation strategies is dependent variable while contextual and governance factors are independent variables. Remarkably, contextual factors are correlated with each other. For instance, income level highly influences the vulnerability level as vulnerability rises if the income level is low or vulnerability becomes lower if income level upswings. Similarly, urbanization rate has a positive influence on vulnerability as climate change threats upsurge with high urbanization rate. However, information, institutional arrangement, and capacity level have been measured as governance factors. Governance aspects are also influenced by the context, especially due to income level of a country. It has been observed that if a country suffers from poor capacity as a result of low income or financial constraints, governance system may exhibit lower performance. Overall, both type of independent factors has a strong influence in determining vertical integration level in NDCs.

Figure 1: Conceptual Framework



Chapter 3: Research Design and Methods

3.1. Introduction

The aim of the research is to open the black box of influential factors that act as drivers or constraining factors to vertical integration of adaptation strategies by exploring empirical experience mentioned in policy documents of NDCs and theoretical perspectives from existing literature. This objective has led to a research design to understand some significant contextual factors which drive countries to adopt adaptation strategies in response to climate change in the national climate policy in relation to local ones. Moreover, during the integration of adaptation strategies vertically, what aspects or internal factors act as driver or barrier will also be analyzed through the current research approach.

After reviewing various studies relevant to this research, conditions that influence the inclusion of adaptations and its vertical integration in policy have been identified. Therefore, the research questions have been revised to comply with the study aim and conceptual framework. This chapter represents research design, approach, and techniques including operationalization of variables and indicators, selection of research strategy, and sampling framework, data source, and collection methods, research validity and reliability as well as data analysis techniques to complete the study.

3.2. Revised Research Questions

What are the factors that influence the level of vertical integration of urban adaptation strategies in NDCs?

3.2.1. Revised Sub-questions

1. What is the level of vertical integration of urban adaptation policies, actions and strategies in NDCs?

The outcomes of this question have shown the level of vertical integration of urban adaptation strategies by analyzing the reflection of urban content in the NDCs and the level of vertical integration has been defined as high, medium and low (see operationalization).

2. What are the major contextual factors that influence the level of vertical integration of urban adaptation in NDCs?

This answer reveals internal correlation among the contextual factors (urbanization rate and vulnerability level as well as income level and vulnerability level) and their influence in determining the level of vertical integration in the NDCs.

3. Which governance factors drive or constraint vertical integration of urban adaptation strategies in NDCs?

By answering the question, significant governance factors have been explored and their contribution to the vertical integration of urban adaptations have also been evaluated.

3.3. Research Approach and Design

As a deductive form of research, the intention of the research is to gather and assess data on factors which influences vertical integration of urban adaptation strategies in the submitted NDCs. The study aim made the research type explanatory rather than only descriptive as it will show the relation of how various factors impel the level of vertical integration. By examining the literature, two types of influential factors have been identified in the vertical integration of urban adaptation strategies. First, **contextual aspects** such as urbanization rate, income level

and vulnerability level which mainly act as major drivers in embracing adaptation strategies for different countries. Secondly, **governance factors** that include information, institutional arrangement and capacity level of the countries to integrate urban adaptation vertically. It is important to note that vertical integration of urban adaptation strategies is a two-way process: first, the way local government (municipality) reflects national policy at sub-national level and signposts it in sectoral projects or strategies which is quite a top-down approach. Secondly, how national policy incorporates local (urban) plan or scheme in national level policy which is a bottom-up layout. The focus of the present research is on the later part which analyzes the effects of various factors on vertical integration of adaptation strategies derived from a micro level.

The study employed secondary sources (NDCs) which are available online. Besides other online documents, country profile, reports of the renowned organization, published articles relevant to research also considered to support policies and fill up missing information. Both qualitative and quantitative study with statistical analysis has been followed to reach in the conclusion regarding dependent and independent variables.

3.4. Research Strategies

The study was conducted by following desk research based on NDCS policy documents submitted in interim NDC Registry which are accessible through online. According to the article 4 of the Paris Agreement NDCs commuted by Parties are recorded in a public registry (NDC registry) maintained by the secretariat. Until now about 176⁴ countries have submitted their first NDCs which is a huge source of information to understand worldwide climate change issues within context, adaptation measures and influential factors in assimilating them in the national policy. The main **advantage** of using the desk research particularly for this study are first, NDC Registry is a common, easily accessible and reliable source of policy information around the world in less time and cost-effective way. Internationally comparative and analytical among countries can be carried out without any traveling being needed or conducting any survey. For quantitative analysis and generalization of the outcome, the research requires a wide range of data from different categories (high, medium and low income) of countries which is available through an online data source. Secondly, the study requires information on adaptation measures approved by various countries with varying urban, income and vulnerability context. The NDCs fulfill this demand of the present research as the countries mainly constructed their policy content to show their nationally determined contribution in response to climate change effects and hardship or barriers they face during integrating strategies. Thirdly, as the research type is deductive, it is easy to concentrate on selective sources for suitable and most essential variables and factors from a huge pool of information. Finally, the research can be done independently without depending on others or not interfere with research situation to collect data on such dynamic issues which reduces the threats to reliability and validity.

However, apart from advantages, there also some **challenges** in conducting desk research which mainly includes operationalization of concepts into variables and indicators. Due to high heterogeneity, the data in NDCs did not entirely matched with the variables or represent all information essential for the study. Moreover, there is only a guideline proposed by the Climate

⁴ <http://www4.unfccc.int/ndcregistry/Pages/All.aspx>

and Development Knowledge Network (CDKN, 2015)⁵ to support INDCs (Intended Nationally Determined Contributions) with few points. It is important to note that it is not an official guide from UNFCCC or not endorsed by other organization and was not mandatory to follow by countries. Therefore, due to lack of a well-established framework to follow for submitting NDCs, countries have presented information in a non-structured and flexible way which are quite difficult to analyze within limited and pre-decide indicators. To overcome the problem, indicators that have been mentioned by most of the countries and most cited in the literature, have chosen for quantitative analysis and some adjustment have been made within indicators to keep the consistency of data within indicators which have discussed in detail in operationalization. Shortcomings of missing data for different variables and indicators have overcome through online supporting documents (proxy data) to fill the gap which also discussed in the individual data section of each variable.

3.5. Operationalization: Variables and indicators

The main two concepts of the research include **influential factors** and **vertical integration of urban adaptation strategies**. The concepts further divided into variables and indicators which can be measured. Influential factors have been categorized into two types: **contextual factors** and **governance factors**. Contextual factors involve urbanization rate, income level, and vulnerability level while factors related to governance involves information, institutional arrangement and capacity level as variables. The variables also sub-divided into indicators which have shown in Table 1. To unpack the concept of vertical integration of adaptation strategies into measurable indicators, three level of integration have been identified as high, moderate and low based on urban content in the policies. As different types of indicators have been used in the research, the measuring scale varied according to data availability and measuring unit. For vertical integration of urban adaptation, 1 to 3 scale has chosen while for independent variables different measurement scale and score have been selected (Table 1). It has been further discussed in the data analysis section.

3.5.1. Outlining contextual factors

Elaborate and extended evaluation of contextual factors in vertical integration are unavailable in literature. In few climate change adaptation research, contextual factors identified and defined as the local root causes, drivers or barriers connected to cultural, social, geographical conditions which influence the level of adaption (Azhoni et al, 2016; Eisenack et al. 2014). Though ample information is not available on urbanization rate and income level as contextual factors, the relevant literature indicates that these two factors have significant relation with vulnerability level and resource constraint to adopt adaptation. Hence, in the present research, these three factors analyzed as important local contexts and causes to drive countries in considering adaptations vertically which has been defined with measuring indicators and scale in Table 1.

3.5.2. Describing Governance factors

In the literature review, various factors were identified which act as driver or constraint in incorporating urban adaptation strategies vertically. It is mentionable that necessary adjustments have been made with few indicators according to available data from NDCs. For example, ‘financial ability’ and ‘existing policy, law and regulation’ indicators have been changed into ‘explicitly mentioned financial ability and financial need for adaptation actions’ and ‘explicitly mentioned existing policy, law, and regulations relevant to climate change’ which have been stated by the countries in NDCs. Though the factors were discussed

⁵ <https://cdkn.org/wp-content/uploads/2015/04/CDKN-Guide-to-INDCs-Revised-May2015.pdf>

individually in the literature, they have been categorized into three categories as follows and measurement scale of 1 to 5 (Likert scale) has considered for governance factors (Table 1).

Information: Under information variable, available reliable data source (national and local); the inclusion of indigenous knowledge and level of information sharing between national and local level have been considered.

Institutional arrangement: Institutional arrangement involves the participation of actors; existing adaptation plan or framework (national and local); collaboration between national and sub-national level; existing international cooperation manage risk, vulnerability, and monitoring, explicitly mentioned existing policy, law, and regulations relevant to climate change; adaption strategies for the poor and vulnerable group.

Level of Capacity: Skill of actors in vulnerability mapping, make projection or model and professional workshop, training; explicitly discussed initiatives to develop techniques, capacity (human skill and infrastructure) and technology for adaptation; explicitly mentioned financial ability and financial need for adaptation actions; Need international support in finance, technology, information, and capacity building

Control variables: Political will, Flexibility of policies to change over time, monitoring cell, long-term actions have been considered as controlling factors. As all the countries have submitted NDC with the commitment to contribute climate change agenda, it can be presumed that they have positive political desire on this issue. The countries will review their NDC every five years, so policies can regard as flexible to change over time. Besides, almost all the NDCs have mentioned the long-term action plan and monitoring necessity. Therefore, these two factors also counted as a control variable.

3.6. Data type and Data collection method

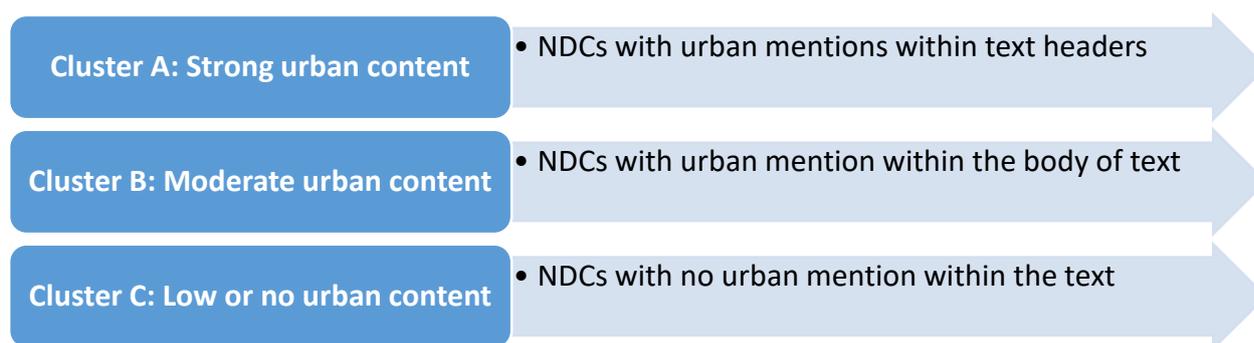
As mentioned before policy documents of NDCs are accessible through online and will be collected from interim NDCs Registry⁶ which are the major documents to analyze. The documents are mainly in qualitative data format with very few quantitative figures. The papers have been used to explore and evaluate mainly governance factors that act as drivers or constraints for vertical integration of adaptation strategies.

3.6.1. Data on the level of vertical integration of urban adaptation (Dependent variable)

To identify the level of vertical integration of adaptation strategies (dependent variable), data from the report of UN-Habitat (2017) on “Sustainable urbanization in the Paris Agreement: Comparative review of Nationally Determined Contributions for urban content” has followed. The report categorized the level of vertical integration into three clusters (Figure 2). Out of 164, 113 countries mentioned urban keywords in the context of national priorities and ambition for mitigation and adaptation. Among 113 countries, 26 papers have strong urban content and 87 presented medium level urban issues which termed as cluster A with high urban content and cluster B with moderate urban content respectively (Figure 3). However, very few urban issues or no urban content belongs to cluster C.

⁶ <http://www4.unfccc.int/ndcregistry/Pages/All.aspx>

Figure 2: Level of vertical integration within urban content (After UN-Habitat, 2017)



3.6.2. Data on Contextual factors (Independent variables)

For evaluating contextual factors data has been collected on three aspects (income, Urbanization rate, and vulnerability level) which motivated the country to consider adaptation integration in the NDCs. To gather data on **income level** per countries primarily relevant information has been checked from NDCs. For cross verification, data have been further collected from world bank report on country and lending groups⁷, the ND-GAIN country index⁸. In the World Bank report, countries have been categorized into four groups, namely High income, Upper middle, Lower middle, and Low-income group (see Table 1 for scale) which also further supported by ND-GAIN database. However, to collect data on **urbanization** (urbanization rate) report of UN Habitat (2017) on “Sustainable urbanization in the Paris Agreement: Comparative review of Nationally Determined Contributions for urban content”, open source data of World Bank⁹ and the World Fact Book-Central Intelligence Agency (CIA), (2018)¹⁰ have been followed.

Vulnerability as a dynamic and contextual issue can be assessed in several ways and it is quite difficult to find one single and standard way to measure vulnerability level. For the present research, to assess the **vulnerability level** of the countries, text of the NDCs have examined for relevant data. For example, ‘Bangladesh is **highly** vulnerable to extreme climate hazard’. Here the text ‘highly noted for vulnerability level which has been supported and verified by proxy data such as ND-GAIN (Notre Dame Global Adaptation Initiative), country’s vulnerability index (2017) to climate change. The ND-GAIN country index¹¹ measured overall vulnerability based on exposure, sensitivity, and capacity to adapt in response to climate change effects. A wide range of indicators (36) with data from reliable sources were taken into account to calculate the vulnerability score by following transparent and scientific procedure (ND-GAIN, 2015, p. 6-10). It provides a vulnerability score for each country by considering six life supporting sectors such as food, water, health, ecosystem services, human habitat, and infrastructure. Along with vulnerability, ND-GAIN also summarized other global challenges in combination with its readiness to develop resilience.

⁷ <https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups>

⁸ <https://gain.nd.edu/our-work/country-index/rankings/>

⁹ <https://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>

¹⁰ <https://www.cia.gov/library/publications/the-world-factbook/fields/2212.html>

¹¹ <https://gain.nd.edu/our-work/country-index/rankings/>

Table 1: Variables and indicators

Research questions	Concepts	Definition	Variables	Measuring indicators	Data type	Measuring scale	Data source
What is the level of vertical integration of urban adaptation strategies in NDCs?	Vertical integration of urban adaptation strategies (Dependent variable)	In the context of incorporating urban adaptation in national policy, vertical integration is the “ <i>process of creating intentional and strategic linkages between national and sub-national adaptation planning, implementation and monitoring & evaluation (M&E)</i> ” (NAP, 2016, p. 3.)	Level of vertical integration	Low -level Medium- level High-level of integration	Qualitative	(1 to 3) 1=Low, 2=Medium, 3=High	NDCs, UN-Habitat, 2017
What are the major contextual factors that influence the level of vertical integration of urban adaptation in NDCs?	Contextual factors (Independent variable)	Factors that represents precise context, characteristics unique to specific countries and drive countries to occupy adaptation strategies at the national level	Urbanization	Urbanization rate	Quantitative	Individual urbanization rate of the countries (in percentage)	The World Fact book-Central Intelligence Agency (CIA), 2018, UN-Habitat, 2017
			Income level	Low- income Lower-middle Upper- middle High- income countries	Qualitative/ Quantitative	Scale: 1 to 4 1= Low 2= Lower middle 3= Upper middle 4= High	NDCs, World Bank, 2017 (Country and Lending group report), ND-GAIN vulnerability index, 2017
			Vulnerability level	Vulnerability index (lower score=low vulnerability, higher score higher vulnerability)	Qualitative and quantitative	Individual vulnerability score of each country	NDCs, ND-GAIN vulnerability index, 2017
Which governance factors drive or constraint vertical integration of urban		Factors that regulate the inner strength and weakness of governance system and policy	Information	Explicit about the availability of data source on climate change at the national and local level	Qualitative	Identify information as Categorical and values: Yes (3)	NDCs, climate policies of the countries and their profile,

adaptation strategies in NDCs?	Governance factors (Independent variable)	framework of countries act as drivers or barriers for determining the level of vertical integration of urban adaptation strategies				No (2), No information (1) If Yes, then assess the information on a 1 to 5 scale where, 1=Very low, 2=Low, 3=Moderate, 4=High, 5=Very high	World Bank ¹² climate change knowledge portal, UNDP climate change portal and UNISDR ¹³ web portal (joint program to formulate adaptation plan)
				Integration of local indigenous knowledge	Qualitative	Yes-3, No-2, No information-1	NDCs
				Information sharing between national and sub-national level	Qualitative	If yes, scale 1-5	„
		Institutional arrangement		Participation of actors in planning process	Qualitative	If yes, scale 1-5	„
			National/ Local adaptation Plan/ Policy framework in response to climate change	Qualitative	If yes, scale 1-5	Country documents, UNDP ¹⁴ adaptation portal (UNDP-Japan Caribbean Climate Change partnership)	
			Existing/initiative for international	Qualitative	Yes-3 No-2, No information-1	NDCs	

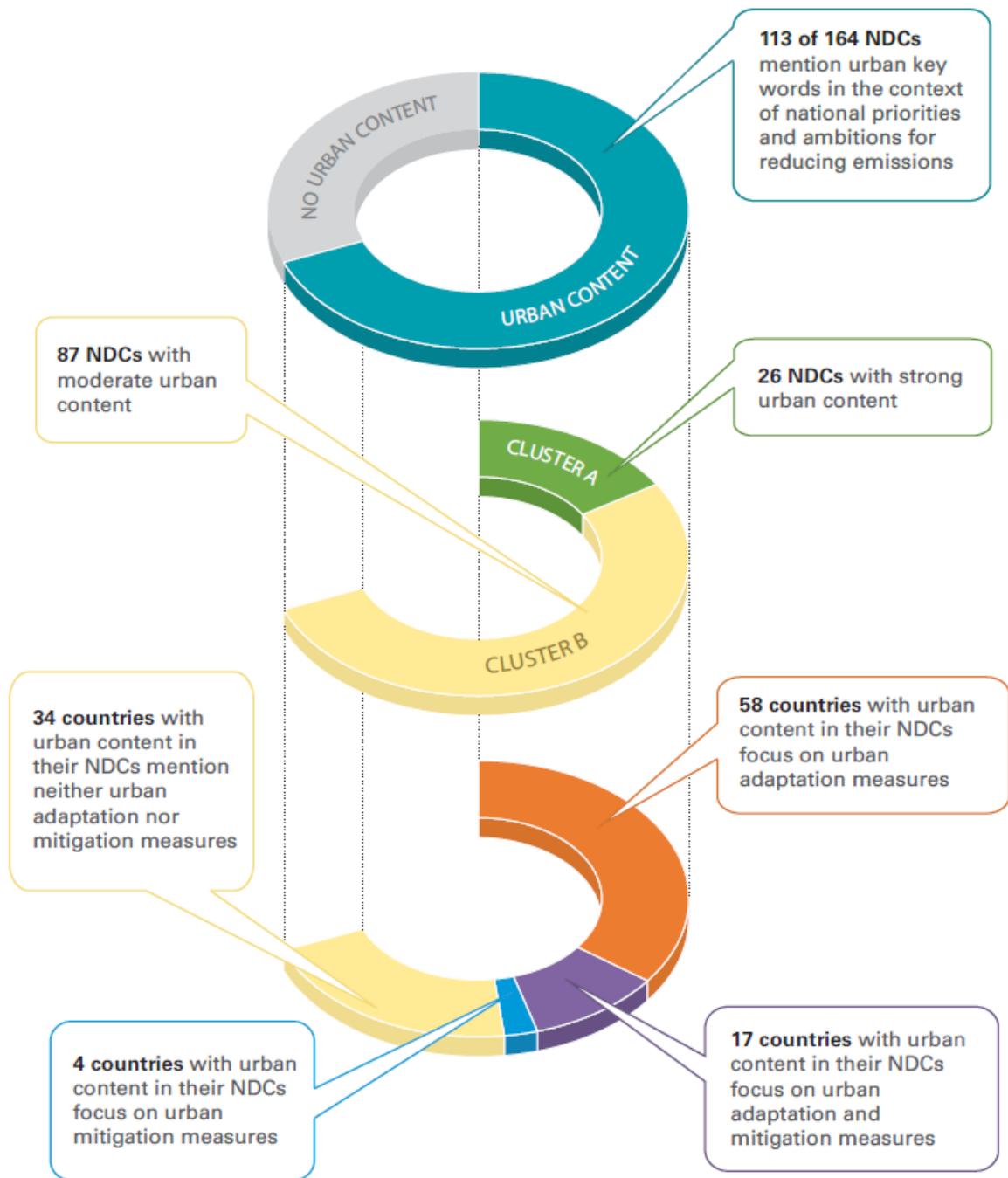
¹² <http://sdwebx.worldbank.org/climateportal/>

¹³ <https://www.unisdr.org/>

¹⁴ <https://sustainabledevelopment.un.org/partnership/?p=12369>

				cooperation/agreement to manage risk, vulnerability, and monitoring			
				Collaboration between national and sub-national level	Qualitative	If yes, scale 1-5	„
				Explicitly mentioned existing policy, law and regulations relevant to climate change	Qualitative	If yes, scale 1-5	„
				Adaption strategies for poor and vulnerable group	Qualitative	Yes-3 No-2, No information-1	„
			Level of capacity	Skill of actors in vulnerability mapping, make projection or model and professional workshop, training	Qualitative	If yes, scale 1-5	„
				Explicitly discussed initiatives to develop techniques, capacity (human skill and infrastructure) and technology for adaptation	Qualitative	If yes, scale 1-5	„
				Explicitly mentioned financial ability and financial need for adaptation actions	Qualitative/ Quantitative	If yes, scale 1-5	„
				Need international support in finance, technology, information and capacity building	Qualitative/ Quantitative	Yes-3 No-2, No information-1	„

Figure 3: NDCs with urban content (After UN-Habitat, 2017)



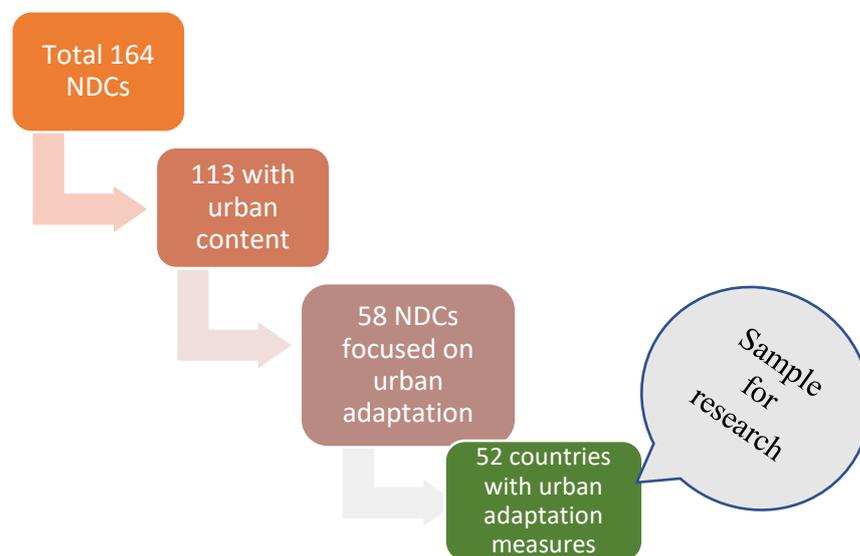
3.6.3. Data on governance factors (Independent variables)

Influential governance factors that drive or constraints vertical integration of adaptation strategies have been identified and measured based on NDCs which have been submitted till August 2017. Later submitted NDCs, update information regarding NAP, NAPA, recent urban measures have also taken into consideration. During scaling of some indicators (1 to 5 scale), for the lack of clear and relevant information in NDCs, proxy data has been collected through the open source of country's other policy documents, country profile, master plan, report or other related and reliable organization (World Bank and UNDP knowledge portal etc.). For instance, to determine scale on 'existing national and local adaptation plan and framework' data from Ghana's climate change master plan, 2015-2020, local plan, Ghana national adaptation plan¹⁵ were considered. A list of proxy data gets through for data analysis has been provided in Annex 3.

3.7. Sample size and selection

The sample documents of the research have chosen by following purposive sampling. The NDCs submitted till August 2017 which fully concentrated on adaptation strategies have been selected as sample. As mentioned earlier out of 164 NDCs, 113 papers stated urban issues based on their priority of consideration. Among these, 58 NDCs completely concentrated on urban adaptation measures (Figure 3). Primarily, these 58 NDCs were counted for scrutiny, but later few countries (e.g. St Lucia) were excluded due to lack of appropriate information. Finally, 52 NDCs were examined for keeping uniformity with available information on urban adaptation measures and governance factors consistent with the reference of UN-Habitat (2017) report. These 52 papers are the sample size (Figure 4) for data analysis. It is also mentionable that there are more 17 NDCs with urban content which focused both on mitigation and adaptation.

Figure 4: Selection of sample



¹⁵http://adaptationundp.org/sites/default/files/downloads/ghana_national_climate_change_adaptation_strategy_nccas.pdf

They were not taken into account because the attention of the study is to evaluate convincing factors for adaptation measures only. If these NDCs were considered, may create a dilemma as the papers may not explain the drivers or constraints for each measure (adaptation and mitigation) clearly or separately. Besides, to keep the research simple and manageable within a limited time, 52 sample size is quite suitable and reliable for qualitative and quantitative (descriptive, inferential statistical) analysis as well as make a concrete conclusion on findings.

3.8. Validity and reliability

Analysis of influential factors for vertical integration of adaptation strategies is very new especially for NDCs as they are a recent attempt in global contribution. Therefore, to ensure the internal validity of the research, data from the various sources used for cross verification. Though sufficient literature on vertical integration of adaptation strategies are not available, there are data on vertical integration of mitigation strategies (e.g. Hus et al, 2017; Andonova et al. 2009) which helped to form variables and indicators. There are also some scientific papers on vertical integration of adaptation strategies based on developing countries (Hallegate, 2014, Biesbroek, 2014; Pietrapertosa et al, 2018). The variables used in these papers are consistent with present research case as most of the NDCs (out of 52) are from middle and low-income countries. Additionally, there is some literature which emphasis vertical integration as a division of environmental policy integration for sustainable development (Lafferty and Hovden, 2003; Urwin and Jordan, 2008; Brown, 2009) and mentioned drivers and constraints to integrate policy vertically. Recent handbook on National Adaptation Plan (2016) has also supported to validate variables and indicators used for the research. For external validity and generalization of the outcome through conclusive remark, data have been assessed through quantitative techniques, correlation of variables, descriptive statistics which have been supported largely by qualitative analysis with evidence from NDCs.

Concerning the reliability of the research, data that have examined is secondary and collected from open but reliable sources or published documents. Specifically, apart from the studies published in academic journals, the main source of secondary data (NDCs) used in this research is retrieved from NDCs Registry and all of them officially submitted by different countries. It has been established by UNFCCC for ensuring participation of all parties in response to climate change effects and represent their contribution on global agenda of reducing emission and increasing adaptive capacity to negative change. The sources such as world bank report on urbanization and income index for all countries are also valid and reliable data source. ND-GAIN (research institute on adaptation) has been providing vulnerability index of countries for long and it explicitly provides the methodology, how they assess the information, determine vulnerability level, summarize index and ranking which also certifies the reliability of data.

3.9. Data analysis methods

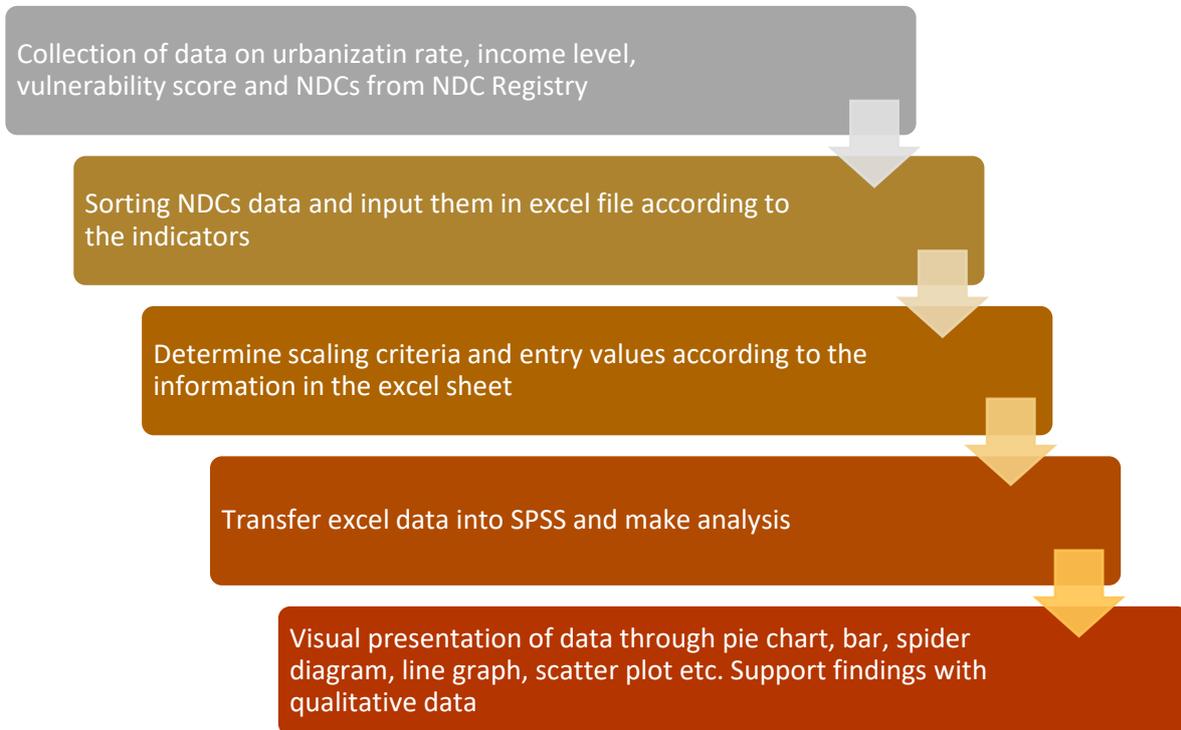
Both quantitative and qualitative method has been followed to analyze data. Contextual indicators namely, income level, urbanization rate, vulnerability level have been evaluated through correlation with each other (e.g. Pearson correlation between income level and vulnerability; the correlation between vulnerability and urbanization rate). Governance factors also examined through the quantitative method and the results have been supported by qualitative evidence. The qualitative study is based on in-depth scrutiny of content and text. The content of NDCs was searched for information relevant to indicators. For instance, in case of 'collaboration between national and sub-national level' relevant information or words regarding collaboration, coordination, cooperation among ministries, line agencies, departments etc. were examined in the text of NDCs. To present findings along with

quantitative data (percentage, mean mode etc.), a significant number of examples, cases were used from NDCs within indicators. Out of 52 NDCs, only 13 have a high level of integration, 38 moderate level and 1 has a low level of integration. As the samples are not harmonized, the correlation between 'vertical level of integration' and other two independent variables (contextual and governance factors) did not present a significant correlation (less than 0.2) in most of the cases. But, descriptive statistics (mean, mode, frequency, percentage etc.) clearly showed the difference between the different level of vertical integration within the factors. Here also the result defended and cross-verified through strong qualitative evidence from NDCs. For quantitative analysis, different scaling was chosen for different variables which have been presented in operationalization section and Table 1. As mentioned earlier 1 to 3 scale has been used for assessing the vertical integration of adaptation strategies which is already available in low, medium and high categories (cluster A, B, and C) within the urban content. For the contextual factors, different measurement scale and score have been chosen according to the data availability. Data on urbanization rate are available in percentage, so the individual percentage of each country has been used for analysis (CIA, 2018). For assessing income level scale 1 to 4 has been identified (see Table 1) according to obtainable secondary data form world bank (World Bank, 2017). In determining vulnerability level, vulnerability score provided by ND-GAIN (2017) has been collected for analysis

Data on governance factors (drivers and barriers of vertical integration) all were available in qualitative form. It was most challenging part to evaluate the data on a Likert scale 1 to 5 through expressing the values from very low to very high (Table 1; details in Table 6, Annex 2). Content or text of NDCs has been examined for all relevant information which supported the scale. For instance, if NDCs mentioned funding constraints to adopt technology for adaptation strategies, then words like 'high' or 'low' were searched in the text as an indication of quantitative value. The data also cross verified and compared with the proposed scale (Table 6, Annex 2) which have been produced by the following '**Qualitative multiple-criteria choice method**' (Hinlopen and Nijkamp, 1990). The value of the scale has been determined by analyzing comparative information (with few assumptions) available in the NDCs where the highest value (5: very high) indicates best available condition among the studied NDCs and lowest value (1: very low) depicts worst cases compare to others.

The other values (scale 2,3,4) scaled with distinct criteria which can easily differentiate the condition from one scale to another. For example, in case of existing national adaptation plan and framework, the highest available condition is having a plan or framework on adaptation like NAP, or NAPA (scale 5) while the lowest condition is not having any plan, framework rather consider climate change or adaptation issues as part of development goal (scale 1). The middle values distributed according to the level of relevant information the NDCs have and assigned criteria followed by the importance which have been clearly defined in Table 6 (Annex 3).

Figure 5: Data analysis process



In case of information unavailability for scaling, proxy data have been used which has been mentioned earlier. As information relevant to some indicators (e.g. integration of local knowledge, international cooperation) were available to a limited number of NDCs, they were evaluated on categorical values (Table 1). Answer options involve ‘yes’, if information shows positive condition about criteria; ‘no’ if negative and ‘no information’ if there is a lack of relevant data. Data have been analyzed through Excel, SPSS (Figure 5) and research results have been presented by using, pie chart, bar diagram, spider chart, line graph, maps etc.

Chapter 4: Research Findings

4.1. Introduction

Scientific research all around the world provide the evidence of climate change and its possible effects through extreme events and gradually changing ecological phenomena. People are more aware and concern about the impacts as various parts of the earth, its natural and man-made environment are already facing climatic problems and difficulties. There is no quick solution to such problems by mitigation measures which make it obvious to adopt adaptation strategies in response to changing climate. As a part of the climate agenda, NDCs are the reflection of global concern and promise to minimize climate change effects. Countries with a lower contribution in emission but more susceptible to climate change are more eager to embrace adaptation strategies because of geographical location, urbanization rate, poverty and resource constraints. However, diverging local contexts and uncertainty about future climate change scenario have made it challenging to propose any definite framework or model for adaption. Therefore, academic research is looking for more example and stories around the world to handle the climate change effects. The finding of the present research on NDCs is an academic contribution on the way to find evidence regarding the issue.

The analysis and findings of the chapter are based on mainly first submitted NDCs in NDC registry (interim) till August 2017 or later. Primarily 58 NDCs were selected (methodology: sample size selection) for data analysis. But later 52 NDCs were considered for final evaluation to keep consistency with information available on urban adaptation measures and governance factors according to the reference of UN-Habitat (2017) report. All up to date information of NDCs such as insertion of environmental or climate change law, the inclusion of National Adaptation Plan (NAP), National Adaptation Plan Action (NAPA), the addition of local level plan, development in initiative or actions for adaptations have been included in the analysis by following updated NDCs. All the information of NDCs has categorized and grouped within the pre-selected indicators mentioned in the operationalization of the methodology section. Both quantitative and qualitative data were used to present research findings evidently. In the support of quantitative data, a significant number of example or cases from NDCs have been used for each indicator (Detail: data analysis part of methodology). NDCs with French and Spanish language translated into English by following google translator.

The chapter presents outcomes of analysis in three sections by answering the research questions. First, the vertical integration level of urban adaptations has been identified and explained. The second section evaluates the internal relation of urbanization rate, income level and vulnerability level among each other and their relation to vertical integration level of studied NDCs as contextual factors. Finally, the governance factors of NDCs have acknowledged and clarified with reference to vertical integration level.

4.2. Level of vertical integration of urban adaptations (findings on research question 1)

According to the report of UN Habitat (2017) cluster data of urban adaptation measures, out of 52, only 13 countries have highest (3) level of vertical integration (count as 25%) while remaining 38 countries (73.1%) have moderate (2) and only one (1.9%) country has a low (1) level of vertical integration of urban adaptation (Figure 6). As the number of NDCs within the highest level of vertical integration are one-third of moderate level vertical integration, findings of quantitative analysis (inferential statistics) dominated by second group and correlation result in some cases was not significant. Therefore, to understand the difference between the two groups within variables and indicators descriptive statistics has been employed and text of NDCs examined qualitatively. Most of the NDCs with a high level of vertical integration are

Asian countries (9) and the remaining 4 are from Africa (Figure 7). Out of 38 moderately integrated NDCs, highest number are from Africa (18) followed by America (13) and Asia (7). Paraguay is the only country among the analyzed NDCs which does not have any urban content and belongs to the low level of vertical integration group.

Regarding the report of UN Habitat (2017), the text with urban terms such as ‘urban’, ‘city’, ‘cities’, ‘settlement’, housing’, ‘municipal’ metropolitan etc. also cross-checked and verified during analysis of vertical integration level.

Figure 6: Countries (%) with vertical integration level of urban adaptation

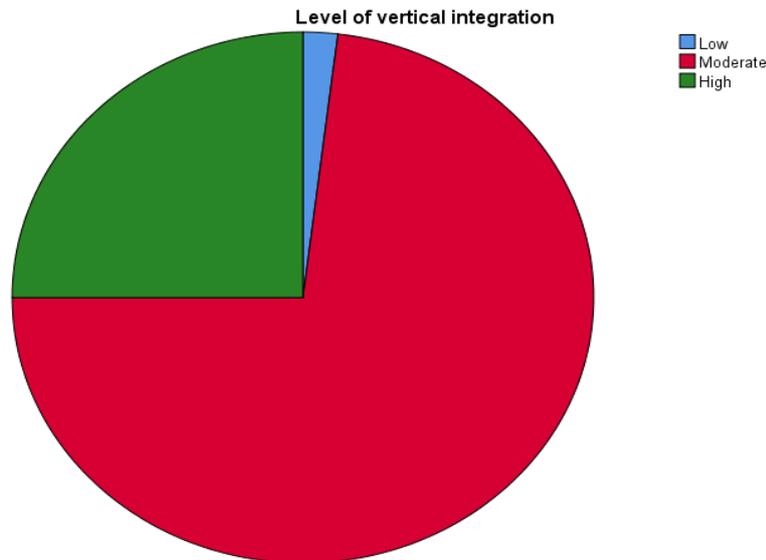
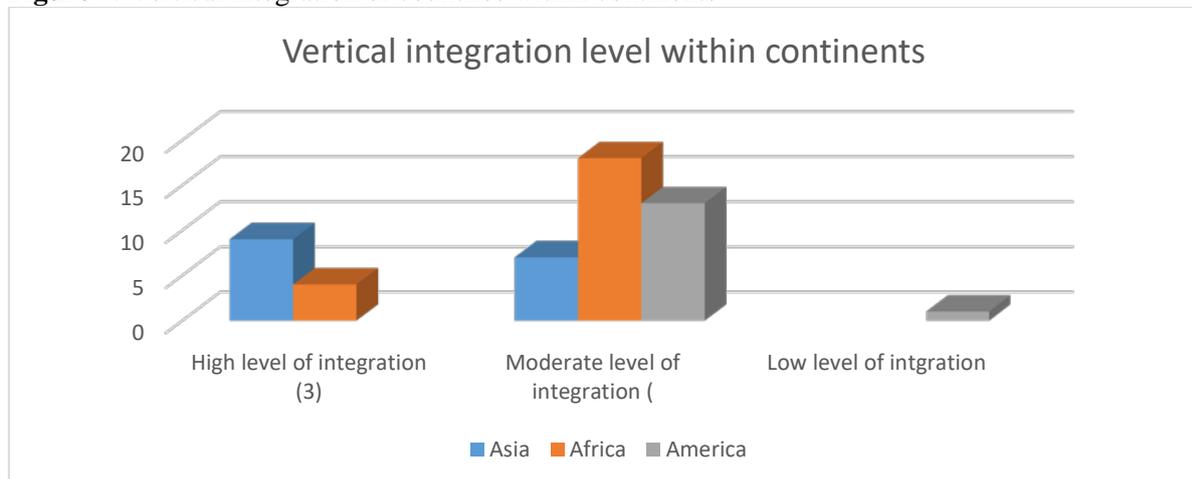


Figure 7: Vertical integration of countries within continents



As mentioned earlier, the report of UN-Habitat categorized three different clusters based on urban content in the NDCs. Cluster A represents NDCs with urban references in the text headers and classified as ‘**strong urban content**’ (High level of vertical integration). Cluster B revealed urban citations inside the body of the text, which has classified as ‘**moderate urban content**’ (moderate level of vertical integration) and the remaining cluster C denotes NDCs with no urban reference in the document and categorized as ‘**low or no urban content**’ (low level of vertical integration) (Map 1). The classification is considered as indicative as the

documents are qualitative in nature and have dimensions or differences in expressing content and context of actions or strategies. Therefore, the analysis is not fully on the statistical base and urban keywords weighted on total words. There is no statistically proved relation with urban keywords and level of vertical integration as well as ‘scaling of governance factors’ are based on qualitative data, so the correlation analysis with the level of vertical integration and influential factors do not show statistically significant relation. Yet descriptive statistics indicated the overall influential relation between independent (contextual and governance factors) and dependent variables (level of vertical integration).

The cross-analysis illustrates that the countries with cluster A have indication of urban or urban related words in the header of the text with focus on particular adaptation measures (Table 2) while NDCs in cluster B have urban indication in the body of the text and mostly addressing urban facts not directly through urban actions rather as a part of relevant mitigation measures. Moreover, the use of urban words is also lower in cluster B than cluster A while Paraguay as a country of cluster C has no urban content.

For example, in the NDC of Bangladesh urban related words has been utilized for several (9 times) times and different purpose such as urban waste management, ensure liveable cities, building underground metro and rapid transit in urban areas and enhance urban resilience in every sector. NDCs mentioned about the improvement of urban resilience through improvement of the drainage system to address urban flooding, build up climate-resilient housing and introduce urban resilience in key adaptation measures. Besides, building an ‘Elevated Express Highways’ in Dhaka city for decongestion of the main urban traffic arteries’ and introduce mass rapid transit system. For using numerous urban content and initiative based on city, the NDC of the country has considered for high (3) level of vertical integration (Table 2)

Table 2: Summary of some countries with urban climate actions and level of vertical integration

Country	Continent	Examples of Climate actions/strategies	Use of Urban words/content in whole NDC document	Urban sectors of focus	Level of vertical integration
Bangladesh	Asia	‘ Urban waste management (p.5); Ensure liveable cities (p.5); Underground metro and rapid transit in urban areas (p.6); Enhanced urban resilience in every sector (p.10); Improvement of Urban resilience through improvement of drainage system to address urban flooding (p.11); Climate resilient housing (p.11); Urban resilience (p.14) in key adaptation measures, building an Elevated Express Highways in Dhaka city for decongestion of the main urban traffic arteries (p.14)’	Urban 7 times, Housing 1 and cities 1 time (urban content both in header and body of text)	Waste management, The drainage system, Transport sector, Housing	3

India	Asia	<p>‘Transformation and rejuvenation of urban areas including Atal Mission for Rejuvenation and Urban Transformation (AMRUT); The ‘vision of Urban Transport policies’ with ‘Mass Rapid Transit System (MRTS)’ (p.15); ‘National Heritage City Development and Augmentation Yojana (HRIDAY)’ to bring together urban planning, economic growth and heritage conservation (p.15); ‘Smart Cities Mission’, to develop new generation cities with 100 cities, introducing recycling and reuse of waste, protection of sensitive natural environment to make these cities climate resilient (P.14); Grants to urban local bodies for solid waste management through public-private partnership (p.14); Incentives for cities to adopt ‘waste to energy conversion projects’ (p.13); Around 236 km of metro rail have been made operational’ and ‘further, about 550 km are under construction and 600 km under consideration for different cities across the country (P.15); ‘National Air Quality Index (AQI)’ was commenced for Indian cities (p.17)’</p>	Urban 17 times, Cities 13 times (Urban content both in header and body of the text)	Urban transport, Heritage and city development , Urban planning, Waste management, alternative energy source, improvement of air quality	3
Ghana	Africa	<p>‘Alternative urban waste management (p.3); Adopt alternative urban solid waste management (p.4); Data on variation in the urban population, the efficiency of urban waste collection and landfill gas recovery were based on national statistics. (p.6); Scale up the 200,000 solar home systems for lighting in urban and selected non-electrified rural households (p.12); Scale up adoption of LPG use from 5.5% to 50% peri-urban and rural households up to 2030. (P.13); Adopt alternative urban solid waste management (p.15); Improve effectiveness of urban solid collection from 70% to 90% by 2030; Improved urban sanitation and waste management; Building standards for strategic infrastructure in housing, transport, coastal, waste management, telecommunication and energy) adopted in 10 urban administrative regions (P.16);</p>	Urban 10, cities-2, city 3 times (urban content both in the header and body of the text)	Waste management, Use of solar energy, Housing Resilient infrastructure , Transport	3

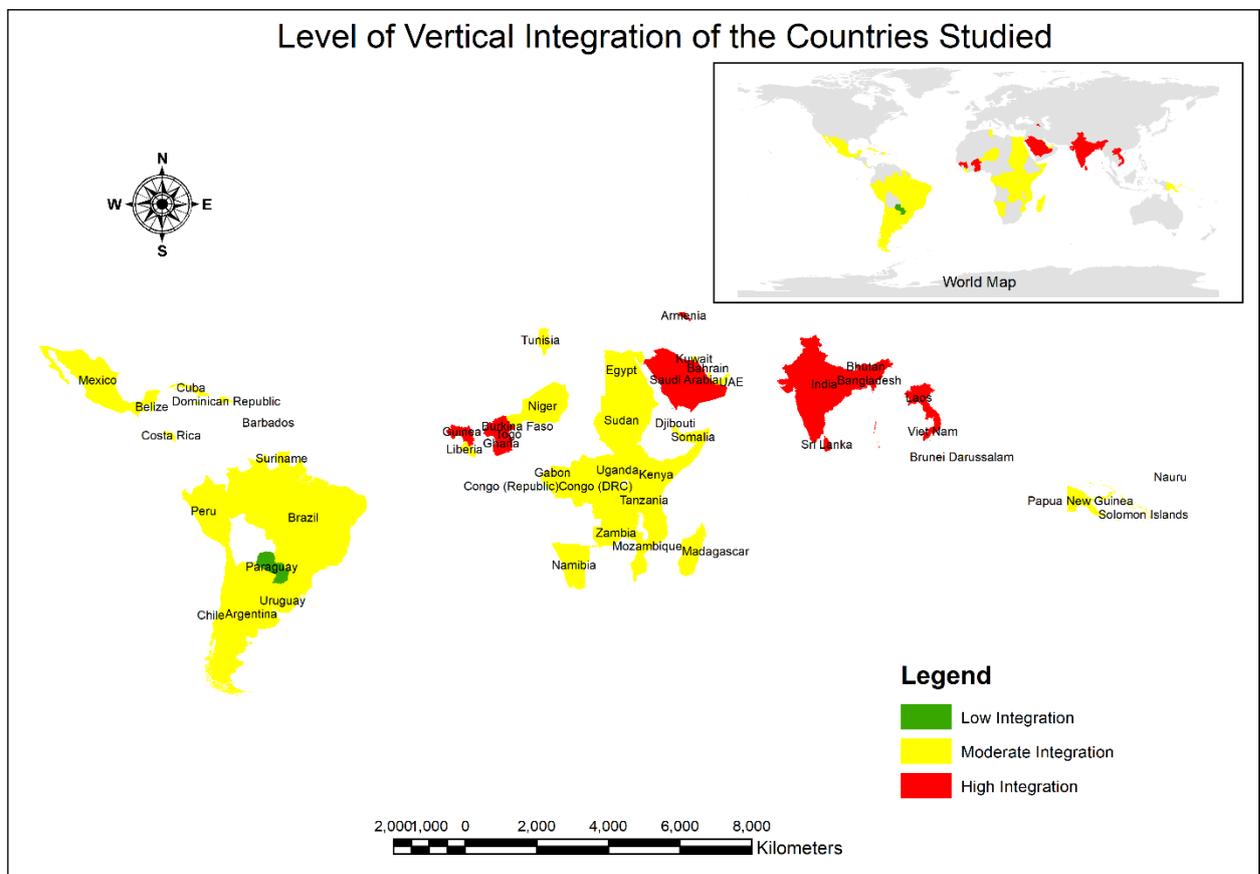
		Expansion of inter and intra city mass transportation modes (Rail and bus transit system) in 4 cities p13; City -wide resilient infrastructure planning (p.8); City -wide resilient infrastructure planning (p.16).’			
Brunei	Africa	As current walking and cycling infrastructure are fragmented, more integrated walking and cycling networks are planned for Bandar Seri Begawan and other areas. Moreover, an Urban Smart Travel Zone is proposed for the capital city Bandar Seri Begawan under the LTMP, which is designed to reallocate road space towards public transport and active travel modes (p.12); Focus on parking management, land–transport integration, investment in public transport, and regulation of access to urban centres and other sensitive locations” (p.13); The Government of Brunei has developed building guidelines including commercial and housing estates, industrial and government buildings; Public houses under the National Housing Programme are designed with green building features that make possible saving in water and energy consumption as well as rain harvesting (p.11); Provision of environmentally friendly and zero carbon modes of mobility (pedestrian and cycling networks) in housing areas enable convenient access to facilities and amenities (p.11)’	Urban 2, city 1, Housing 3 times (in the body of the text)	Transport Housing	2

Belize	America	<p>‘Urban areas of Belize include an adaptation strategy, vulnerability assessment is undertaken with greater focus being placed on assessing the vulnerability of the transport infrastructure, particularly in urban areas (p.19); Develop housing and settlement patterns/practices that enhance climate change adaptation (p.19), The policy specifically recognized the negative effects on the social, economic and productive sectors such as human settlement (p.10); The undertaking of comprehensive assessments on human settlements and infrastructure (p.11); Building Resilience of Human Settlements to promote the adoption of an integrated land tenure and land classification policy and developing and implementing programmes which discourage the establishment of human settlements in areas prone to natural hazards (p.19)’</p>	Urban 2, Housing 1, Settlement 5 times (in the body of the text)	Settlement/ housing, transport, infrastructure	2
Uganda	Africa	<p>‘Promoting intensified and sustained forest restoration efforts (including in urban areas (p.6); Risk management (particularly in urban areas) (p.7); Specific activities have been developed on the ground to increase resilience, regarding, among others, agriculture, water, and urban planning (p7). Managing water resource systems, including wetlands, particularly in cities, in such a way that floods are prevented and existing resources conserved (P6), those living in slums are especially vulnerable as they have lower capacity to cope with and adapt to the impacts of climate change (p.4); The country will continue to work on reducing vulnerability and addressing adaptation in agriculture and livestock, forestry, infrastructure (with an emphasis on human settlements, social infrastructure, and transport.p.2, Climate change is affecting a wide variety of sectors-agriculture, water, health and human settlements have been particularly affected (p.4)’</p>	Urban 3, cities 1, settlement 2 times (in the body of the text)	Urban planning, Settlement, Water and wetland management, Reforestation	2
Paraguay	America	No actions with urban content	No urban content		1

India is another country of cluster A which incorporated urban issues in its climate initiatives and for developing climate resilient urban centers. In the NDC the word ‘urban’ used for 17 and ‘cities’ for 13 times. Specific initiatives include number of schemes for transformation and rejuvenation of urban areas including ‘Atal Mission for Rejuvenation and Urban Transformation (AMRUT)’, the ‘vision of Urban Transport policies’ with ‘Mass Rapid Transit System (MRTS)’ ‘National Heritage City Development and Augmentation Yojana (HRIDAY)’ to bring together urban planning, economic growth, and heritage conservation. The ‘Smart Cities Mission’ intended to develop 100 new generation cities and introduce recycling, reuse of waste, protection of the sensitive natural environment to compel these cities more climate resilient. The government also supplied grants to urban local bodies for solid waste management through public-private partnership and incentives are provided to adopt ‘waste to energy conversion’ projects. In the country, ‘around 236 km of metro rail has been made operational’ and ‘further, nearly 550 km are under construction whereas 600 km under consideration for different cities across the country including Ahmedabad, Pune, and Lucknow. Besides, in 2014, a ‘National Air Quality Index (AQI)’ was commenced for Indian cities (Table 2).

In the NDC of Ghana, ‘urban’ word has been observed for 10 times, ‘city’ 2 and ‘cities’ 3 times (Table 2) in climate action development and management, data handling which intended its vertical integration level as high (3). Urban initiatives involve alternative solid waste collection and management, building a solar home for lighting, improved urban sanitation management, building standards for infrastructure in some urban administrative region, expansion of city mass transportation mode, citywide resilient infrastructure planning and so on.

Map 1: Countries with different level of vertical integration



On the other hand, the NDC of Brunei mentioned the word urban 2, city 1 and housing 3 times to express climate actions regarding the urban area in the body of the text. The country proposed Urban Travel Zone for the capital city to reallocate road space towards public transport and active travel modes. For urban and other sensitive location focus on public transport management, investment in public transport, land-transport integration, regulation to access urban centres have been made. Apart from travel and transport, urban areas also got priority in the housing sector by building guidelines and 'National Housing program'. The program gave special attention to green building features to save water and energy consumption as well as rainwater harvesting. Similarly, Belize provides greater focus in assessing vulnerability in the transport sector, climate change adaptation for different housing and settlement patterns and practices. The country will promote integrated land tenure and land classification policy for building the resilience of human settlements in urban hazard-prone areas. Belize indicated the words urban 2, housing 1 and settlement for 5 times. However, Uganda promotes urban climate strategies through sustained forest restoration practices, risk management, urban planning, managing water resource and wetlands in cities, reduce vulnerability for slums and human settlement. In the NDC urban content expressed with the words urban (3), cities (1) and settlement (2 times).

Although the review is based on urban content and the level of vertical integration has been determined through the availability of urban keywords in the header and body, it's not surprising to have exceptions. The NDCs without mentioning urban keywords, relevant actions can be applied in urban areas and it is not impossible to get urban relevant sectorial content without specific urban reference (UN-Habitat, 2017)

Box 1

The NDCs with high level of vertical integration have more sector specific and clear urban actions while moderately integrated NDCs considers urban actions as a part of national program and not clearly outlined specifically for urban areas

4.3. Influence of contextual factors on vertical integration level of urban adaptation strategies

Studies suggest that rapid urbanization rate and 'economic transformation' generate climate change challenges regarding sensitivity and low level of capacities. The countries with lower income tend to suffer more in these challenges than high-income countries (Garschagen and Romero-Lankao, 2013) due to poverty, resource constraint and lack of capacities. Consequently, apart from geographical and locational variables, urbanization and income level often impel vulnerability level of the countries as well as their capacities, interest, and barriers to response climate change effects. The literature on climate change and disaster have delivered more focus on geographies and locational factors in determining vulnerability issue. Yet, urbanization rate with different income level may influence vulnerability conditions and the results, in turn, drive the climate change response capacity and level which need to acknowledge further (Garschagen and Romero-Lankao, 2013).

For the present study, income level, urbanization rate and vulnerability of countries have measured as significant factors those are interrelated to each other and have an influence for envisioning adaptation in the NDCs. It has been revealed that the countries with lower (23.1%) and middle income (lower-middle 32.7%, upper-middle 26.9%) are more interested in embracing adaptation strategies in the NDCs (Figure 8).

Figure 8: Income level of NDC countries with urban adaptation strategies

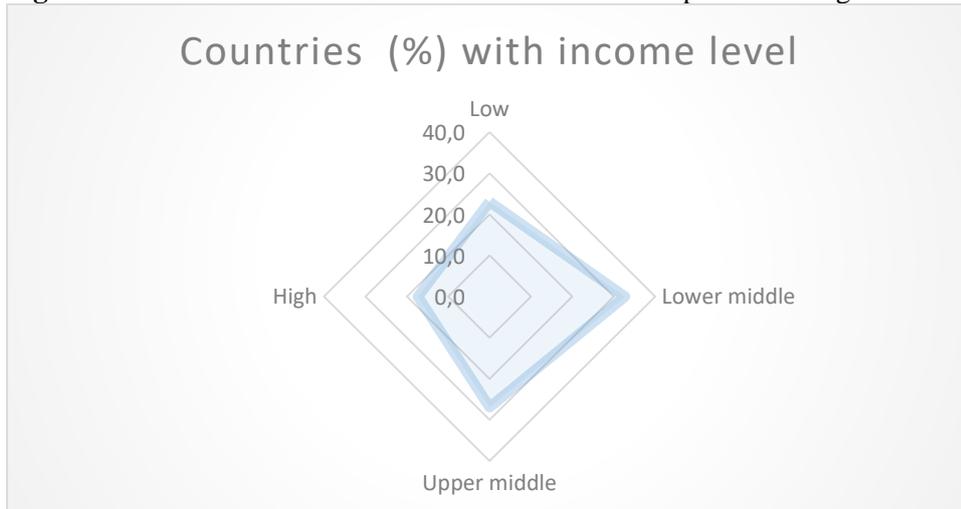
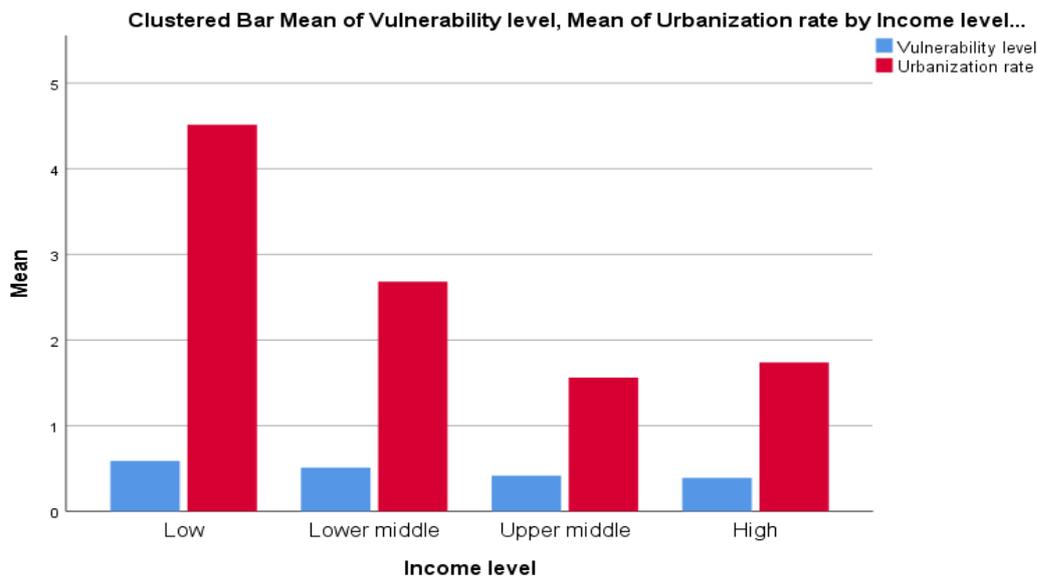


Figure 9: Vulnerability and urbanization rate of different income level countries



Contrary, less than twenty percent (17.3%) high-income countries have concentrated on urban adaptations. The world cities are now facing a high level of urbanization. Among them, cities of developed countries have a more urban population with a developed economy, but the current rate of urbanization is higher in developing countries (UN-Habitat, 2017).

Cities as a center of productivity, innovation, job opportunity, urban facilities and better living standard have been magnetized people for long. Generally, in the theory of agglomeration economies, it is contemplated as a progressive response for the sake of economic growth and development. Urban areas bestow a varying degree of economic scale with better-off market structure than rural areas and amplify the opportunity for the labor to become more productive and generate chances of more earnings (Bloom et al, 2008). Nevertheless, rapid urbanization also invites overcrowding, environmental pollution (Bloom et al, 2008) pressure or stress on urban amenities and vulnerabilities to climate change effects especially for countries with limited income. Though the low and middle- income countries from Asia and Africa enjoy

economic growth at some extent by increased urbanization rate, are also at the risk of higher vulnerability to climate change effects particularly the poor and vulnerable group. Consequently, income level, urbanization rate, and vulnerability are strongly correlated to each other as lower income countries (among studied countries) portray both high urbanization rate and high level of vulnerability (Figure 9, Map 2&3).

Map 2: Urbanization rate and vulnerability of different countries

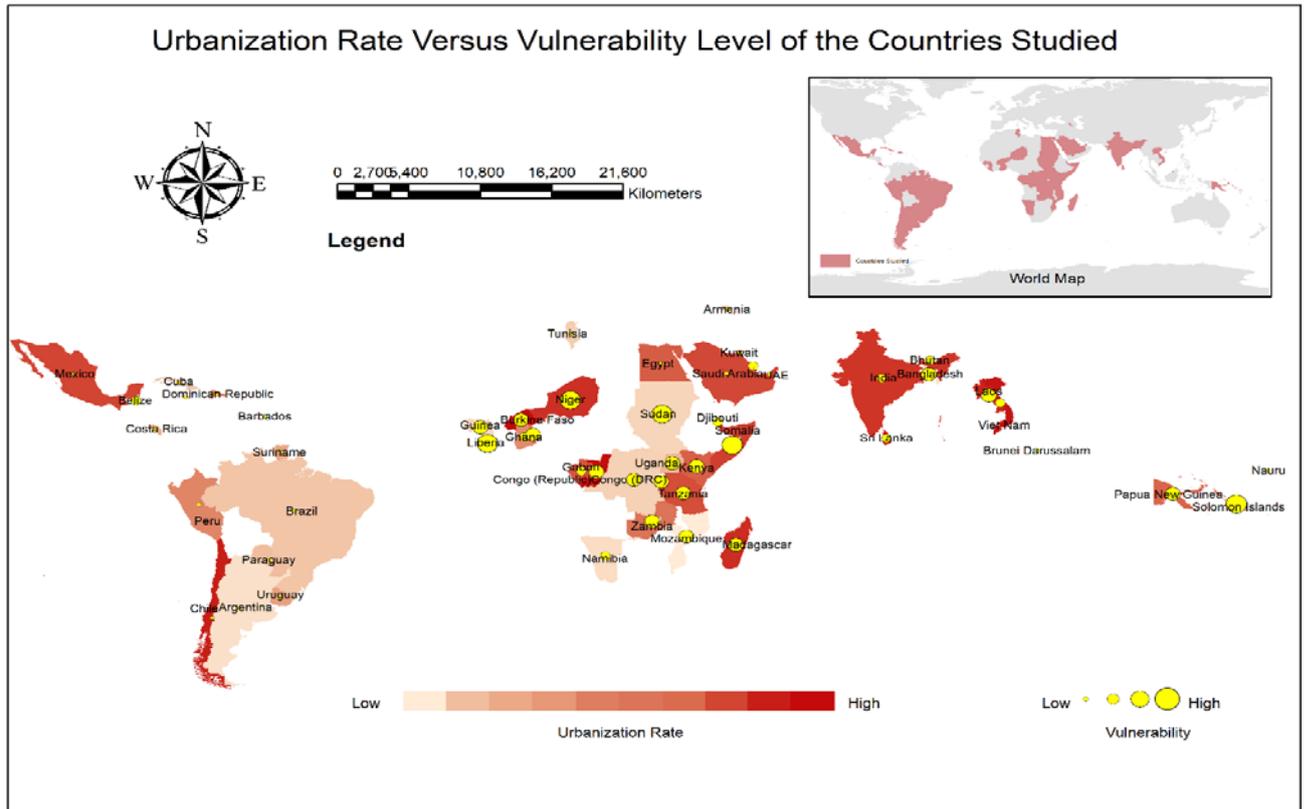


Figure 10: Correlation of urbanization rate and vulnerability

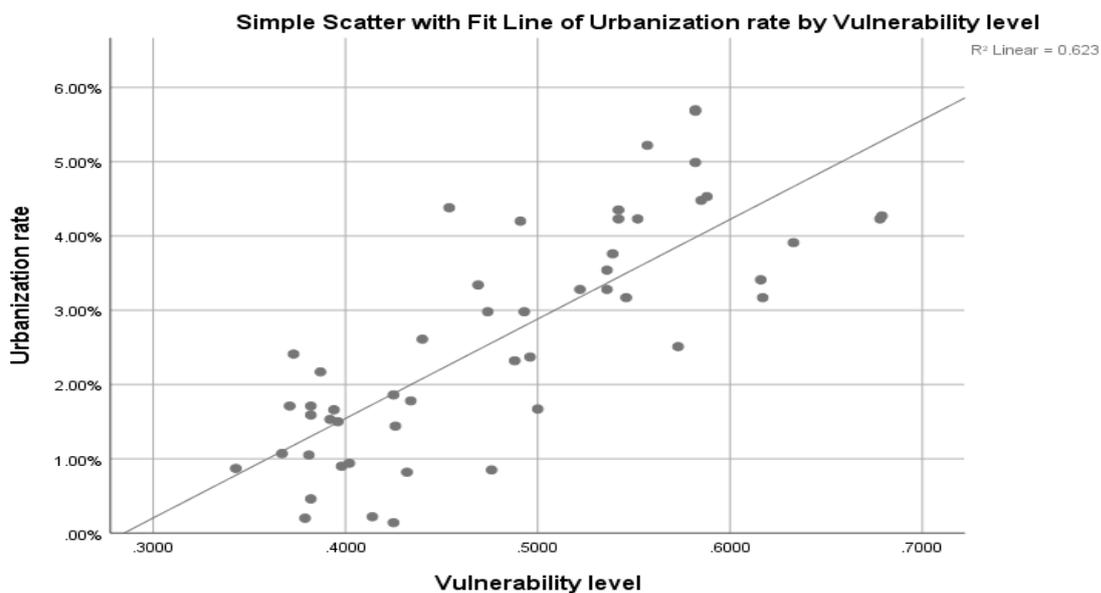
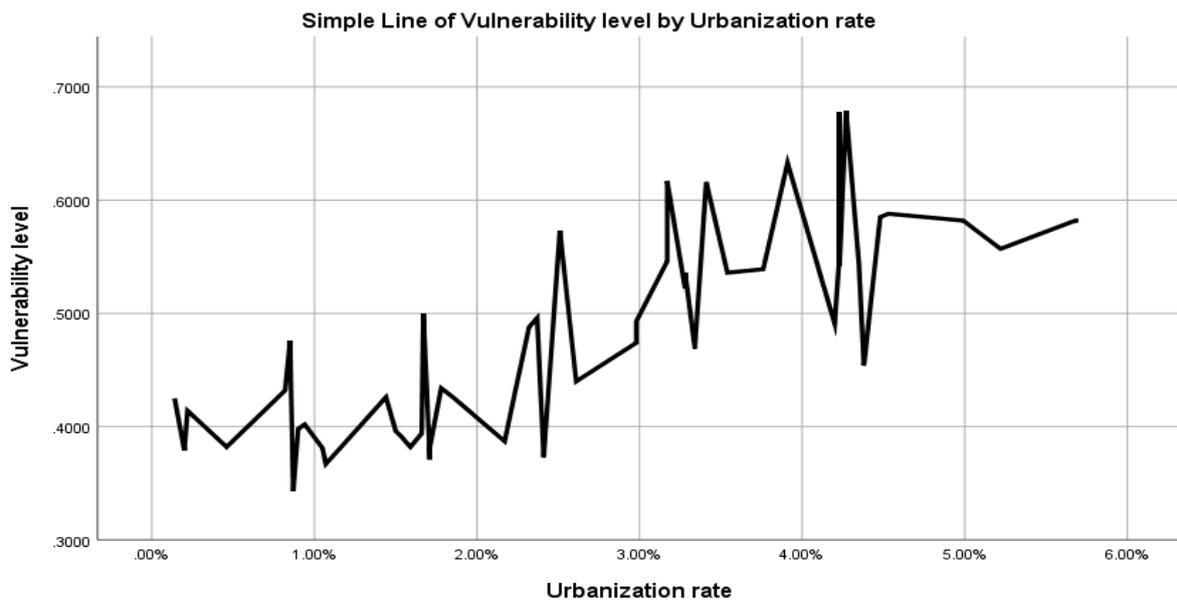
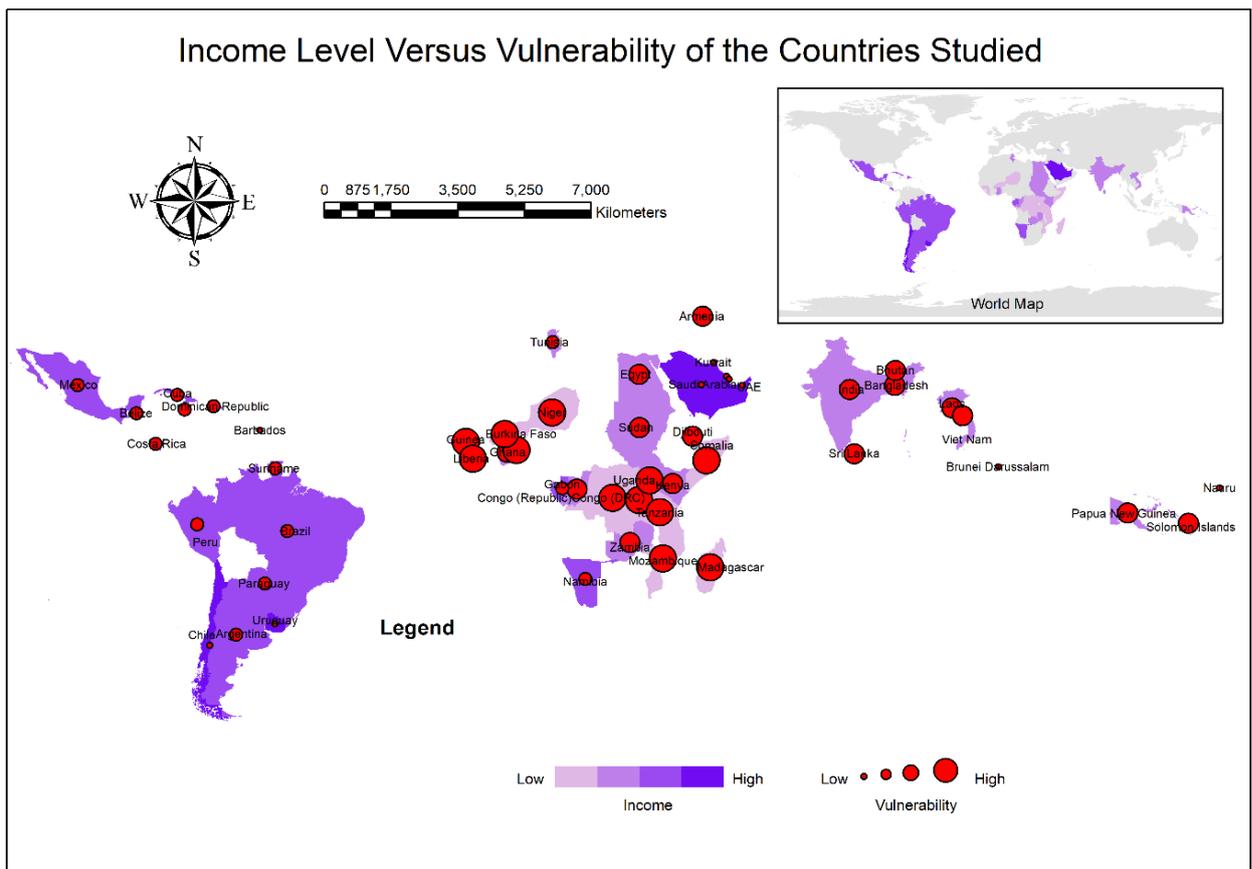


Figure 11: Vulnerability increase with an urbanization rate



Map 3: Climate change vulnerability of countries with various income level

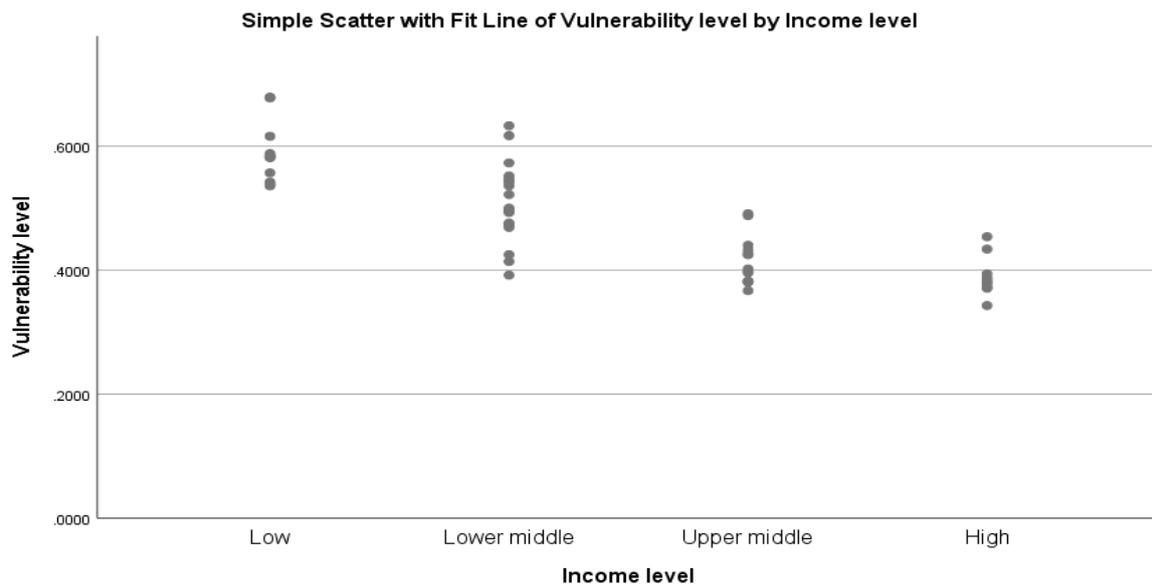


People of lower and middle-income countries move rapidly to urban areas in search of job opportunity or urban facilities but poverty, lower social, institutional and economic capacity of the government fails to serve overcrowded or burden population. The overall conditions push them more climate change vulnerabilities. The statistical analysis reveals that there is a

significant positive linear correlation between urbanization rate and vulnerability level. The Pearson correlation is 0.789 which is significantly less than 0.01 level (Table 3, Annex 1). It means with increasing urbanization rate vulnerability also increases (Figure, 10 &11; Map 2). Countries with high urbanization rate confront pressure on the existing system which coupled with the unplanned growth of infrastructure, expansion of urban sprawl, stress on housing, transport, water, energy resource, reduction of open space and degradation of the environment. Poor rural people move towards urban areas and very often lead to unemployment, poverty, congestion, and even violence (Garschagen and Romero-Lankao, 2013). In the third world, urban expansion associated with rapidly growing slum population is a major concern for many climate change vulnerable cities. As per UN-Habitat report (2015)¹⁶, one in every eight people live in slums in the current world while approximately one billion are below minimum living standard. In developing countries, about one third (more than 30 percent) people live in the slums and the number is mounting day by day. Slum challenge endures being a precarious factor for the persistence of poverty which is depriving citizens from the benefit of urbanization, impartial and equal opportunities of progress and prosperity as well as social and economic justice (Bloom et al, 2008).

Correspondingly, outcomes of studied NDCs represent that, vulnerability varies with income level. Chile as a high-income country shows the lowest vulnerability score (0.343) which is highest for Niger (0.679), a low-income country. Most of the countries with high income have vulnerability less than 0.4. Contrary, low and middle-income countries (especially low and lower-middle) are in the face of greater climate change vulnerability (Figure 12, Map 3). The vulnerability scores range from 0.539 to (Togo) to 0.679 (Niger) both of which belong to low-income countries. Therefore, the Pearson correlational analysis of vulnerability and income level shows strong inverse correlation (-0.815) between them with less than 0.01 significance level (Table 4, Annex 1).

Figure 12: Relation between income and vulnerability level



¹⁶ <https://unhabitat.org/slum-almanac-2015-2016/>

The correlation explains that countries with lower income have a higher level of vulnerability and with increasing income level, vulnerability decreases. Due to geographical location, poor socio-economic conditions, low-income countries suffer more than well-off countries in climate change impacts. For example, Sudan Niger, Uganda, Guinea, Mozambique, Liberia, Somalia Madagascar with low income made the countries critically vulnerable (Map 4&6) and most of the countries among them have a high rate of urbanization rate (Map 5).

The vulnerability scores have taken from Notre Dame-Global Adaptation Index (ND-GAIN) that analyzed the country's current vulnerability to climate disruptions by assessing 36 indicators. Three components consisting of social, economic, governance components have evaluated with 12 indicators for each and crossed by six life supporting sectors. These six 'life-supporting' sectors include food, water, health, ecosystem services, human habitat, and infrastructure'. "Each sector is in turn represented by six indicators that represent three cross-cutting *components*: the *exposure* of the sector to climate-related or climate-exacerbated hazards; the *sensitivity* of that sector to the impacts of the hazard and the *adaptive capacity* of the sector to cope or adapt to these impacts" (ND-GAIN, 2015, P.3)

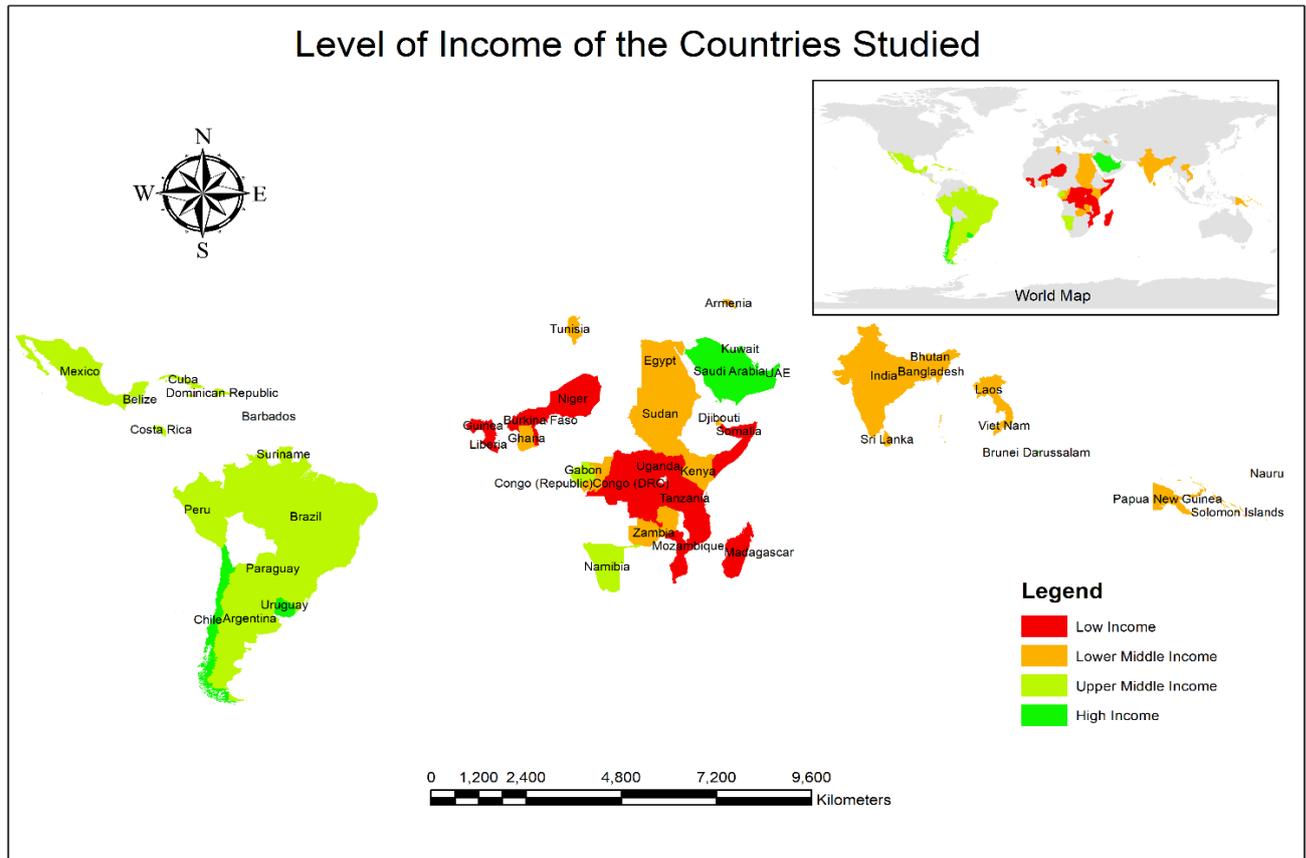
4.3.1. Vertical integration of urban adaptations and influence of income, urbanization rate and vulnerability

Out of 13 countries with a high level of vertical integrations, 3 countries are from the low-income level, 8 are from lower middle and 2 from high-income countries (Map 4). Bahrain and Saudi Arabia are high-income countries and have an urbanization rate of 4.38% and 2.17% respectively (Map 5). Interestingly, Bahrain with high urbanization rate (4.38%) has a greater vulnerability (0.454) than Saudi Arabia (0.387) (Map 5). These may be a reason to include urban issues more in NDC than Saudi Arabia. Bahrain mentioned sustainable urban planning with emphasis to improve green infrastructure to save water and energy. An additional attention of Bahrain is reducing traffic time for an increased and projected vehicle of the future by improving the efficiency of public transport while Saudi Arabia concentrated only in improving mass transport system through the metro in Riyadh.

Among the lower-middle income countries (Map 4), India addressed rapid urbanization (Map 5) growth and the associated problem with it. The NDC stated as "*Rapid urbanization in the country will be one of the most dominant trends in the coming years. It is expected that about 40% of the population in 2030 would be urban as against 30% currently. As population expands and incomes grow, this shift will likely be realized alongside demographic changes that will exponentially increase the demand for urban amenities like housing, energy, transport, water, waste disposal. It is estimated that more than half of India of 2030 is yet to be built*" (NDC of India, p.6). For urbanization, the country considers development process as 'double challenging'. Urbanization pressure is a barrier to complete current ongoing development agenda which may increase the development gap in the future. Hence, the urban issue reflected very clearly in the climate action plan and strategies of NDC. For instance, under 'Smart cities mission' 100 cities have taken into account for improving infrastructure, clean and sustainable environment through recycling and reuse of waste, use renewable energy and ensure a better quality of life for the citizen. Moreover, a new mission has been launched for 500 cities through 'Atal Mission for Rejuvenation and Urban Transformation (AMRUT)' to ensure basic infrastructure service. The services involve water supply, sewerage, stormwater drains, transport and developing green space, parks through approving climate resilient and energy efficient policies and regulations. As the pressure of urban people is increasing, the

country adopted ‘Urban Transport policies’ by focusing on moving ‘people’ rather than ‘vehicles’ through the Mass Rapid Transit system.

Map 4: Income level of studied countries



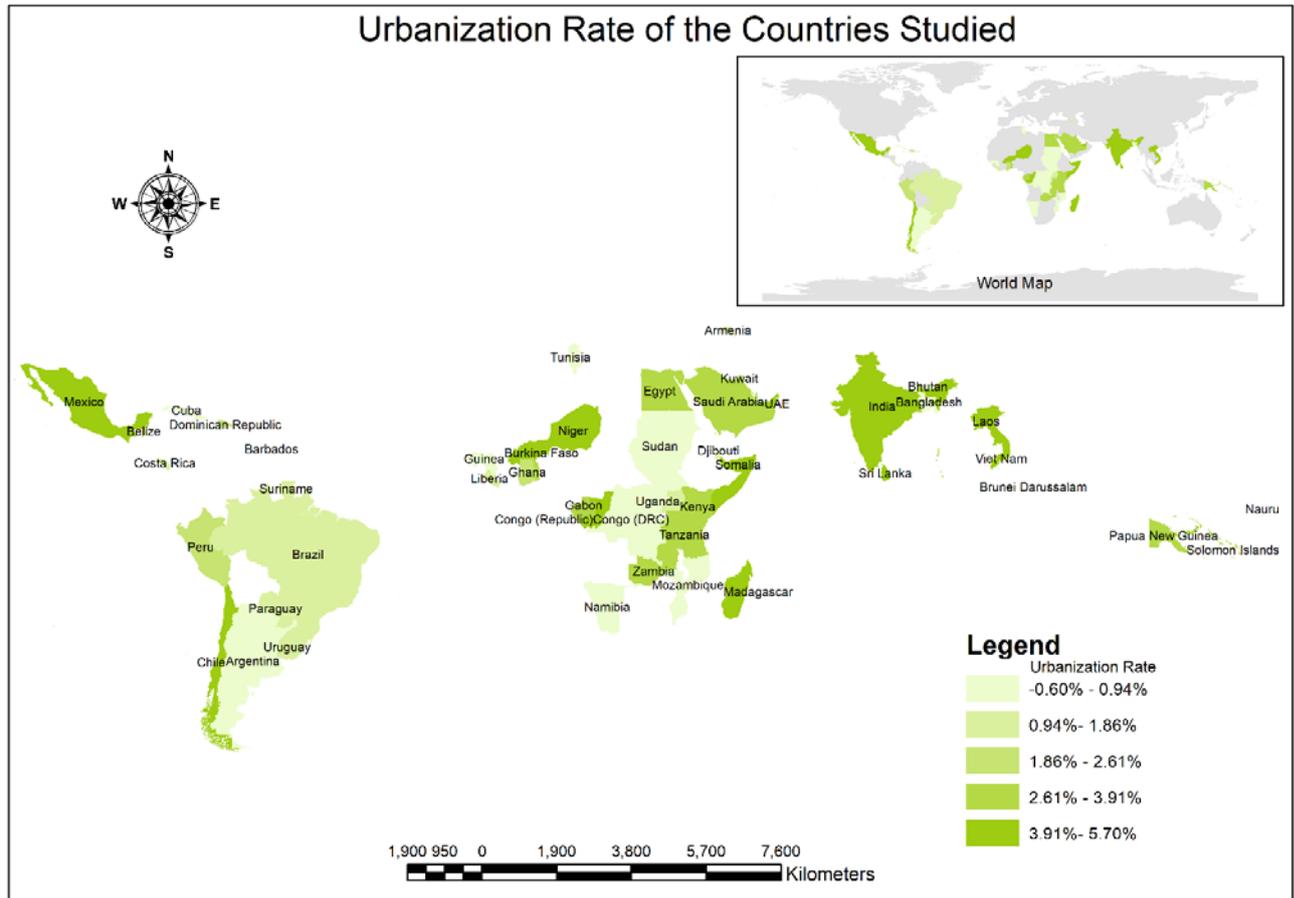
Bangladesh is another lower-middle income country (Map 4) with a high level of vertical integration which has higher urbanization rate (3.17%) (Map 5) and higher vulnerability score (0.546) (Map 6) due to its geographic location, poverty, and disturbances of extreme hazard. The country is regularly affected by monsoon and flash flood, devastating cyclone, urban waterlogging, landslides, salinity intrusion, riverbank erosion and so on resulting loss of human life and resources¹⁷. Every year, thousands of poor migrate to urban areas in search of livelihoods. For this reason, major cities of Bangladesh are experiencing rapid but unplanned growth due to a high level of urbanization. For example, Dhaka is the world’s eighth largest city by population and stressed with massive amount of solid waste, more energy consumption, motor vehicle use, traffic congestion, high flooding during rainfall (Alam and Rabbani, 2007) accretion of open space, land, water bodies by people for housing, generation of huge solid waste poor settlements and slums.

Though the NDC of the country did not cite urbanization as a challenge directly, many of the climate actions focused on the associated problem with urbanization. By addressing high vulnerability issues in this regard, the country mentioned increasing urban resilience especially

¹⁷ <https://www.worldbank.org/en/country/bangladesh/brief/bangladesh-disaster-risk-climate-change-program>

for urban flooding through improving drainage system. Besides, improving the traffic system through underground metro and bus rapid transit system to reduce traffic congestion is one of the significant climate change action plans. Developing climate-resilient housing and managing urban waste are issues that have been addressed in the NDC as the country has enormous slum people and pressure of solid wastes in major urban areas.

Map 5: Urbanization rate of studied countries

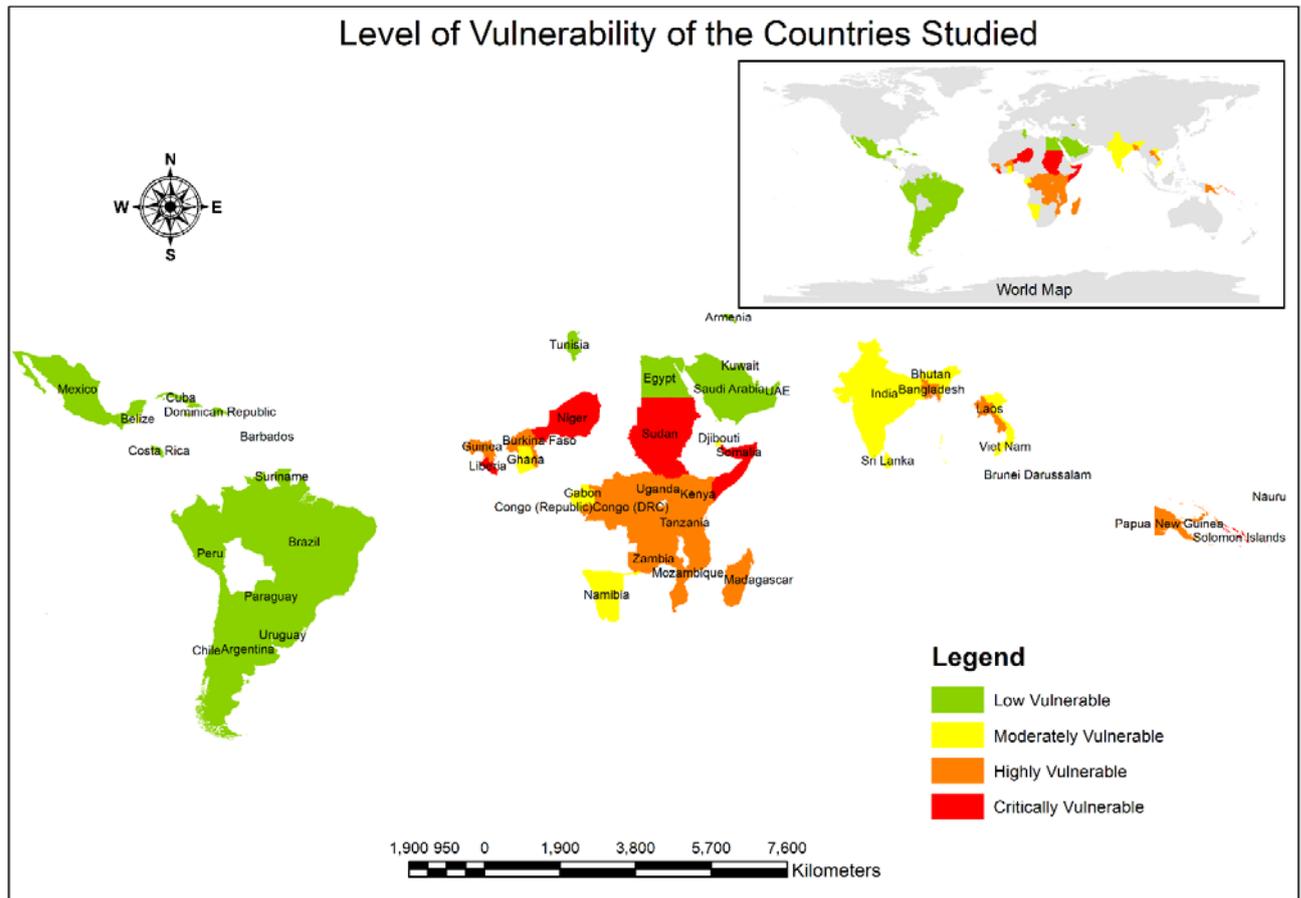


Guinea is a low-income country (Map 4) with a high level of vertical integration and identified urbanization as one of the important reasons for climate change vulnerability (0.536) in the NDC. The country is strained by the vulnerability of the coastal zone, degradation of environment and deforestation on a massive scale due to urbanization effects. As it stated in NDC “*In the absence of available forest inventories (the last dates back more than 20 years), it is difficult to get a precise idea of how far deforestation has gone in Guinea. However, there is no doubt that it is rapid due to human pressure (i.e. firewood collection, urbanization, and farming). AGRYHMET spoke in 2005 of a 10.3% reduction in the area of mangroves and a 33% shrinkage of the whole forest area over the period 1972-2000*” (NDC of Guinea, p.12). Consequently, the country aimed to enhance the development of technologies and practices which will be energy efficient and alternative to wood. To reduce urban pressure, the country has proposed an urban development program.

Likewise, high urbanization rate (3.76%) and high level of vulnerability (0.539) of Togo encouraged the country for a higher level of vertical integration of urban adaptation strategies.

The country concentrated on planned urban housing, National urban planning, and improvement of urban services involving water supply and sanitation, managing rainwater in main urban centers etc. Development of urban roads and transport system, promoting urban forestry, management of urban waste, harmonious spatial development of urban centers are some climate strategies of the country.

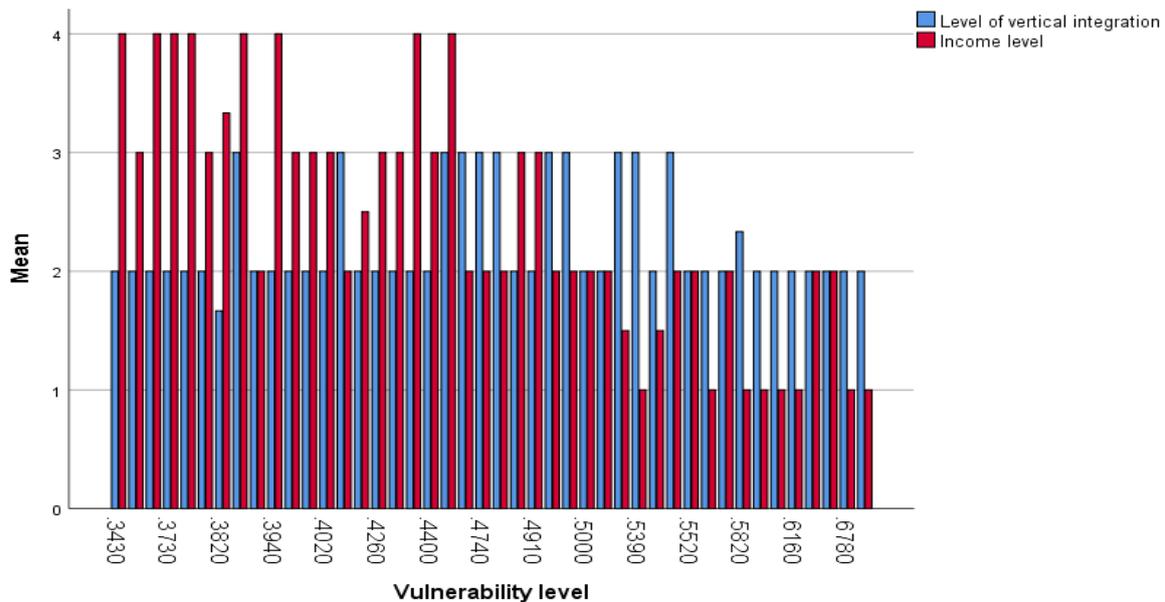
Map 6: Vulnerability profile of the studied countries



On the other hand, NDCs of cluster B have comparatively low level of urbanization rate and vulnerability, high income and better capacity to deal with climate change effects which made them less prioritize urban adaptations. Chile is a high- income country (Map 4) and has low urbanization rate (0.87%) (Map 5) and lowest vulnerability score (0.343) (Map 6) than other countries of the study. The urban content of NDC reported mostly as a part of mitigation measures in the body of the text. The lower level of urbanization rate, lesser pressure on existing urban system and a low score of vulnerability with high-income capacity made the country less concern to incorporate urban adaptation issues. Brazil is an upper middle income with a bit higher urbanization rate (1.05%) which made its vulnerability higher (0.381) than Chile. Currently, developing economies of the country aligned with the urbanization process is producing urban problem to be concerned with. Though the NDC mentioned about urban risk areas, poor housing, improvement of basic infrastructure, health, sanitation, and transportation as key focus areas for adaption, there was lack of specific actions or strategies regarding these issues. In the body of the text only once reported about upgrading infrastructure and transportation without any detail which reflects its position with the lower level of vertical integration.

However, the scenario is different for low-income countries of cluster B due to poverty, resource limitation and lack of capacity. For instance, Uganda is a highly vulnerable (0.582) country with a high rate of urbanization (5.7%) (Map 5&6). Although the NDC did not address the urban issue in the header, there are mentions about urban adaptation actions in the body of the text. Human settlement has been considered as one of the most vulnerable parts of weak infrastructure and reported several times in the NDC. The adaptation actions involve urban afforestation and reforestation program, risk management through vulnerability and risk mapping, improve settlement and transport system, as well as increase resilience by urban planning. In the same way, Niger is the most vulnerable (0.679) (Map 6) among the studied countries with high urbanization rate (4.27%) (Map 5). In the general objective of NDC, it has mentioned about controlling the rapid rate of urbanization by promoting local job opportunities in the rural areas, improving quality of rural life and preserving the environment. Integrated water resource management, urban waste management, urban hygiene and sustainable development are few actions adopted by the country. Surprisingly, both the countries are highly or critically vulnerable to climate change with very high urbanization rate but still, belongs to cluster B.

Figure 13: Vulnerability of countries with income and vertical integration level



The reason may be, as low-income country (Map 4) it will be too ambitious to include adaptations more than present level due to resource barrier or lack of good governance system to incorporate local actions in the national level. Hence, the income level distresses governance structure and poor governance system modifies level of vertical integration of urban adaptations which will be examined in the next section later.

From the analysis of this section and correlation analysis (Table 4, Annex 1) it is quite clear that vulnerability of countries is directly linked with their income level. The countries with lower income have a higher level of climate change vulnerability (Figure 13) than high-income countries. People in poor countries move towards urban centers in search of livelihoods, better opportunities or a better life. Countries with hazard-prone geographical location face the stress of rapid urbanization as the poor migrate to the cities from disaster-affected or economically depressed areas. South Asian coastal countries like Bangladesh, India, Vietnam or drought-

prone Niger, Kenya, Somalia region of Africa have higher urbanization rate by migrants' movement from rural areas to cities.

Cities with poor socio-economic, infrastructural capacity are unable to manage and serve an extended number of population and stressed out in transport, housing, water supply, sanitation, energy, health, education and other amenities. Unplanned growth, urban sprawl, deforestation, air pollution, urban flood, water-logging, traffic congestion, slum, the pressure of solid waste, overall environmental degradation are some negative outcomes of the rapid rate of urbanization which upsurge climate change susceptibility. Therefore, in poor economics, vulnerability and urbanization have a positive correlation and influence each other strongly. Generally, it is observed the countries with high level of vulnerability and low level of income (low and lower middle-income countries especially) have a higher level of vertical integration of urban adaptation strategies (Figure 13) in NDCs and concern about the problem and sufferings. Though, Pearson correlation is not significant (Table 5. Annex 1) but show some positive relationship (0.103) which has been supported by qualitative information from the NDC text.

Box 2

Income level, urbanization rate and vulnerability are strongly correlated to each other and the factors have clear influence on level of vertical integration of urban adaptations. But most of the countries were unaware to address the issue in the NDCs.

4.4. Influence of governance factors on vertical integration of urban adaptations (Answer to the question 3)

Governing process varies from place to place and country to country with the influence of local context. That is why, it is still challenging to study governance process or determining its drivers and barriers in planning policy within a commonly accepted framework ((Biesbroek, 2014). Different kinds of literature, theories, postulated barriers and drivers which are conceptualized and based on the perspective of studies. For example, some studies considered participation of actors as must and positive or significant driving factor in planning process (Biesbroek, 2014; Pietrapertosa et al, 2018, Hallegate, 2014) while other literature regarded this as barrier as it may produce chaos or problem due to unequal socio-economic power (Few et al, 2007). For particular factors, the outcomes may be positive or negative which is 'case sensitive' but overall there are well-accepted and evident governance factors that influence the planning process particularly in climate change policy. By studying literature and analyzing NDCs, the present research identified most common and significant factors that are crucial in governance system to integrate urban adaptation strategies vertically. The factors have been clustered into three categories according to their nature and characteristics namely, **information, institutional arrangement and level of capacity** (detail indicators are in methodology: operationalization)

4.5. Vertical integration with information availability

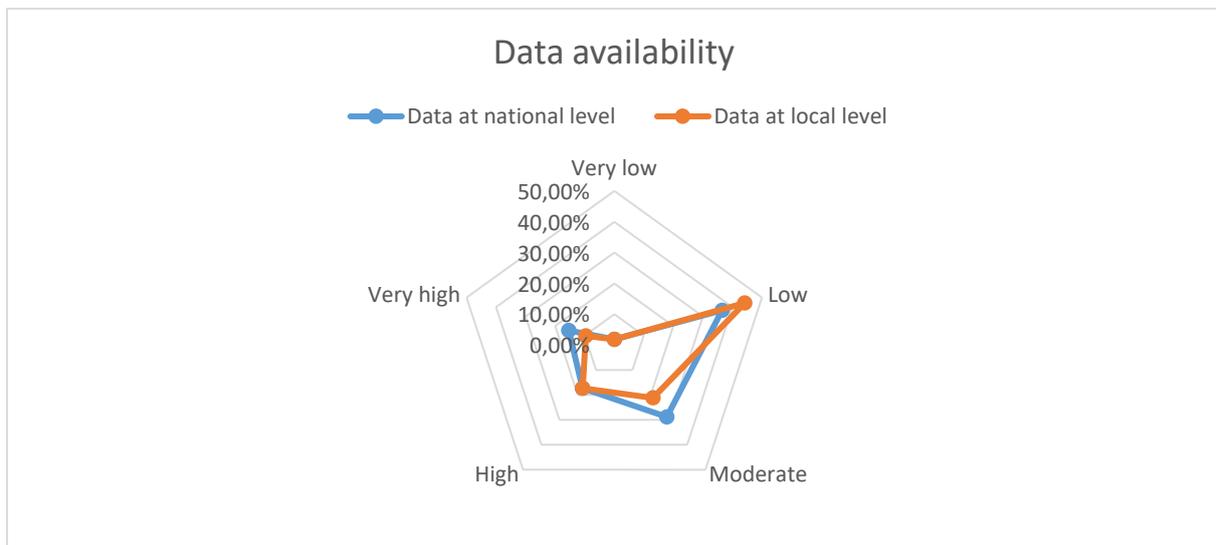
Information on climate change effects, sectors specific loss, damages due to disaster, vulnerability or risk of various sectors are very significant to determine and organize adaptation actions. Indeed, climate change strategies for 'urban sectors', prioritize actions and 'way of implementation' are derived from available data source and information reliability. Therefore, this section includes data availability, information regarding poor and vulnerable, integration of local knowledge in adaptation actions and sharing all kinds of data between national and local level effectively

4.5.1. Data Availability at national and local level

From the descriptive statistical analysis, the study reveals that most of the countries lack available data source on climate change effects, vulnerabilities, adaptation technologies both at the national and local level. The highest number of NDCs (national 36.5%, local 44.2%) have a low level of data availability (Figure 14). Only a few NDCs reported about the high and very high level of data source but the percentage in both cases are below 20%. Paraguay lacks (cluster C) data source but proxy data shows the country has data availability in medium scale regarding climate change historical data, vulnerability, disaster effects and future risks.

For instance, 8 from national and 5 NDCs from local level have very high level of data source (Figure 15). In strong vertical integration, one in every three has a very high national data source, while the number is almost one in every eight for moderately integrated NDCs. Few countries such as Armenia, Barbados, Mexico, Djibouti, Gabon, Kenya, Paraguay etc. did not mention anything about data availability or the source. In these cases, proxy data discloses that there is some information about the vulnerability, disaster effects, climate change risk and future trend in the knowledge portal of World Bank, UNISDR, UNDP. The countries also referred to these sources in their report, master plan, and policy.

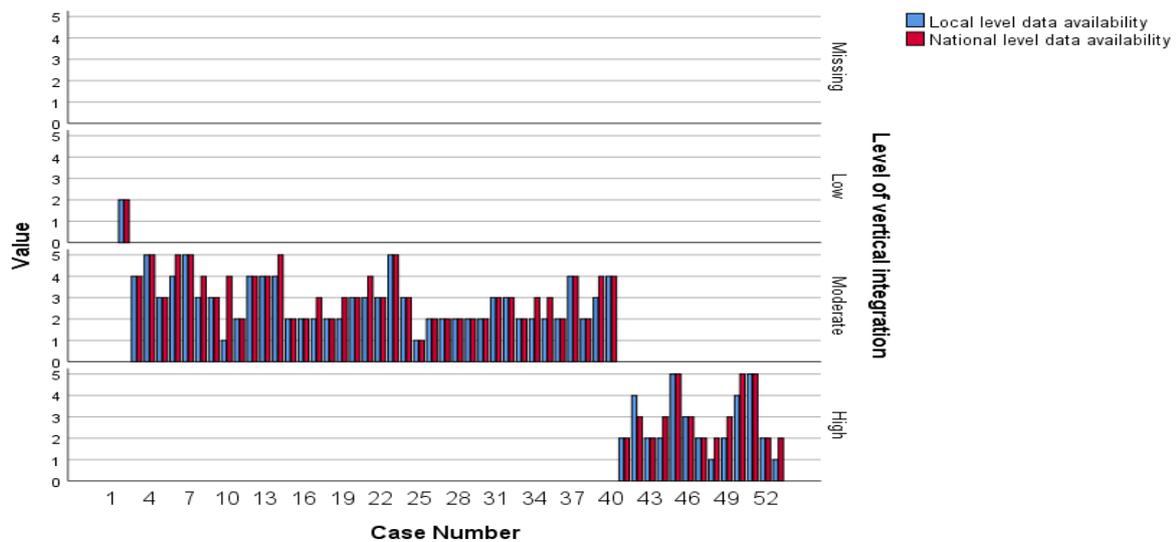
Figure 14: Data availability at national and local level (total percentage)



Contrary, India has a very high level of national and local level data as the country formally launched the National Mission under NAPCC to gather scientific information and technological advancement. In all coastal areas, program on wind energy, health data, conversion of waste to energy, national mission on sustainable agriculture have been started. Moreover, the Department of National Science and Technology has introduced ‘Climate Change Centre’ at the state level particularly in the Himalayan district to gather and disseminate data. Similarly, Ghana has a national MRV system which will integrate NDC with prevailing national monitoring and evaluation configuration. The purpose of the system is to encompass sector-base information regularly through ‘Annual Report (APR)’, review it and update the database. To increase transparency and accountability, NDC mentioned about suitable institutional coordination with active functionalities.

Another country, United Arab Emirates (UAE) with a high level of vertical integration, has also very high commitment to creating a reliable data source. The country has founded ‘Climate change assessment program’ at a local, regional and national level to address data challenges across the wider region on climate change adaptation strategies and vulnerability concerns.

Figure 15: National and local data source of NDCs within the vertical integration



Few NDCs with the moderate level of vertical integration reported the weakness of data availability. Mozambique, for instance, stated as “*Weak capacity to determine the cost of the losses and damages caused by the impacts and of the measures to adapt to climate change and few research and investigation actions addressing climate change*” (p.7). While the country is still on the primary level of data formation, Somalia is trying to improve scientific data and information accessibility through project and research program. Burundi reported about “*Insufficient climate data due to outdated facilities*” (p.11) and is still on the preliminary stage of data collection on vulnerability assessment. The country considered lack of scientific personnel and limited skill to run scientific program, project or research are main reasons for the shortage of data source.

Box 3

Overall, very high number of NDCs have no information about climate change data source or their availability. However, NDCs with high level of vertical integration have better values on scale regarding data availability than moderate ones which indicates positive but not strong correlation between these two variables

4.5.2. Adaptations actions for the poor and vulnerable group as well as the integration of local knowledge in NDCs

Adaptation strategies aiming poor and vulnerable is an essential part of climate response which also prioritizes in the National Communication guided by UNFCCC to reduce the vulnerability of different group. But, NDCs displayed very insignificant information regarding this issue. One in every four NDCs has information regarding poor and most of them are from low income and highly vulnerable countries. Countries that indicated actions and strategies for destitute and vulnerable mainly followed community-based approach with the assimilation of local knowledge in adaptation actions.

As adaptation strategies are mainly based on local context, integration of local knowledge enhances an additional significance to climate change adaptation actions and policy. Therefore, local or indigenous knowledge practiced by local community play important role in emergency survival, adapting with changing condition or strengthens resilience. Besides, there is a strong recommendation from UNFCCC to include local knowledge in the national adaptation plan,

reframe or improve existing techniques to amplify effectiveness. However, less than one third (15) NDCs stated about the inclusion of indigenous knowledge in adaptation actions but no details available on the fact. Among this fifteen NDCs, six are from cluster A which means one in every two of highly integrated NDCs were responsive to integrating local knowledge. India for example pointed out *“The indigenous locally appropriate knowledge and technology may also be used for the purpose”* (p.24) while Sri Lanka cited as *“it is vital that local technology is prioritized, used when available and promoted for use and supported for development, and used in implementation of the NDCs in Sri Lanka”* (p.25). Both the statement lacks specific evidence, sectors or techniques that will be used or improved. Lao PDR reported about ‘maximizing the use of indigenous climate resilient knowledge’ to conserve agricultural soil, secure animal health, and control diseases, improve long-term feed storage, introduce climate resilient crops and cropping system. The focus of Burkina Faso in integrating local knowledge is mainly rural-based than urban for sustainable production system whereas Ghana is more interested about adopting *“climate change informed health information system including traditional knowledge on health risk management”* (p.15)

Out of 38 moderately integrated NDCs only 9 NDCs informed about relevant data about the integration of local knowledge and most of them are unclear about ‘what knowledge’ for ‘which sector’ and ‘how to integrate’ the fact. For instance, Argentina cited about the ‘identification of good practices and tools’ for adaptation. But there is no suggestion for ‘which sector’ or ‘what kind of knowledge’ will be considered. Even though, Peru encourages only the contribution of ‘indigenous organization in climate actions’ and here also, it is ambiguous to ‘what kind of climate actions’, with ‘what knowledge’ and ‘what purpose’. However, Belize, Solomon Island, and Somalia are interested in community-based adaptation actions and better than other NDCs of cluster B in defining actions of local people. Though Belize’s attention is limited to ‘community-based approach for environmental education’ to increase public awareness, Solomon Island and Somalia have suggested for involving vulnerable communities in risk mapping, adaptation planning, and design, prioritized the resilience measures with the local knowledge and include them in the management system.

On the other hand, countries like Niger, Tunisia, Sudan, Namibia, Mozambique, Uganda etc. have vulnerable communities and local practices to adjust with the changing climate. Yet, there is no information regarding community-based approach or integration of local knowledge in climate change adaptation actions, strategies or plans of NDCs.

Box 4

Very few NDCs have information on actions regarding poor and vulnerable group. Correspondingly, the issue of incorporating local knowledge in adaptation actions was not clearly addressed in most of the NDCs.

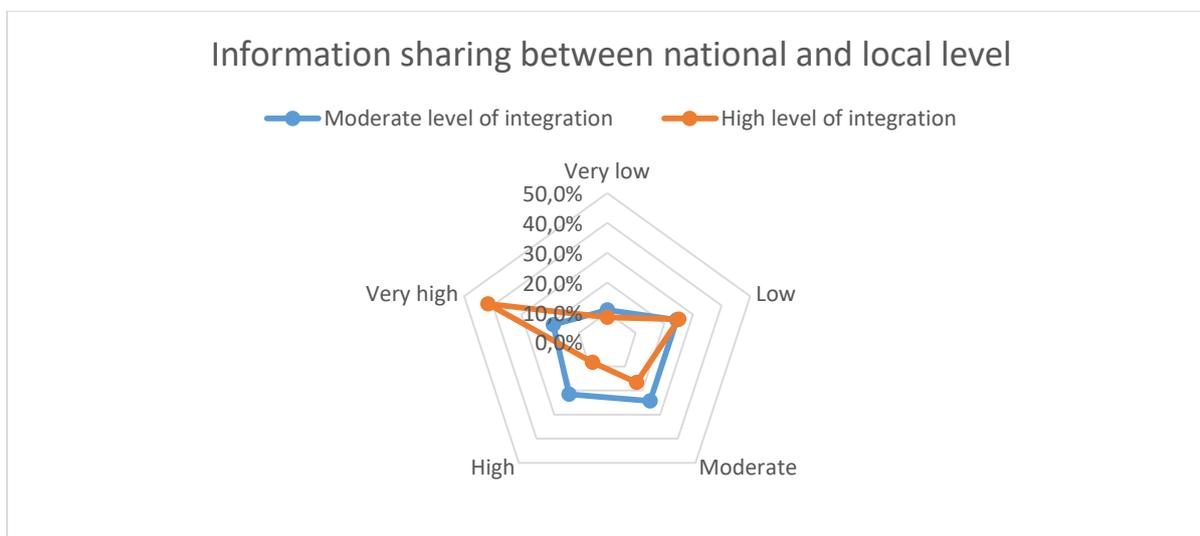
4.5.3. Vertical integration and information sharing between national and sub-national level

For effective climate change governance, it is essential to have information, but the more significant fact is to share those data or information for activating functions and activities in different levels. The analysis reveals that the information sharing is very high (41.7%) in cluster A which is below 20% for moderately integrated NDCs (Figure 16). Almost one in every two of highly integrated NDCs have very high data profile on information sharing while it is one in every five for moderate level of vertical integration (Figure 23, Annex 1). Moreover, one-fifth portion of cluster B shows a high level of information sharing in the scale. In fact, there

is an almost similar number of high, moderate and low level of information sharing for moderate level of vertical integration (Figure 16) which fluctuated for highly integrated countries. Paraguay, the only member of cluster C NDC that does not have any evidence on information sharing.

To identify and assess the level of information sharing is very difficult through analyzing text. Therefore, the scale (1 to 5 detail in methodology and Annex 2) recognized some criteria and key elements which helped to reflect the condition and differentiate the level of information sharing. The NDCs which have a very high level of information sharing, Armenia is one of them. The country reported about ‘open and accessible information system’, ‘introduction of national and international MRV system’ which will be ensured through a participatory process. Moreover, inter-sectoral coordination will be supported by conventions and treaties. For secure information sharing and exchange experience, NDC proposed to form an internal network (ArmCTCN) within the country by following the same mechanism of "Climate Technology Centre and Network" (CTCN).

Figure 16: Information sharing between national and local level with different level of vertical integration

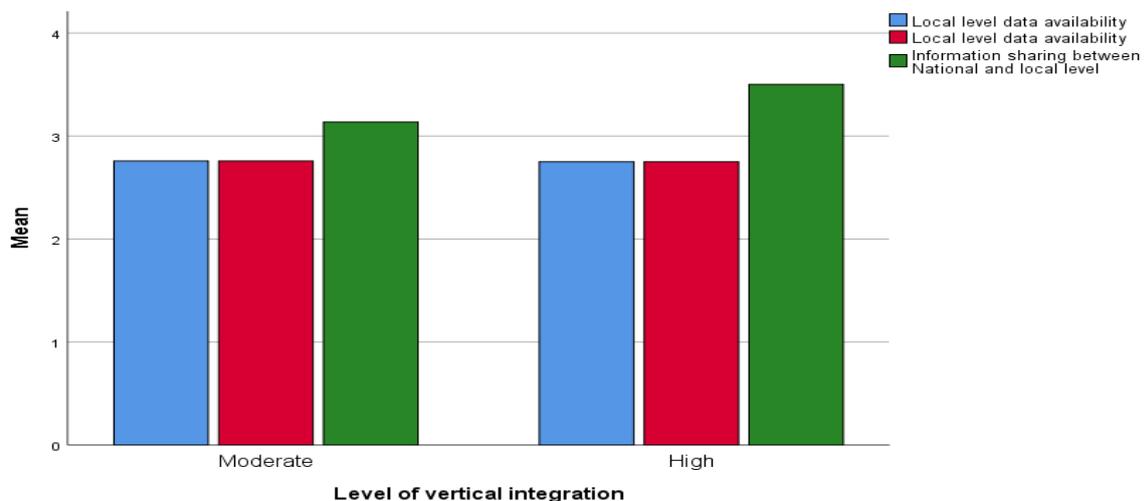


In the same way, “a network of 127 institutions called “INCCA” (Indian Network on Climate Change Assessment) has been set up to share knowledge and work in a collaborative manner on climate change issues” (p.26) by India. For vulnerable region (e.g. Himalayan region), Department of Science and Technology introduced Climate Change Centres which will gather data and ensure circulation of information to take necessary steps. Furthermore, Burkina Faso offers a good example of the very high level of information sharing. The NDC stated that a ‘Technical Adaptation Cell’ will be responsible to coordinate and follow up the outcome of scientific research, technological innovation, evaluation of development projects within the staff of various ministries. “The project evaluation actors are external and will come from the technical and financial partners of the projects to be implemented. These evaluations will take place annually or at given intervals and, at certain stages in the implementation of the projects, will consider the work of the independent evaluators” (p.34). Here, the transparency and accountability of information get higher acceptance both internally and externally as actors are involved from the outside and even from development partners.

While these countries have strong institutional support to disseminate information into various levels, some have started the process of strengthening the information system like Argentina

which is on the scale of ‘high’ level of information sharing. Argentina is on the way of developing “*a virtual platform to visualize climate risk a step between the diagnosis and the decision-making process*” (p.7). The country has already performed sectorial studies to generate climate information, research on vulnerability, climate change impact, and adaptations that will provide the basis for planning and implementation of policies at local, provincial and national level. Similarly, Cuba established ‘thematic networks’ for enhancing “database on scientific and technological services such as meteorological, hydrological, seismological, geodetic, oceanographic, radiological, health” (p.7) and disseminate them for actions in the local level. Mexico, Madagascar, Somalia, Sudan, Niger, Uganda, Zambia are some of the countries without a well-established information sharing system but are planning to do it with a quite clear process.

Figure 17: Comparative data on overall information (Data availability and information sharing)



Contrary, Burundi, Brunei, Cost Arica, Kuwait, Nauru Namibia, Mozambique, Solomon Island are few names among the countries which have moderate scale due to not having a formal process, platform, individual institution or network to distribute information. The responsibilities for sharing information goes to the staff of the ministry or environmental department through arranging advocacy, workshop, training etc. Namibia, for example, has a climate change unit under the Directorate of Environmental Affairs to coordinate climate change activities. For low and very low-level information sharing NDCs, there are margins in information distribution which are limited to training only ministerial staffs, awareness building, including climate change information in education curricula or project implementation for the specified vulnerable group. Few NDCs also mentioned about the limitations directly such as Solomon Island, “*Adaptation knowledge sharing, coordination and collaboration among ministries as well as with non-governmental organizations (NGOs), the private sector, faith-based organizations and development partners is less than adequate in the Solomon Islands*” (p.13).

From the above figure (Figure 17), it is clear that in terms of data source or availability, there is a minor difference between the moderate and high level of vertical integration. The mean in both categories is less than three which denotes the low level of data accessibility for most of the countries which discussed in detail earlier. On the contrary, there is a significant difference in information sharing between national and local level in two clusters and that is much strong in highly integrated NDCs. Having reliable data source is essential but it is more crucial to distribute the data at all levels properly to direct actions actively and effectively. Interestingly,

most countries with high vulnerability despite having poor income, are more concern and clear about the data sharing process and management in both clusters. The reasons may be the climate change risks and high vulnerability, the frequency of disasters, current loss and damages by climate hazards and having more poor, vulnerable community to suffer in these circumstances.

Box 5

There is very strong relation between level of vertical integration and information sharing as highly integrated NDCs have greater values than moderately integrated NDCs.

4.6. Institutional arrangement and vertical integration of urban adaptations

Institutional structure is the most significant part of the governance system as it decides the process and outcome of the actions. Active participation of actors, strong collaboration between institution and actors at the national and sub-national level, well-established framework to guide actions, existing law, act to support implementation etc. are some of the prerequisites of robust institutional arrangement and effective implication of policy.

4.6.1. Participation of actors

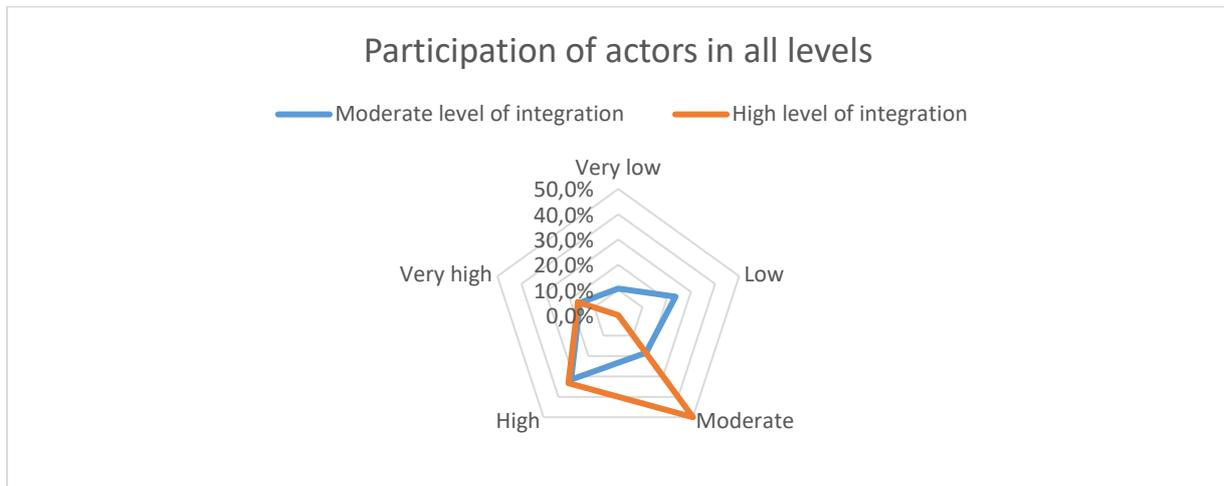
As a part of the institutional structure, the participation of actors within government and outside the government ensure transparency, accountability, equality and often effectiveness of policy, actions or strategies. Indeed, it paves the way for better collaboration between national and local level actions. The present analysis reveals that almost all NDCs considered the participation of actors from different levels in formulating policy, strategies and action plan but some NDCs were very explicit about expressing the actors' type while others were not. Figure (18) on participation depicts that half of the NDCs with strong urban content have moderate level of actors' participation which is below 20% for cluster B. With slightly higher percentage than moderately integrated NDCs, nearly one third portion belongs to high level of participation for cluster A. For both clusters very few NDCs (below 20%) mentioned very high level participation of actors.

Burkina Faso, NDC with strong urban content expressed explicitly about the participation of actors in the planning process. In the economic framework of 'outlook Burkina 2025' stated about keeping sustainability at the centre of public actions with involving government and *"non-state actors (technological and financial partners, civil society organisations, non-governmental organisations and the private sector) in a socioeconomic development drive that generates growth and fairly distributes revenues in the medium and long-term in climatically high-vulnerability sectors such as those identified in National Communication 2"* (p.2). Furthermore, national experts from civil society, private and public sector contributed through a consultation workshop to prioritize climate actions. Strategies with more than 50% positive response from most of the stakeholders have been included in the priority list. All the process indicates very strong participation of the actors.

Lao PDR, though not very obvious with the process but exposed quite detail about stakeholders who participated in the consultation process for deciding actions and strategies. For example, actors from *"line ministries, research institutions, civil organizations, provincial governments, private sector and international development partners"* (p.7). Likewise, Mexico consulted with stakeholders from government institutes, academia, legislatures of private, NGOs and economic sectors by arranging workshop and discussion at national level. Moreover, few countries with upper-middle and high income such as Jamaica, Barbados, Cost Arica, Chile,

Belize have better participation despite being moderately integrated which is maybe for their financial capacity and concern to ensure it.

Figure 18: Participation of actors within vertical integration level



On the other hand, NDCs with a moderate level of stakeholders’ participation was equivocal with a wide range of actors and limited to government actors, few private sectors, and vulnerable people or community. Brunei, Ghana, Niger, Kenya, Namibia, Uganda, UAE are few names of medium level participation. Countries of lower and lower middle income like Gabon, Djibouti, Burundi, Papua NG, Dominican R, Congo, Egypt, Madagascar, Tunisia etc. of cluster B have limited involvement (low or very low) of actors due to lack of resources and comprehension to ensure participation.

Box 6

Overall, participation level mentioned in NDCs were not ‘highly satisfactory’ though data regarding participation of actors are better and more explicit in highly integrated NDCs. It indicates positive and strong correlation between level of vertical integration and participation

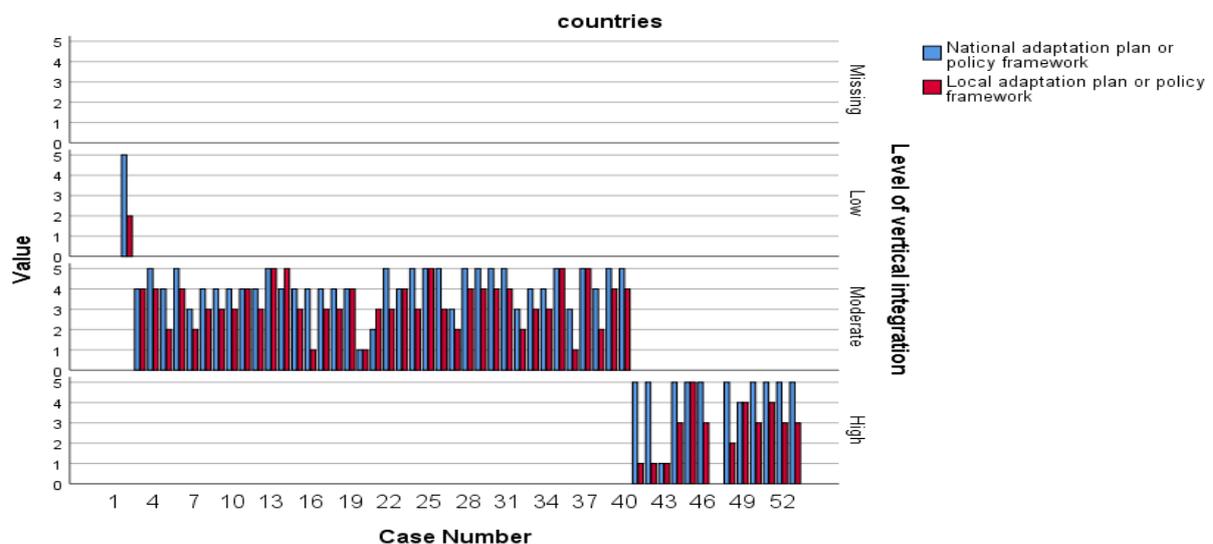
4.6.2. National and local adaptation policy, plan or framework of NDCs

Adaptation policy, plan or framework act as a guideline to put actions on the right track and assess the outcomes. In recent decades, most of the countries started to adopt adaptation policy/plan or framework at the national level and some countries at the local level also as the concern on adaptation increased. The present analysis reveals that most of the countries of high level of vertical integration have committed adaptation issues through national adaptation plan, actions, climate change policy or as part of environmental apprehension. As outlined in the scale (see Annex 2) very high level includes National Adaptation Plans (NAP) and National Adaptation Program of Actions (NAPA) or other integrated adaptation policy framework. Out of 13, 10 NDCs of cluster A embrace ‘very high’ level profile for national level adaptation plan which is less than half (15 out of 38) for cluster B. Most of the countries from moderate urban content showed high-level status on having national adaptation action plan or framework (Figure 19).

Few countries with strong urban content (e.g. Bhutan, India, Srilanka, Burkina Faso, Togo) already prepared or on the way to finalize NAPs. NAP was established in ‘Cancun Adaptation

Framework' (CAF)¹⁸ under UNFCCC in February 2017 to assist parties in formulating medium and long-term adaptation needs, developing and executing actions, strategies through a participatory process. Contrary, NAPA was established as a part of Least Developed Countries' (LDC) work program according to the convention of UNFCCC¹⁹ (article 4.9) in the COP, in 2001 to address challenges of climate change vulnerability. Therefore, most of the low income and climate vulnerable countries until present are attempting to incorporate NAPA at the national level to emphasis adaptation strategies. Alternatively, very few NDCs (e.g. Tanzania) stated about considering climate change strategy with elaborate actions on mitigation and adaptation together which denotes its status as medium scale. There is no specific information regarding adaptation plan or framework in the NDC of Bahrain but mentioned about considering climate change issues as a part of 'Economic vision 2030' which represents 'very low' status in the scaling criteria.

Figure 19: National and local adaption policy, plan or framework with vertical integration level



However, particular NDCs mentioned about separate adaptation action plan at the local level. India for instance, is one of those highly integrated countries which is preparing local action plan as cited in NDC "All the 29 states and 7 Union Territories in India are preparing a State level action plan to deal with the challenges of climate change incorporating local needs and priorities." (p.25). In the same way, Vietnam is constructing an action plan at 'national, ministerial, sectoral and local levels' in response to climate change effects, to mitigate or prevent disaster risks. Almost One in every eight NDCs of cluster B discussed mainstreaming actions in the social and economic sector (e.g. Madagascar), sectoral risk plans, local emergency (e.g. Uruguay) and contingency plan. Still, in most of the cases, local actions are guided by national plan or integrating risks plans or sectoral plans at the sub-national level. Generally, lower-income countries like Bhutan, Burkina Faso, Tanzania, Tunisia, Niger, Uganda etc.) cannot make separate action plan due to resource constraints (budget, human capital or skilled personnel) in spite of having high necessity.

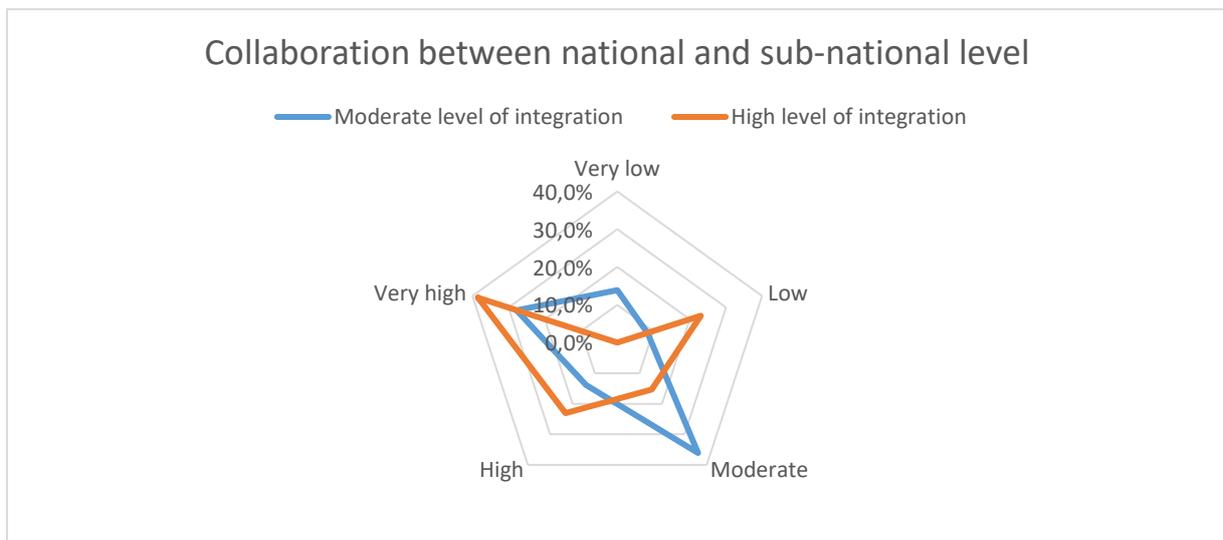
Box 7

Overall status on national level adaptation plan or framework is better than other factors and it is very strongly correlated with vertical integration level as almost all the NDCs from cluster A have the framework which is one in every three for cluster B. Yet, very few countries from both clusters have clear and separate action plan at local level.

4.6.3. Collaboration between national and sub-national level and vertical integration of urban adaptations

Collaboration in the form of cooperation, coordination is a fundamental condition of the good governance system. Very often it is observed that lack of collaboration in a different level of government can be the only reason for the failure of any policy or actions. To maintain actions effectively there are needs of allocation of ‘regulatory responsibilities’ at the national and sub-national level, balance and enhance capacities of actors, staffs and guide co-ordination mechanism between different levels (OECD, 2010)²⁰ within timetable and action framework.

Figure 20: Collaboration between national and sub-national level with vertical integration level



In the NDCs of countries, it is observed that collaboration is better in cluster A than cluster B which also explains the findings on information sharing and participation of actors. Indeed, effective collaboration determined by smooth information flow and active participation of wide range of actors which was better in cluster A (see relevant sections). Nearly 40% or one in every three have very high collaboration from national to the local level in strong urban content NDCs which is less than 30% for cluster B (Figure 20). However, data indicates a moderate level of collaboration is dominant for cluster B with few cases in low and very low scale.

The NDC of Bangladesh expressed high collaboration by following a process and a formal body to manage functions of climate change. As it stated *"INDC implementation will be taken forward by existing governance arrangements under the BCCSAP, with coordination being managed by the climate change secretariat in the Ministry of Environment and Forests, reporting to the Advisory Committee and the National Environment Committee (chaired by the Prime Minister). Specific implementation activities will be carried out by the appropriate line ministries and agencies with fiscal support under the fiscal framework of the Government. A comprehensive and robust INDC implementation framework will be developed in line with the existing CFF and other climate change related bodies"*(P.13). Recommendations have been made to set out a clear roadmap, fix up the timetable of short, medium and long-term action,

²⁰ <https://www.oecd.org/gov/regulatory-policy/45418514.pdf>

fill up the institutional gap and establish a structure for NDC implementation. Likewise, Lao PDR informed to implement the NDC through cross-ministerial National Disaster Management Committee (NDMC) and work with the cooperation of the Ministry of Natural Resources and Environment (MoNRE). MoNRE will act as secretariat body and circulate the relevant information, action plan, responsibilities to all related central ministries, line agencies at the local level.

Contrary, NDCs with moderate scale do not have the formal body to collaborate actions, and strategies but through inter-institutional coordination, or inter-sectoral coordination (Armenia) planning, management of activities on adaptation are directed. Sometimes, a multidisciplinary support team (e.g. Argentina) are formulated to support ongoing initiatives. Argentina, Brazil, Jamaica, Mexico, Uruguay, Cuba, Liberia, Namibia, Niger, Uganda, Sudan from cluster B have a moderate degree of collaboration. The collaboration status is low or very low when the alliance is performed separately with only ministries and line agencies without involving other relevant institution and face limitation during the implementation of actions. Fragile institutional structure, lack of legislation may also cause wispy coordination. Evidence can be found from NDC of Mozambique, “*Weak coordination and charge of the sectors in the implementation of the approved policies, strategies and plans, due to a low ability to verify and enforce the laws and regulations associated to a weak capacity to cross-sectoral and integrated planning* (p.7). Hence, limited collaboration or shortage of coordination not only impede governance structure but also restraints vertical integration of adaptation actions.

Box 8

NDCs of cluster A confirms very high collaboration than cluster B which means vertical integration of urban adaptations and collaboration between national and sub-national level have positive and strong correlation.

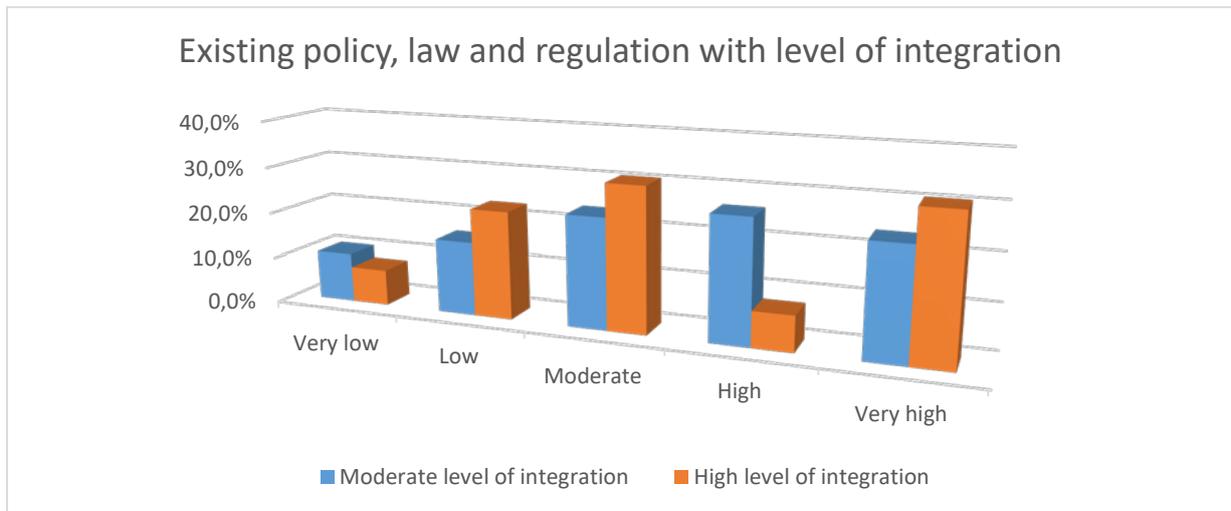
4.6.4. Existing policy, law, regulations and vertical integration of urban adaptations

The indicator has been measured by the comparative degree of explicit information of NDCs’ regarding existing policy, law and regulations on climate change. Policy, law, and regulations are very imperative and interlinked with other factors of the governance system. As the evidence cited in the previous section, weak law, regulations or enforcement caused weak coordination or collaboration of climate actions in Mozambique. The legislation supports the institution to implement actions in the field securely and effectively. Therefore, countries with good legislation profile get the benefit of integrated actions vertically. Following figure (21) represents that most of the NDCs with strong urban content have an equal figure (30.8%) for moderate and very high scale in explaining law or act which is higher than moderately integrated NDCs. Remarkably, there is also an equal (23.7%) distribution of NDCs in medium and very high scale for cluster B. However, one in every three NDCs of cluster A is very explicit about existing policies and laws which is almost one in every five for cluster B.

Lao PDR with strong urban content is very explicit in mentioning existing policy, law and act to support NDC actions. The country aimed to establish a regulatory framework to continue “*development and promulgation of the Climate Change and Disaster Law, which is expected to be in 2017. This law will be a continuum for earlier achievements on climate change policies and plans such as the Environmental Protection Law, Revised Urban Planning Law, Strategic*

Plan on Disaster Management 2020 (2003) and the National Strategy on Climate Change (2010)” (p.7). The country also incorporated NDC in the ‘8th National socio-economic development plan’ with the aim of mainstreaming climate policy. Correspondingly, Uruguay mentioned the policy, law, and acts which is also aligned internationally with the United Nations Framework Convention on climate change. The NDC cited in detail about existing policy and laws- ‘Law on Environmental Protection, No. 17.283; the National Climate Change Policy; Use and Conservation of Soils and Superficial Waters destined to agriculture ends, Law No. 15.939; the Forestry Fund – Natural resources, Law No. 17.234; the creation and management of National Protected Areas System, Law No. 18.610; the National Water Policy; Law No. 18.195’ are just few of them.

Figure 21: Existing policy, law, regulations with the vertical level of integration



Nevertheless, the NDCs which reported about national climate change policy, law by specifying priority or vulnerable sector belong to the high scale. Sudan, for example, developed climate change-related policy nationally which involve Agriculture Revival Program (ARP) of 2008-2011, The Forest Policy, 2006, National Resource Management policy with clear guidance to facilitate local rehabilitation. Though the NDC did not mention the act and law directly, proxy data indicates these policies are supported by law. Alternatively, few NDCs referred mitigation and adaptation together such as Mozambique, Madagascar, Namibia, Argentina, Brazil while some other mentioned about environmental laws as a part of development goal, vision without specifying climate change issues like Vietnam. Exceptionally, it is possible for many of the countries to have climate change laws, act or policy but did not mention in the NDCs. As for evidence, the name of Armenia, Ghana can be specified which have environmental laws, climate change policy or act but information is absent in the NDCs.

Box 9

Significant number of NDCs were not explicit about existing policy, law and act to support adaptation actions though NDCs from cluster A have better narration on relevant law, act than cluster B. That means, there is a positive strong correlation between existing law, act and level of vertical integration of urban adaptations

4.7. Level of capacity and vertical integration of urban adaptations

Capability in climate change policy and planning process includes the skill of actors to comprehend vulnerability, expertise to map it, identify probable solutions, actions and act accordingly. Financial capacity enables the institution to invest for strategies, techniques, and technology as well as to develop skilled manpower for analyzing the problem, planning, management and monitoring while technology requires both funding ability and proficient actors. It was very difficult to evaluate capacity level based on these indicators as most of the countries are still in the preliminary stage or ambiguous condition of assessing their capability to implement adaptations regarding NDCs. Thus, indicators have been assessed on explicit information of the NDCs concerning these issues.

4.7.1. The skill of actors (vulnerability mapping, expertise in projections, model making etc., professional training) in response to climate change

Overall, minor difference has been observed from the available information in the skill of actors between highly and moderately integrated NDCs. Though the NDCs mentioned about initiatives to develop human skill, the level of ‘existing capacity’ has not clearly acknowledged by specifying ‘what already have’ and ‘what needs to develop’ in the coming future. Most of the NDCs (23 NDCs) stated that moderate level skill for the actors in both clusters while significant numbers have low or very low-level capacity and there is no information for Paraguay, cluster C.

Few NDCs expressed unequivocally about existing capability and actions that will be initiated to develop it. Some countries focused on training, scientific and technological research to improve skill. For instance, the government of India is currently implementing a National Training Policy naming ‘Skill India’ with the target to train 400 million people from different sectors by 2022 for sustainable development. The country is also looking for alternative energy solution through new scientific research and advanced technology on wind energy, waste to energy, in coastal areas. Uruguay has the hazard maps of different threats such as fire, floods by now which helped to create departmental, interdepartmental and sectoral risk plans, local emergency and contingency plan. By 2020, the country aimed to have trained people from different level as stated in NDC *“To have, by 2020, a Climate Change and Health Training Program for the staff working in the health care sector. Ongoing training on climate change and climate risk management for decision-makers and the general population by 2020. An increasing number of actors, managers, communicators, and institutional, political, productive, and social decision-makers have received training in the past few years and should continue to do so in the future”* (p.18-22).

Many low and lower-middle countries with high vulnerability and medium capacity level (mainly from Asia and Africa) reported about the limitation of capacity for measuring vulnerability, disaster loss and damage, use of technological knowledge. In skill development initiatives professional training, improving early warning, vulnerability mapping, enhance research, technical knowledge development, environmental education and awareness building program are commonly found. For example, Tanzania, Mozambique, Madagascar, Kenya, Uganda, Niger, Zambia are focusing on early warning, awareness, and education, assessing microclimate conditions and vulnerability. While Armenia provides attention for professional training and education at a regional and international level on climate change related issues, Bangladesh is more interested in research and knowledge management, improving local-level knowledge as well as enhance capacity at individual and institutional level through training program and projects. Yet, Bhutan is planning for integrated risk monitoring and early

monitoring for hydrometeorological extreme events, assessment on dangerous glacial lakes, flood forecasting in temporal and spatial scale as well as enhance capacity through research, education, and awareness.

Though Cuba, Brazil, Barbados, Jamaica, Chile, Mexico countries with upper level and high-level income are intended to vulnerability and disaster risk assessment, increase capacity for monitoring, but many of them lack details on ‘how’ to achieve that. The NDCs with low and very low capacity are not exceptions to this information lacking. However, it is not surprising that most of the lower income countries’ skill development program is limited to low-cost vulnerability assessment, training, awareness program, early warning system, as they have a financial barrier for a giant project or technology-based initiatives.

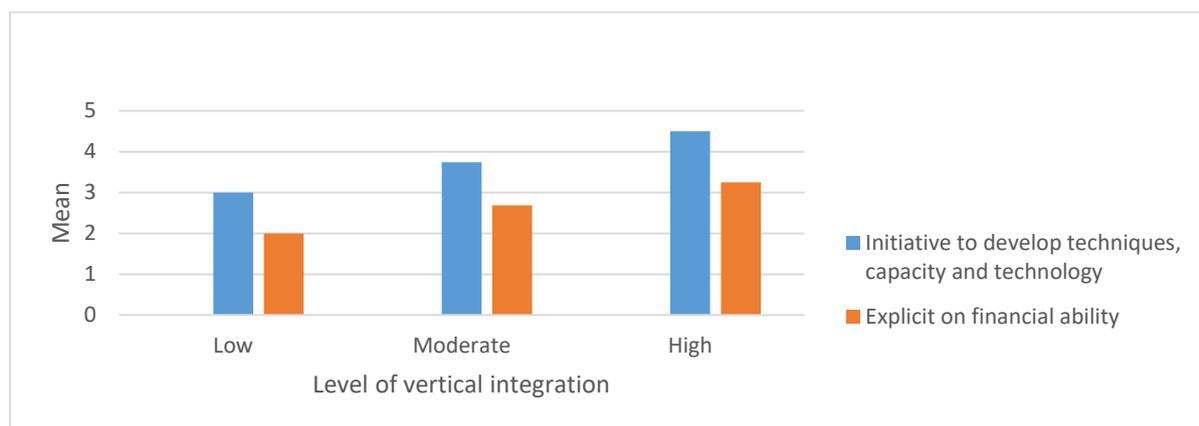
Box 10

There is huge information gap in expressing about skill of actors as most of the NDCs from all clusters lack evident information on the issue. Consequently, skill of actors and vertical integration level did not display any significant correlation.

4.7.2. Initiatives in response to adaptations (to develop capacity, techniques, and technology) and financial ability in different levels of vertical integration)

Initiatives in response to climate change adaptation and financial ability expressed in NDCs both indicates countries of cluster A have more detail and clear information than cluster B and C. Though, the mean value for the information on financial ability indicates (Figure 22) moderate or less than that for all NDCs. Almost 70% (9 out of 13) NDCs with strong urban content, very highly specified actions related to capacity building (both human and infrastructural) and technology transfer which is less than half (31.6%, 12 out of 38) for cluster B (Figure 24 & 25, Annex 1). One in every four has moderate scale information regarding initiatives for highly integrated NDCs (Figure 24).

Figure 22: Initiatives in response to adaptations with different level of vertical integration



The actions, strategies listed in NDCs have been proposed according to country’s vulnerability, priority sector and utmost actions are based on agriculture, water, forestry, energy, wildlife, infrastructure, and health. Bangladesh and India for example, highlighted actions on urban resilience through improving transport system (underground metro and rapid transit system, elevated high ways Smart city project of India), urban housing and waste management (recycling, reuse), maintain drainage system and reduce urban flooding. The focus is different

for Bhutan that involves Integrated Water Resource Management, promote climate resilient agriculture, reduce climate-related health risk, sustainable forest management and biodiversity conservation.

Low-income countries like Uganda, Sudan, Niger, Djibouti, Somalia which have a sensitivity to drought, have concentrated on low-cost adaptations namely, forest conservation, reforestation or afforestation actions. Such actions also have synergies to mitigation as forest considered as a carbon sink. Contrary, better income enhance capacity level, the evidence are found in NDCs of Barbados, Jamaica. As Jamaica interested about “*investment in the installation and maintenance of automatic weather stations at strategic locations across the island. This includes training in the skill set to keep the stations operational*” (p.7).

Nevertheless, international cooperation with regional, developed countries and support of development partners also influence the inclusion of actions or prioritize strategies. As Barbados has a number of ongoing projects with development partners, included actions related to project in adaptations actions of NDCs. Piloting CCA to protect human health project, water and sanitation system upgradation (Global Project by WHO/UNDP & GEF funded)’ are two priority actions of Barbados. Though all NDCs do not have information on existing international cooperation, Armenia, Bangladesh, India, Lao PDR, Saudi Arabia, Brazil, Egypt, Uruguay, Peru, Brunei, Niger, Somalia, Djibouti, Uganda are some of the countries those mentioned about projects with the support of development partners, other countries and expecting international cooperation in implementing NDCs’ adaptation actions.

Box 11

Vertical integration level and initiatives in response to adaptations are strongly correlated as most of the NDCs from cluster A have explicit information on capacity building, technology transfer which is less than half for cluster B. However, there is lack of information in all clusters on existing international cooperation for project implementation.

Almost all NDCs remarked adaptations actions as conditional which demand international support for successful accomplishment. Supports mainly require for funding projects, technology transfer, information sharing, skill development or capacity building. Without few exceptions, most NDCs did not specify their needs for ‘which actions’, ‘what type’ of help are required and in ‘what level/degree’. The condition is more ambiguous in terms of funding as the highest number of NDCs lack information on the domestic capability of raising fund and amount need from outside. One in every four NDCs from high level of vertical integration was very explicit about funding ability which is very low for cluster B and C. (Figure 24, Annex 1). Out of 38, only 1 NDC (Zambia) particularized its internal funding source and requirement from outside. Cost Arica, Argentina, Uruguay, Brunei, Qatar, UAE, Gabon, Sudan, Tunisia, Uganda, Paraguay are examples from cluster B and C which were implicit in expressing the needs. In contrast, NDC of Ghana as highly integrated NDC pointed out financial necessities as “*These 31 programmed of actions will drive the strategic focus of a “10-year post-2020 enhanced climate action plan” that would be developed after Paris. In the 10-year period, Ghana needs USD 22.6 billion in investments from domestic and international public and private sources to finance these actions. USD 6.3 billion is expected to be mobilized from domestic sources whereas the USD 16.3 billion will come from international support*” (p.3). While Ghana clearly identified the amount of money required, Burkina Faso ascertained the source of funding such as Green Climate Fund (GCF) (external) and Environmental Action Fund created by government (internal).

Being more advanced in expressing financial ability, Bangladesh informed in detail about domestic fund availability and estimated cost for all adaptation actions. NDC referred to ‘Bangladesh Climate Change Trust Fund (BCCTF)’ from the Government’s domestic budget and the ‘Bangladesh Climate Change Resilient Fund (BCCRF)’ with the support of development partners. The government has distributed approximately \$ 400 million to Bangladesh Climate Change Trust Fund (BCCTF) and by 2015 funded more than 236 projects for adaptation actions. It has been estimated that the country will need to invest \$40 billion from 2015 to 2030 for implementing plans which also identified clearly in the NDC. Correspondingly, NDC of Guinea has notified internal funding capacity and supports need from outside with all the proposed actions. In fact, the country is running a project on Mano River conservation which is co-funded by GCF and expecting future support for other adaptation actions.

All these countries mentioned above with detail information on need assessment and funding ability are from a high level of vertical integration which also supports the quantitative findings (figure 22). High-income countries demand supports for technology transfer and capacity building rather than financial help. Saudi Arabia, for example, stated, “*the implementation of Saudi Arabia’s INDC is not contingent on receiving international financial support, but the Kingdom of Saudi Arabia sees an important role for technology cooperation and transfer as well as capacity building for INDC implementation*” (p.5).

Box 12

Few countries with high level of vertical integration have detail information while other lack specific and unambiguous data to assess financial capacity and need. Therefore, vertical integration level and explicit information on financial ability are positively correlated but the relation is not strong.

Indeed, highly integrated NDCs have better performance in governance factors than the moderate or low level of vertical integration which has been discussed in the earlier sections with the support of quantitative scale and qualitative evidence from the text of the NDCs. Hence, there is a clear and positive correlation between governance system and vertical integration level of urban adaptations. As a context, Poor income and resource limitation often shape governance structure negatively. The research also reveals that due to weakness in governance issues, despite having high urbanization rate and vulnerability score, countries (for example, Niger, Uganda, Zambia) belong to the moderate level of vertical integration. Interestingly, it is also plausible to think that high vulnerability and urbanization rate distress governance system to operate smoothly which open-up scope for further in-depth investigation on this part of the current research base.

Chapter 5: Conclusions and recommendations

5.1. Conclusion

Climate change effects have generated worldwide concern in the last few decades. With many other efforts, it is expected that NDCs will produce more effective and fruitful outcomes to tackle climate change challenges at local, national and global scale. Urban adaptations in climate change policy actions are the latest addition for many of the countries. As it is not a straightforward or easy task to determine appropriate, cost-effective adaptation strategies on local context, countries are still in the dilemma of prioritizing strategies. The difficulties coupled with financial inadequacy, limited human skill, and weakness in the governance system. However, the qualitative and quantitative evidence of the present research assists to come up with few new concepts or theories in the academic field regarding vertical integration of urban adaptations which can conclude as follows

5.1.1. High level of vertical integration requires sector specific, unambiguous urban adaptation actions

The analysis based on urban content of NDCs, reveals that strong urban content has sector-specific actions such as improvement of transport network and infrastructural development, waste management through conversion of waste to energy, recycling, alternative energy use, urban housing development, reduction of urban disaster especially flood, improve drainage pattern and so on. For moderate urban content, attention is more on vulnerability assessment, risk management, settlement improvement (without specification), afforestation, early warning and monitoring particularly in low-income countries. As these are the first NDCs for all countries and still there are some doubts and difficulties in deciding actions, it is possible to get urban relevant sectoral strategies, actions without specific urban reference.

5.1.2. Income level, urbanization rate and vulnerability highly influence each other and level of vertical integration of urban adaptations

Vertical incorporation of urban adaptations is highly influenced by income level, urbanization rate, and vulnerability level. However, these three contextual factors are also strongly correlated to each other as lower income level and high urbanization rate intensify climate change vulnerability of a country. Statistical analysis indicates that there is inverse linear (-0.815) correlation between vulnerability score and income level as lower income aligned with higher vulnerability. Evaluation of NDCs also supports this quantitative correlation as most of the low and lower-income countries showed 0.5 to 0.6 or more than that climate change vulnerability score. Indeed, poverty, overpopulation, unemployment, living in risky and hazardous areas, illiteracy, shortage of skill, fragile and inadequate infrastructure, lack of technology and technological knowledge all fit together to generate vulnerability of climate change. Nevertheless, the circumstances reinforced by rapid and unplanned urbanization, particularly in low and middle-income countries. The study reveals that urbanization rate and vulnerability also confirm a positive linear correlation (0.789) at a significant level. Due to the economic transition of developing countries, jobless, homeless people migrate towards the city in search of income source and better life which create pressure on prevailing urban system and services. Urban transport, housing, water, and energy supply, waste management and environment are stressed out with an overcrowded population which is also responsible for mounting climate change vulnerability. Therefore, countries with high urbanization rate and vulnerability embrace more adaptations actions to adjust to changing circumstances and reduce susceptibility. The study suggests that countries with low-income level, high rate of urbanization and greater vulnerability score have a high level of vertical integration of urban

adaptations. Among analyzed NDCs, only one in every four have a high level of vertical integration and most of the NDCs are moderately integrated. All the NDCs from cluster A are from low and lower-middle-income countries except Bahrain and Saudi Arabia which belong to high income. Due to lofty income, these two countries have low vulnerability score than others as they are able to manage challenges through better financial capacity.

5.1.3. Income level influence governance system which in turn affects vertical integration of urban adaptations

Interestingly, despite having high level of urbanization rate and vulnerability, many countries from cluster B (Niger, Tanzania, Uganda, Zambia etc.) belongs to the moderate level of vertical integration. The reasons are mainly for the low level of financial, technological capacity, lack of data and expertise on climate change issues which affects the various components of the governance system. The result also depicts that above-mentioned countries have low performance in governance issues particularly in information sharing, participation of actors, collaboration, human skill etc. which are shaped by mainly financial capacity. Hence, the evidence helps to come up with the concept that income level as a contextual factor not only influence vertical integration level but also governance capacity in incorporating urban adaptation actions.

5.1.4 Governance factors highly influence vertical integration level of urban adaptations

Overall, highly integrated NDCs have better performance in governance factors (refer to section 4.5 to 4.7) than moderate level of vertical integration. Some indicators have very strong correlation with vertical integration such as, information sharing between national and sub-national level, participation of actors, collaboration between national and local level, existing adaptation plan or framework, clear and detail information on existing policy, law and act to support actions, explicit initiatives to develop technology and capacity (refer to Box 3 to 12). Some indicators for instance, information sharing, participation of actors and collaboration also influence each other as countries of cluster A showed very good profile in these three factors while cluster B was opposite. Though other indicators did not represent strong correlation but had better values in strong urban content than moderate one. Paraguay lacks information or low score for most of the governance indicators which explains largely about its low level of vertical integration.

To conclude, NDCs are a very potential platform for world leaders to share and exchange information, skill, knowledge, technology, fund and even adaptation experience which will heighten adaptive capacity to reduce climate change vulnerability and enhance resilience both at local and national level. Therefore, it is crucial for countries to identify present capacity, gaps for all sectors and assess to what extent international support will be essential for implementing NDCs.

5.2. Recommendations

During data analysis it was very difficult to identify and assign values to certain governance factors as most of the NDCs lack clear information on data source or availability both at the local and national level, adaptation actions aiming poor and vulnerable group, integration of local knowledge, level of information sharing. Though existing national and local adaptation plan or framework, initiatives and strategies regarding vulnerability and priorities have been addressed by most of NDCs (few exceptions for which proxy data has been used) clearly, how these actions will be supported by legislation remained unclear in many cases. Limited information about the collaboration process, actors' involvement, capacities and gaps in skill

development were unable to answer implement ability and effectiveness of NDCs. Moreover, maximum countries demanded aid for finance, technology transfer, information or data and capacity building but very few NDCs explicitly acknowledged the existing capacity and need in these sectors. As the first submission, NDCs displayed very committed and encouraging efforts from respected countries. It is quite normal to have information lacking, doubts and dilemmas as there was no guidelines or framework to follow and restriction on information consistency. However, the outcomes of the present research provide some recommendations which may offer guidelines (see also Table 7, Annex 2) to construct more strong, clear and effective NDCs for the next review.

5.2.1. General recommendations

- Countries should be clearer and more explicit (with reference to **Box 1**) in indicating sector specific urban adaptation actions in NDCs;
- Indicate urban specific sectoral climate actions, goals to achieve within the time frame of next twenty or thirty years (short, medium and long-term basis);
- NDCs should be precise on vulnerability condition, threats due to urbanization rate and constraints due to income level (with reference to **Box 2**);
- Countries should follow a common and consistent structure to present the data which will help to analyze and compare within ‘common indicators’;
- Present all information relevant to opportunities and challenges unambiguously;
- Clearly refer existing capacities and limitation within the governance system;
- Mention how institutional functions, outcomes of adaptations actions will be monitored, who will be responsible for monitoring and how the expense will be managed;
- Assess consequences of particular adaptation action (positive or negative feedback) and share the knowledge with others in the NDC platform. Bring forward the success stories of adaptations actions

5.2.2. Specific recommendations

- Available data have a high influence on vertical integration (with reference to **Box 3**). Therefore, it is crucial to have clear identification of existing data source (national and local) on climate change, disaster vulnerability, loss and damages (sectoral), hazard or risk zone mapping, future climate change projection. Mention how these data will be gathered and used (information network or form database);
- It is also essential to recognize the channel through which data will be streamed who will be responsible for disseminating data and how (with reference to **Box 5**); how the data will be incorporated in local and national action plan; what action will be taken to improve data source, database or network;
- Identify and classify actions (with reference to **Box 4**) for the poor and vulnerable group with the specification (gender, indigenous people, disable etc.) and address why, how and which local knowledge will be encouraged for practice;
- Clearly and explicitly identify (with reference to **Box 6**) institutional, organizational actors (govt. private), experts, research centers, civil society, communities who will participate, for what actions and how participation from all levels will be ensured;
- Explicitly outline adaptation framework, action plan both for the national and local level (with reference to **Box 7**) and acknowledge how, with what resource and which time frame these action plan will be implemented;
- Existing policy, law and act is highly correlated with vertical integration level (with reference to **Box 9**) which support adaptation actions. Therefore, countries should

acknowledge the prevailing policy, laws, act and identify what new policy or law will be incorporated to fill the gap;

- Unambiguously define collaboration process between the national and local level (with reference to **Box 8**) through which responsible institution, group, committee, actors will be addressed for respected actions. Outline cooperating ministry, line agencies, environmental department or organizations at the local level and identify who will implement the actions in the field and how others will coordinate the work. Recognize the gaps and propose solution/actions to reduce the mismatches relate to collaboration;
- Evidently recognize (with reference to **Box 10**) the skill of the actors in performing actions (CNA or Capacity Need Assessment) including existing capacity in vulnerability mapping, loss and damage assessment, making model or projection on future climate change, ability to use prevailing technology and indicate the gaps where assistance and further development should take place and what way or action (training, workshop, knowledge or technology transfer etc.);
- Explicitly discuss initiatives regarding adaption actions (with reference to **Box 11**) and address the prevailing international cooperation, bilateral project and supports for development or implement NDC's strategies;
- Acknowledge existing financial capacity (with reference to **Box 12**) to implement actions (FNA or Financial Need Assessment). Estimate cost of each action, outline how and from where the fund will be managed. Mention internal /domestic source: budget, pollution tax, raise climate change, social or welfare fund from the bank, industries etc. and estimate the approximate amount of fund. Identify international funding source: Green climate change fund, funding from development partners (world bank, UNDP). Explicitly identify TNA (Technology Need Assessment) to implement actions; existing cooperation with international body/co-project in technology transfer, import or develop the technology.

5.3. Scope for the future research

Relevant to this research, there is still scope for further investigation about what may the other factors of governance that influence vertical integration of urban adaptations. As here income level has been considered an important context which affects governance system and capacity of integrating actions, same way other contextual (particularly other two factors, urbanization rate and vulnerability) and locational variables can be measured for an in-depth understanding of adaptation challenges worldwide.

Although present research is based on adaptations only, mitigation actions can also be very interesting areas of focus. Many NDCs mentioned adaptation and mitigation synergies, co-benefits of some integrated actions. Therefore, one of the potential future research could be the evaluation of opportunities and challenges of integrating such actions, strategies that have co-benefits.

NDCs have been proposed in recent years and still in the planning process of the countries. There are huge scopes to analyze the drivers and barriers of implementing NDCs' actions not only inside the country but also the effectiveness of NDC platform which is promised to share knowledge, capacity, and experience with each other.

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Young O.R. (1996) Institutional linkages in international society: polar perspectives. *Global Governance*, 2, pp. 1–24. Available at <https://www.jstor.org/stable/27800125>. [Accessed on 10-4-2018]

Annex 1:

Table 3: Correlation of vulnerability and urbanization rate

Correlations			
		Vulnerability level	Urbanization rate
Vulnerability level	Pearson Correlation	1	.789**
	Sig. (2-tailed)		.000
	N	51	51
Urbanization rate	Pearson Correlation	.789**	1
	Sig. (2-tailed)	.000	
	N	51	52

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

Table 4: Correlational analysis of income and vulnerability level

Correlations			
		Income level	Vulnerability level
Income level	Pearson Correlation	1	-.815**
	Sig. (2-tailed)		.000
	N	52	51
Vulnerability level	Pearson Correlation	-.815**	1
	Sig. (2-tailed)	.000	
	N	51	51

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

Table 5: Correlational analysis of vertical integration level and vulnerability

Correlations			
		Level of vertical integration	Vulnerability level
Level of vertical integration	Pearson Correlation	1	.103
	Sig. (2-tailed)		.471
	N	52	51
Vulnerability level	Pearson Correlation	.103	1
	Sig. (2-tailed)	.471	
	N	51	51

Figure 23: Data on information sharing within case number

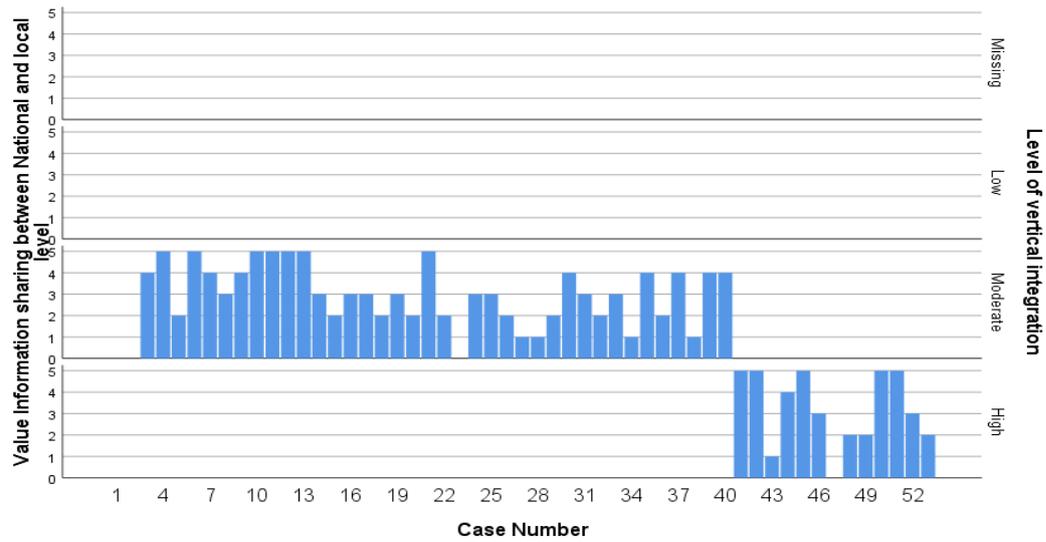


Figure 24: Data of initiatives and explicit information on financial ability within case number

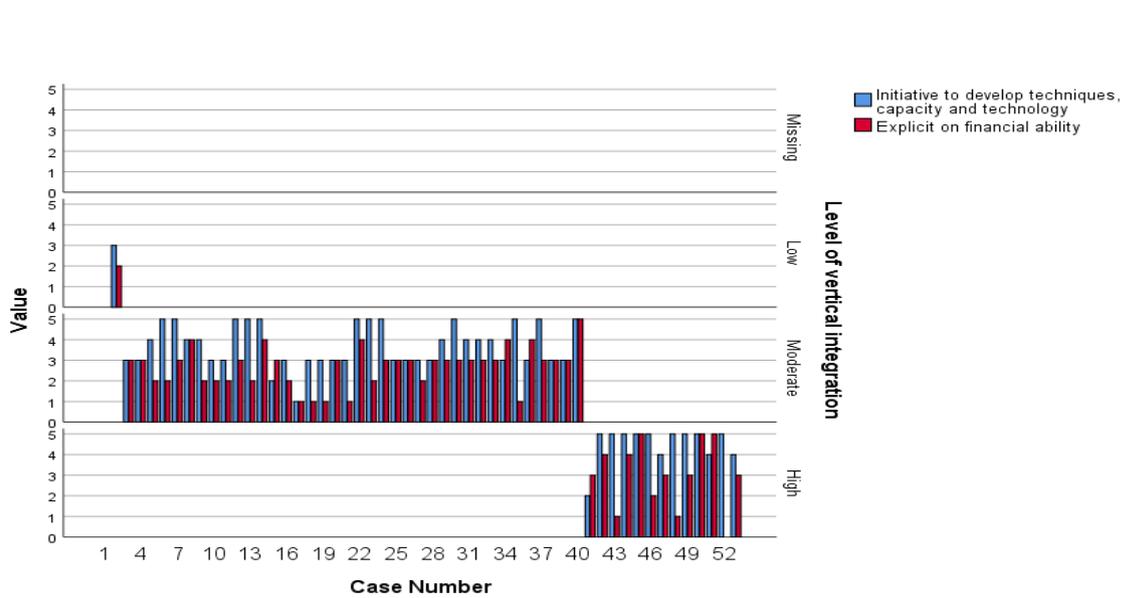
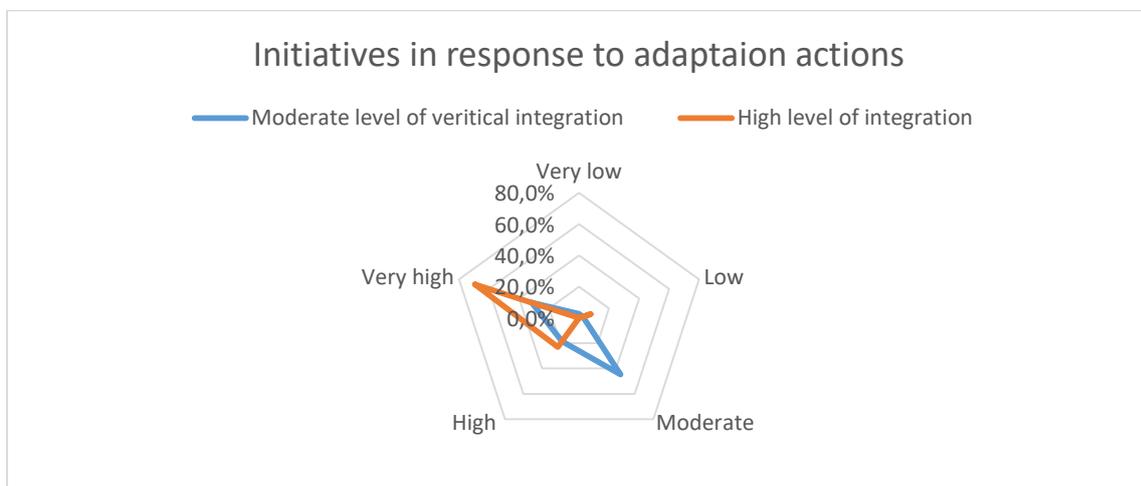


Figure 25: Percentage of initiatives of adaptation actions within vertical integration level



Annex 2

Table 6: Scaling criteria

The scale (Likert) follows the general upward trend in which with the increase value, conditions of lower values are automatically considered. For example, in case of adaptation plan in national level, if a country has separate of individual framework for adaptation (scale 5) and also strategies or sectoral risk plan etc. (scale 3) will be considered on highest level value.

Indicators	1	2	3	4	5
Explicit about availability of data source on climate change at national level	Very few information on data availability; mentioned about high limitation of data; Data are available only for selective or few disasters, recent climate change impacts and probable future scenario at very small scale;	Few information on data availability; Mentioned about limited access to data; Data on climate change effects, specific disaster, vulnerability, trends available through online knowledge portal (world bank); other organization	Mentioned recent provision of collecting data/information system, information is available for vulnerable sector, community and disaster effects and adaptations in policy, country profile	Mentioned about institution, Committee/team to research, gather, assess and analyze data, information available on climate change impact, vulnerability, adaptations of priority sectors; Ongoing program on data base formation	Mentioned about national data base, institution, information center, research by experts, scientist, projections on climate change effects and adaptation evidence etc.' regular updates are available
Explicit about availability of data source on climate change at local level	Mentioned about high limitation of data; Information only on disaster impacts	Limited Information on effects of disasters and climate change on vulnerable sector	Information available for some specific vulnerable sector, disasters and detail of adaptation actions, ongoing data collection program	Information on climate change for most vulnerable or priority sector, adaptation actions evaluation of action outcomes	Data cell, information center in every state/province; Project or mission for data development in national level; available data for maximum sectors, scientific knowledge and technological advances on significant sectors
Explicit on Information sharing between national and sub-national level	Mentioned about low level of stakeholders' understanding about climate change, high limitation in institutional	Not explicit information on information sharing; Awareness building program, policy dialogue, inclusion of	Mentioned about information sharing through policy or strategies in govt. institutional level,	Indication of Climate change information center/network; climate change research on vulnerability, adaptations	Indication open and accessible International and National MRV (Measuring, Reporting and Verification) system, climate change

	knowledge sharing, awareness building, communication, information pass to specific group, vulnerable community	climate issues in sectoral policy, education, mentioned limitation of knowledge sharing in institution level	institution strengthen program, expert opinion or advocacy workshop, training on climate change issues in national level with govt. NGOs and other stakeholders	and outcomes sharing from national to local level	advisory board, research cooperation and experience/knowledge exchange network
Participation of actors	Not explicitly mentioned about stakeholders; participation of common people in awareness creation or involvement of vulnerable in specific project; mentioned very low level of participation	Ministerial or departmental actors, public/ private, specific or vulnerable community; mentioned low level of participation	Ongoing process in forming climate change advisory committee/institution for actors' participation; involvement of relevant govt. institutes, department, community people private sectors	Explicit on stakeholders' involvement including line ministries, research institution, civil org. provincial govt, Planning Commission, technical departments, professionals, experts, NGOs, community people private sector and development partners	Very explicit on wide range of stakeholder (from local, national and international) involvement in development agenda or process, involve actors with the guide of national program or govt. advisory committee/institutions in planning process
Adaptation plan/ policy framework- national	National development plan/agenda with an issue of climate change/environment conservation facts	Environmental commission/ institution with framework with climate change issue (sectoral risk plan, disaster emergency plan, (DRRP) etc.	National Adaptation and mitigation Plan together; National Environmental policy with issue of climate change, Significant sectoral adaptation plan	National Climate Change policy/ strategy/ action plan with especial attention to adaptation	Individual or separate adaptation plan/framework (e.g. NAP); National adaptation plan for action (NAPA), On the way to formulate national adaptation plan (NAP)
Adaptation plan/policy framework-local	No information about local plans or framework, Actions are applied in local level as a part of national plan, development goal, agenda, vision	Local climate change departmental, interdepartmental and risk plans for vulnerable sector, local emergency action plan	Actions guide by NAP/ NAPA, Adaptation actions across relevant agencies and sectors, local level planning, disaster management plan, across sub-national regions, and actions under other multilateral	Mainstreaming adaptations actions across all or most of the sectors, strategic development plan for vulnerable and relevant environmental sectors;	Individual or separate state/province/ territorial strategic, action plan/framework for climate change

			environmental agreements		
Collaboration between national and sub-national level	Mentioned about high limitation in collaboration, connections only with relevant ministries and line agencies or departments	Mention about limitation in coordination between ministries, line agencies, Collaboration with relevant environmental institution for planning and implement national and sectorial climate policies	Inter-institutional coordination for planning and management on adaptation to the climate change.; Creation of multidisciplinary teams to support the diverse actions; ongoing or planned initiatives under ministries and line agencies in state level	Legal and legislative framework for decentralization; collaboration among cross-cutting ministries, line agencies, relevant environmental organization from national to sub-national level including private sector for planning and management	Coordination arranged by climate change or environmental institution, secretariat/ cell, legal framework for decentralization with all relevant and cross-cutting ministries, line agencies department, cross-sectoral, all environmental organization at national, state, province level including private sector for planning, implement management and regular monitoring or reporting
Explicitly mentioned existing policy, law and regulations relevant to climate change	No mention on environmental law/act, regulations; mentioned about considering principle and provision of UNFCCC Convention (in particular article 4)	Mentioned about national environmental laws to support actions; Laws/act related to environment as a part of development goal, vision or agenda;	National Climate change act/laws (not explicit) and regulation (law about adaptation and mitigation together); Ongoing formulation to new laws on climate change adaptation	Mentioned about national climate change policy law/act; regulations referring some vulnerable and priority sectors to support adaptation actions	Explicitly mentioned about policy, law /act, regulations to support adaptation strategies for all or most of the vulnerable sectors to support actions
Skill of actors in vulnerability mapping, projections and professional workshop, training	Mentioned about high limitation in knowledge and human skill; training/actions for vulnerable, specific group of people to adjust adaptation strategies	Mentioned about limited knowledge, skill and capacity of actors; Provision of professional training, workshop on skill development at national level	Introducing new institution or centre to deal with climate change; ongoing research, vulnerability assessment and skill development program for institutional actors, vulnerable community at national and local level	Actors have expertise in vulnerability mapping on specific sectors, capacity to assess effects of disaster, projection capability, cooperation in local, national level and ongoing skill development program	Actors are able to vulnerability mapping, hazard assessment, model making and prediction; have scientific knowledge, research cell to analyse climate change impacts and adaptation outcomes; cooperation at local, national, regional and

					international level; ongoing skill development program
Explicitly discussed initiatives to develop techniques, capacity development (human skill and infrastructure) and identify need for technology development or transfer for adaptation	Very few discussions on adaptation actions regarding vulnerability of sectors or climate change issues; no information on capacity building and technology	Mentioned about adaptation actions on some vulnerable sectors, Indication of requiring support (lack of details/not specified) from outside in capacity development actions or techniques, and technology transfer	Mentioned about many vulnerable sectors but specified comparatively few adaptation actions; few information on techniques, capacity and transfer technology	Explicit about priority and vulnerable sectors and relevant adaptation actions with capacity, techniques development program and need of technology transfer	Very explicit about all or maximum sectors of vulnerability and adaptation actions; developing technical capacity, technology and areas for international support (capacity development, technology transfer)
Explicitly mentioned about financial ability and financial need for adaptation actions	Mentioned about need of financial support from outside but no specific information on source of funding, for what actions and how much will be needed	Mentioned about financial support (amount is not specified) need from outside to support actions (source and actions are specified)	Mentioned about adaptation cost (specified); limited/no internal funding capacity, financial help will be needed from outside (source specified), detail indication of actions for which financial support will be needed from outside	Mentioned internal specific source (trust fund, adaptation fund, climate change fund); specified amount of funding capacity, indicated specific amount of support need from international source (e.g. Green climate fund, global environmental facility)	Explicitly assessed the internal financial ability (specified amount) and source of funding (Adaptation fund, taxing, internal climate fund) and identified the specific gap and need of external fund (green climate fund, partnership with other organization, country); Identify detail need for most of the project/action/sector

Table 7: Guidelines for difference factors/indicators of governance factors

Data availability (may use qualitative information or quantitative based on proposed scale/ weighted value by their own)

Data availability	Source (internal /external (World bank knowledge portal, UNDP, OECD etc.)	Level of expertise in vulnerability mapping, projections, modelling	Inclusion of best adaptation practices/ local knowledge (sector specific)	National data base/ local data source	Information sharing process (institution, department, group etc.)	Part of any information network (local/national /international
National						
Local						

National and local adaptation plan (Qualitative information)

Adaptation plan/framework	Type (national-NAP/NAPA), Local-state action plan, risk plan, sectoral, emergency, contingency plan etc.	Goal/aim/objectives	Actors involved in planning process	Actors involved in implementation	Instrument for implementation	Existing policy/ law/ act to support actions/ plan and strategies
National						
Local						

Adaptation actions and governance

Urban adaptation actions	Sector	Target group (if any)	Goal (with time frame-years)			Existing capacity (may use qualitative information or quantitative based on proposed scale/ weighted value by their own)				Collaboration process (responsible actors, institutions/climate change cell)		International Assistance (may use qualitative information or quantitative based on proposed scale/ weighted value by their own)		
			Short term	Medium term	Long term	Financial (specify source and amount)	Actors involved (Planning and implementation)	Skill of actors (implementation)	Technical or Technological	Existing process, gap	Actions for improvement	Financial (specify source and amount)	Assistance for capacity building	Technical or technological support
	(e.g. transport housing, waste)													

Annex 3:

List of proxy data reference of various countries used for scaling and analysis

Connecting to build a National Adaptation Plan roadmap in Mozambique. Available at <http://globalsupportprogramme.org/connecting-build-national-adaptation-plan-roadmap-mozambique>

Costa Rica's national adaptation efforts: Ministry of Environment and Energy, Costa Rica. Available at https://unfccc.int/sites/default/files/20160524_girot.pdf

Country Future Climate - Gabon - Climate Change Knowledge Portal. Available at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Africa&ThisCcode=GAB

Country Future Climate - Kenya - Climate Change Knowledge Portal. Available at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Africa&ThisCcode=KEN

Country Historical Climate - Liberia - Climate Change Knowledge Portal. Available at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCcode=LBR

Country Historical and Future Climate - Congo, DRC - Climate Change: World Bank climate change knowledge portal. Available at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCcode=COD

Country Historical and Future Climate - Tunisia - Climate Change Knowledge Portal. Available at Country Future Climate - Tunisia - Climate Change Knowledge Portal

Country Future Climate - Paraguay - Climate Change Knowledge Portal. Available at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_future_climate&ThisRegion=Africa&ThisCcode=PR

Jamaica's National Adaptation Plan: Integrating Climate Change into National and Ministerial Budgets. Available at <http://napglobalnetwork.org/wp-content/uploads/2017/08/jamaica-cc-budget-integration-workshop-july2017.pdf>

Kenya National Adaptation Plan 2015-2030 Enhanced climate resilience towards the attainment of Vision 2030 and beyond. Available at http://www4.unfccc.int/nap/Documents%20NAP/Kenya_NAP_Final.pdf

Kenya National Adaptation Plan: UNFCCC, NAP central. Available at http://www4.unfccc.int/nap/Pages/Kenya_NAP.aspx

Mexico's Climate Change Mid-Century Strategy November 2016. Available at https://unfccc.int/files/focus/longterm_strategies/application/pdf/mexico_mcs_final_cop22nov16_red.pdf

National Climate Change Strategy 10-20-40 Vision. Available at https://www.transparency-partnership.net/sites/default/files/encc_englishversion.pdf

National climate compatible development management policy (2014) Published by the Office of Climate Change & Development Port Moresby National Capital District Papua New Guinea. Available at https://www.pacificclimatechange.net/sites/default/files/documents/National_Climate_Change_Policy1.pdf

National Adaptation Programme of Action (NAPA): Approved by the Council of Ministers at its 32nd Session, December 04 2007, Maputo. Available at <http://unfccc.int/resource/docs/napa/moz01.pdf>

Qatar: Sustainable Development Goals 2030: High Level Political Forum, Voluntary National Review 2017. Available at https://sustainabledevelopment.un.org/content/documents/16517Qatar_VNR_2017_En.pdf

Vulnerability, Risk Reduction, and Adaptation to Climate Change, Djibouti (World Bank Knowledge Portal). Available at http://sdwebx.worldbank.org/climateportalb/doc/GFDRRCountryProfiles/wb_gfdr climate_change_country_profile_for_DJI.pdf

Vulnerability, Risk Reduction, and Adaptation to Climate Change, Madagascar: Madagascar - Climate Change Knowledge Portal - World Bank Group. Available at http://sdwebx.worldbank.org/climateportalb/doc/GFDRRCountryProfiles/wb_gfdr climate_change_country_profile_for_MDG.pdf

Tanzania climate action report for 2015, Climate Policy, Irish Aid, September 2016. Available at <https://www.irishaid.ie/media/irishaidpublications/TZA-Country-Climate-Action-Reports-Tanzania-2015.pdf>

Country Historical Climate - Tanzania - Climate Change Knowledge. Available at http://sdwebx.worldbank.org/climateportal/index.cfm?page=country_historical_climate&ThisCCCode=TZA

National adaptation programme of action on climate change (NAPA), 2013. Available at <http://unfccc.int/resource/docs/napa/som01.pdf>

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