

Article

Factors Affecting Climate Change Governance in Addis Ababa City, Ethiopia

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Abstract: Climate change in Ethiopia's capital city of Addis Ababa is characterized by an increase in rainfall and subsequent flooding and severe temperature with more heat waves. The city government has now recognized climate change as a serious threat, including it being a reason for loss of life and livelihoods. Even though governance has become a key mechanism to address a reduction in greenhouse-gas emissions and vulnerability to climate change, the practice of climate-change governance has been undermined by different factors. Thus, this study examined factors affecting climate-change governance in the city. The research adopted a mixed research design and depends on primary and secondary data sources. The binary logistic regression model and descriptive statistics were both used to analyse the quantitative data, while the descriptive method was used for the qualitative data. The results reveal that a lack of coordination, political will and leadership are the major factors that hinder the practice of governance in the city, followed by inadequate finance, policy, strategy, and regulation. In addition, a shortage of knowledgeable experts, lack of access to information and technologies had their own contributions to the ineffectiveness of climate-change governance. Thus, the city administration should place emphasis on climate change, giving it comparable weight to other crosscutting issues, and enabling the functioning of the steering committee with a strong accountability system. In addition, the city administration should take aggressive measures, including revising or formulating new policy, strategy or regulation, and even creating an independent institution for climate-change issues. Furthermore, the Addis Ababa City environmental protection and green development commission should create an enabling environment to attract non-state actors, in general, and NGOs, in particular, and should assign one directorate to mobilise finance, following the approach taken by the federal environmental protection commission. The commission should implement a mechanism to efficiently utilize the budget by applying continuous monitoring and evaluation. The commission should also provide continuous training and capacity building for leaders and experts at sub-city and Woreda levels.

Keywords: climate-change adaptation; coordination; actors; political willingness; policy



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1. Introduction

Climate change is one of the most contested and undeniable environmental issues, and has been receiving significant attention around the world. It manifests as rising temperatures and increasingly erratic rainfall, as well as severe floods and droughts [1,2]. Climate change is no longer a low-level issue but has become a life-threatening global emergency [2,3]. According to a study by IPCC [2,4], temperatures are predicted to rise by 2.4 °C by the year 2100. This is significantly above the target value of 1.5 °C, which was accepted by the Paris agreement. The effects of this increment are likely to be disastrous in the future.

All economic sectors are affected by climate change, which also poses different challenges for environmental systems [5,6]. These challenges are more pronounced in cities, since most of the world's people resides there. Currently, cities are significantly affected by consequences of climate change such as heat waves, flooding, heavy rains and storms [7,8].

At the same time, cities produce around two-thirds of the total global greenhouse-gas (GHG) emissions, and account for a similar proportion of total global energy consumption [7,9].

During the world leaders' meeting of the 26th annual summit (COP26) held at Glasgow in 2021, the assessment of past performance revealed that the targets of a reduction in GHG emission had not been achieved [10]. While around 23 countries signed the COP26 coal-to-clean-power transition agreement, the largest coal producers, including Australia, China, India and United States, were missing from the agreement. A total of 105 nations signed an agreement to minimize the source of methane, but the agreement was not signed by the top three methane producing countries (China, India and Russia), which are responsible for about 35% of the methane in the atmosphere [10]. Studies in climate modeling show an urgent policy responses is needed (2, 4) but most countries' governmental climate action in place today aims to achieve a gradual reduction in GHG emissions [10–12].

Climate change is a global threat which requires policy action at international, national, and local levels of governance. Climate-change governance refers to a range of initiatives, regulations, and government decisions aiming to establish cooperation between state and non-state actors in dealing with climate change [13,14]. It is a subset of the broader governance field, but the difference is that a greater emphasis is placed on the mitigation and adaptation of climate change [15,16]. In environmental terms, climate-change governance is the mechanisms and response measures aimed at steering social systems towards preventing, mitigating, and adapting to the risks posed by climate change [11,17,18]. Climate-change governance in cities is manifested by the process of the formulation and implementation of adaptation and mitigation measures [14,19]. Cities are rapidly becoming key locales for climate-change governance, through the designing of institutions and infrastructures that drive decarbonization and adaptation to the changing climatic conditions [7,20–23]. The first successful international negotiation of the 2015 Paris agreement marked a milestone in global climate governance [24]. However, the practicality of the agreement was questioned, particularly due to the withdrawal of the United States, the world's second-largest emitter of GHGs [23,25]. The COVID-19 pandemic also caused significant disruption to the response to climate change in cities and created a great challenge to meet the global goals defined in the Paris agreement [3,10,25,26].

To this end, several empirical studies show that the effectiveness of climate-change governance is hindered by a number of factors. One of the main determinants of responses to mitigation and adaptation is effective policy, strategy, regulation and law [27,28]. Conflicts of interest during issue framing or giving priority to mitigation and adaptation in relation to other policy concerns, such as infrastructure provision or poverty reduction, are the major factors that hindered climate-change governance [29–31]. A lack of implementation of policy, strategy, rules, plans and inadequate legislation are also part of the factors that determine climate-change response [24,32].

Several studies indicated that a shortage of finance is another factor for the implementation of climate-change response measures [27,29,32–34]. Mostly, local governments or municipal authorities face a shortage of finance to implement mitigation and adaptation because of the existence of many competing issues on urban agendas [27,32,35]. According to Aylett [29], cities face three major resource-related challenges for an effective response to climate change, including access to financial, human and technological resources. Lack of human resources is also a major challenge of climate-change governance in cities [17,29,36]. Governance capacity to respond to climate change is also affected by legal frameworks and legitimate institutions [37]. Lack of an independent institution that is directly accountable for climate-change matters is also a factor that determines the governance of climate change, especially at a local level [20,38].

Weak coordination of actors and sectors are also key factors that hinder climate-change governance [11,32,33,37,39,40]. Most countries' local governments or municipalities lack cooperation with academia, the private sectors, the community, and NGOs [34] and lack vertical coordination between national and local levels, which is important to devise solutions to governance problems at the local level [3].

Another factor that hinders climate-change governance in cities is access to updated sources of data, including future climate predictions, GHG inventories, and climate vulnerability assessments and impacts such as heat waves and flood [34]. Information accessibility and availability can improve decision-making skills by assisting decision-makers in assessing and prioritizing climate change [27,41]. Building a solid foundation for effective urban climate-change governance requires scientific data [37].

The political willingness of leaders and leadership is another major factor that hinders climate-change response [34]. Lack of political will is a challenge the collaborative governance of the climate-change response in most cities [38,42]. Leadership quality is also critical in shaping climate-change responses [32,37,43]. Climate-change action is also affected by a lack of technology that is needed to take action on climate-change issues [3,32].

When we look at African cities, the coordination of actors is a major factor that hinders good climate-change governance [5,44,45]. In African cities, collaborations regarding climate-change response between the local government and government departments at different levels and sectors, civil society, residents, and community-based organizations are weak [35,46–48]. A study conducted in two cities of Africa, Karonga from Malawi and Dar es Salaam from Tanzania, found that climate-change governance is hindered by poor collaboration among governments, the private sector and civil-society organizations (CSOs) [47]. A study conducted in Lusaka, Zambia and Durban city, South Africa, indicated that there is a lack of finance and capacity problems for executing policies, strategies and plans at all levels of government. This is more pronounced at the local government level [48]. Lacking political willingness and poor leadership are other problems for implementing an effective climate-change response in African cities [45].

When it comes to Ethiopia, an African country, one of the factors that determines climate-change response is lack of coordination among actors [49]. The country accepts and implements the New Urban Agenda [50] and Sustainable Development Goal [51] that are necessary for the development of an industrial base to create employment in urban areas. However, climate-change response still ranks low on the list of overall development priorities [50,52]. According to a study conducted by Climate Action Tracker [53], Ethiopia showed less concern about climate-change action compared to other countries, such as Kenya and South Africa. However, without an effective response to climate change, sustainable development can not be achieved [23]. The Climate-Resilient and Green Economy (CRGE)'s Strategy implementation and evaluation results show that the strategy was not effective as it lacked political commitment at local and national levels, as well as in multiple sectors [52,54]. In the country, limited numbers of non-state actors were involved in the governance of climate change [53,55]. In addition, security concerns and the pandemic have adversely hampered the implementation of climate action [49,56].

Addis Ababa City is highly affected by climate change, such as flooding, drought, heat waves and land slides [57–61]. In the city, climate change and its impacts are aggravated by an unprecedented rate of urbanization and rapid population growth, built-up-area expansion, less green-area coverage and land use change [57,62–65]. To govern climate change in the city, the Addis Ababa City Environmental Protection and Green Development Commission (AAEPGDC) was awarded a mandate and will implement a climate-resilient green growth strategy for 10 years until the year 2025, based on the 2011 country's CRGE strategy [66]. The strategy addresses both climate-change adaptation and mitigation issues, and began in 2014.

Adapting this strategy, the AAEPGDC has made climate-change issues mainstream across various offices: land use, housing, transportation, water supply, solid waste, education, energy and more than 22 other sectors [67–69]. Even though the strategy is in place, the implementation of the strategy is still piecemeal and climate-change response action is given a low priority compared to other issues.

The provision of empirical information on the major factors that hinder climate-change governance using a comprehensive study is vital to city administrators at different levels and other non-state actors. This is important for redesigning sound policies and strategies

to address climate-change impacts and a reduction in GHG in the city. However, most of the previous studies conducted related to climate change in the city were mainly focused on trends, vulnerabilities and impacts [57,59–62,64,70–73]. None of them focused on climate-change governance by considering governance factors. Therefore, it is important to ask the question: what are the major factors that hinder climate-change governance in Addis Ababa city? To provide a concrete response to this query, analysing and conducting empirical research using both quantitative and qualitative method is essential. Numerous international scientific research works have been carried out in this area. However, those studies concentrated on comparative study in cities of industrialized countries, neglecting to do so in developing cities. Hence, this research intends to bridge this gap by identifying factors that hinder climate-change adaptation and mitigation response action. The study's findings can be applicable for other African cities facing comparable difficulties.

2. Methodology

2.1. Theoretical Gap of the Research

In the past, state-centred theories were applicable, where governments acted as leading planners, regulators, and policy formulator and implementer [74]. Starting from the 1970s, several new issues emerged, including the stronger influence of local governments and transnational institutions, globalization, the deregulation of the financial market, and others. In response to these pressures, national governments began to explore new directions, which involves depending on horizontal connections and collaboration across private–public divides. This brings new ways of formulating and implementing public policy, which is described by the concept of governance [18,75]. Governance implies that national governments have shared authority over the formulation and implementation of public policy with local government agencies, private actors, NGOs, transnational organizations, and citizen groups [76].

Climate-change governance is a subset of the broader notion of governance. However, the difference is that it places more emphasis on the mechanism of coordinating different social actors in order to prevent, mitigate, and adapt to the threats posed by urban climate change [14]. The key theoretical argument of climate-change governance is that all actors are responsible for addressing the climate-change-related issues of cities in multi-level systems [77]. Global actors are increasingly in agreement that effective climate-change governance has a long-term impact on climate efforts. Hence, in general, good climate-change governance is often indicated by the effectiveness with which the climate-governance actions realize the objective of a reduction in GHG and risks [78].

The 1990s were considered a turning point for climate-change response because of the increased awareness of the difficulties caused by urban GHG emissions [77,79]. The foundation of the current system of global governance is the UN Framework Convention on Climate Change (FCCC), the Kyoto Protocol, and the 2015 Paris Agreement to reduce greenhouse gases and the release of highly toxic persistence organic compounds [80]. Various theoretical concepts that underpin the governance of environmental issues, such as climate change, have emerged to minimize the impact of climate change, such as network theory, urban regime theories, green growth cities, sustainability cities, smart cities, and new urbanism [81–87].

However, cities in both developed and developing countries still face challenges to govern climate change effectively. For many cities in the world, housing provision, sanitation and waste disposal are the most essential issues for governance [21]. Across the world, there still is high levels of policy rhetoric about urban climate governance, but the practice on the ground is limited [22,37]. Research on the development of urban climate policy and governance began in the mid-1990s and focused on single case studies, predominantly on cities in the United States, Canada, Europe, and Australia. Although some research has more recently been conducted in Asia, South Africa, and Latin America, [14], the information from cities in developing nations is still fragmentary [22]. Thus, the provision of empirical information on the major factors that hinder climate-change governance using

a comprehensive study is vital to city administrators and other non-state actors for re-designing sound policies and strategies in cities for addressing climate-change impacts and a reduction in GHG in developing countries. Thus, this research is intended to contribute to bridging this gap by identifying the factors and applying a mixed-methods approach.

2.2. Conceptual Framework

The motivation for the need for climate-change governance includes the rapid increase in population and economic growth, transportation, and the increase in GHG emissions [9]. Now, and going forward, cities have also become the home of a major section of the population and its economic activities, which makes them particularly vulnerable to climate-change impacts. A conceptual framework is primarily designed to guide the research work, which shows the interactions between and among variables. In this regard, the central part of the framework is urban climate-change governance. Based on the empirical and theoretical literature, urban climate-change governance requires the multiple interactions of major urban actors, which include private businesses sectors, public agencies, and civil-society organizations.

City governments create partnerships with civil society and private sectors to govern cities in a sustainable manner. Especially in developing countries, governments alone cannot provide adequate and quality infrastructure and services for residents because of the fast rate of urbanization and low level of economic development. Local governments create an enabling environment; they empower and assign clear roles and responsibilities to civil society and the private sector for the formulation and implementation of a city's climate-change responses [29]. The relationship among governments and civil society; governments and the private sector; civil society and the private sector; and the interaction of the three: governments, the private sector, and civil society, need to formulate and implement both mitigation and adaptation measures.

A relationship between public and private actors, for the purpose of emission reduction or in the formulation and implementation of adaptation and mitigation strategies, such as involving private actors in energy-saving and emission-reduction schemes, transportation, provision of renewable energy, waste management and the mobilization of resources, are crucial in cities. Governments also interact with actors from civil-society organizations, for example, setting climate-change agendas, collecting expert opinions, developing policy directions, engaging in mitigation and adaptation actions, and engaging in public-awareness programs. State actors working with environmental issues together with civil society organizations can gain the advantages of achieving closer contact with grassroots movement and communities [20]. In addition, the relationship of the private sector and civil-society organizations through sponsorships, consultation or an exchange of ideas, joint research or development, or the promotion of new products and new markets is important for non-state actors themselves and for the government to implement policies and strategies effectively [88].

Climate-change governance, being a rapidly increasing research agenda among academics and development partners, has generated discussions concerning which variables to employ as factors that determinant the effectiveness of the governance of climate-change responses. Based on the theoretical and empirical literature, seven variables were selected to analyse the factors that hindered governance related to climate change, including 30 specific questions. The factors are adapted from many scholars. These factors include policies, strategies and regulations; finance; human resource; technologies; political willingness and leadership; information; and coordination [7,13,14,20–22,27,29,33,37,77].

2.3. Study Area Description

Addis Ababa, the capital city of Ethiopia, is geographically located in the central part of the country, surrounded by the Oromiya region (Figure 1). Specifically, it is located at 9°1'48'' N latitude and 38°44'24'' E longitude. The city has a total size of 540 square kilometres [89]. Its altitude ranges from 2100 m, in Akaki, in the south part, to more

than 3000 m above sea level, in the Entoto Mountain, in the north part [90,91]. The administrative hierarchy in the city is composed of three levels: the top level, known as the city administration; a middle level, known as the sub-city; and the lowest level, known as the Woreda level. Currently, the city is divided into eleven sub-cities and 120 Woredas [92]. The sub-cities include Gulele, Yeka, Lemikura, Kirkos, Akaki, Arada, Bole, Lideta, Addis Ketema, Nifas Silk Lafto and Kolfe Keraniyo (Figure 1). The topography of the city varies, especially between its northern and southern parts. The altitude and slope decrease from north-to-south direction [89].

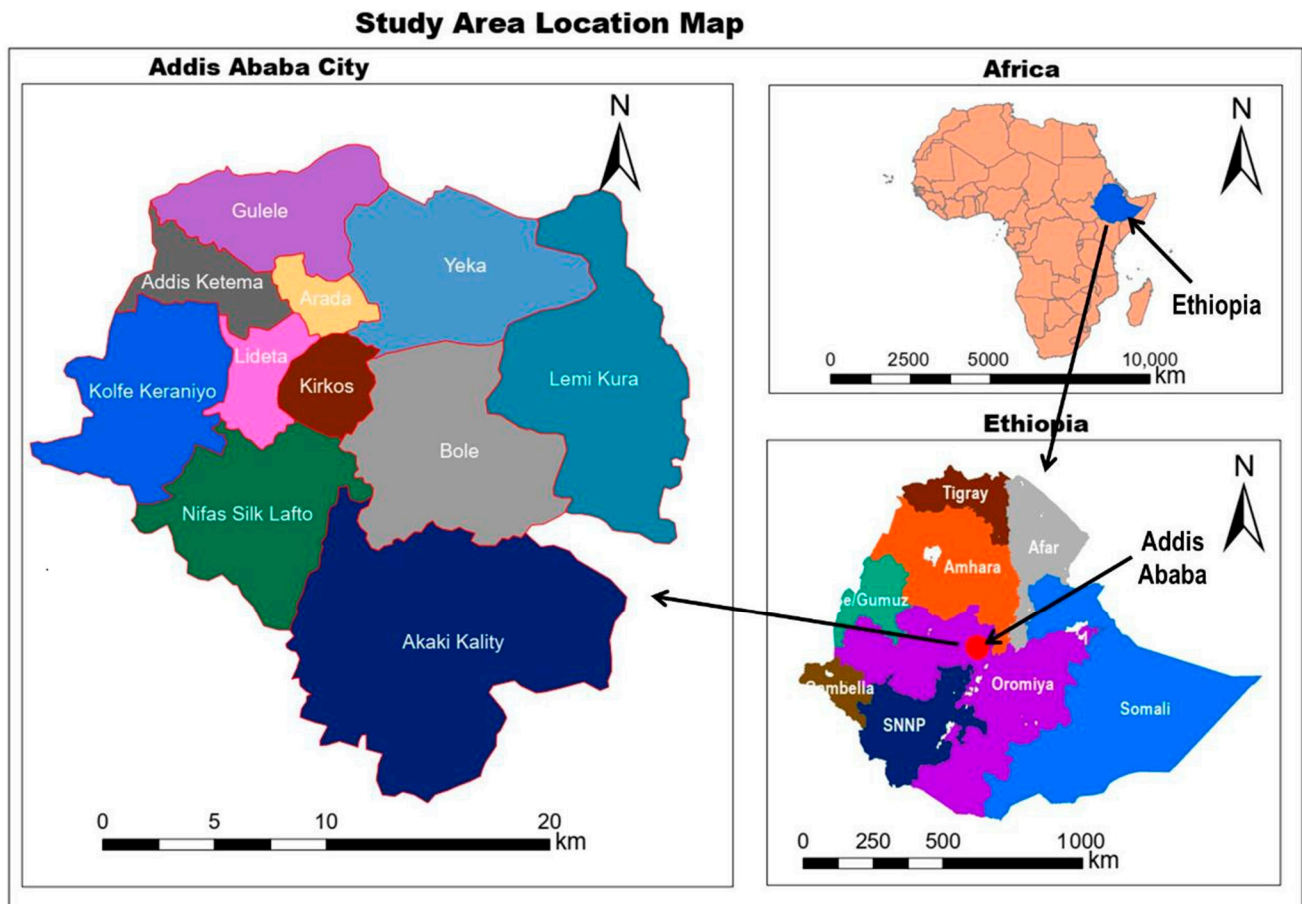


Figure 1. Map of Addis Ababa city with 11 sub-cities.

Addis Ababa is the primate city, which dominates the political, economic, and historical issues of the nation. It is the capital of the federal government, and it is also the headquarters of the African Union [90]. As the last census in Ethiopia was carried out in 2007, the current population of the city is based on estimation. There are several estimates about the population of the city in different sources. However, the national central statistical agency that carries out national census projections is the appropriate source. When considering the trend in the city's population, in the year of 2007, the population was 2,739,551 [93] with 22.77% of the 11.86 million people living in urban areas of the country [94]. In 2015, the population was around 3.3 million; whereas, currently, the estimated population is around 4 million [91]. The population is projected to reach about 6 million in 2030 [94] (Figure 2).

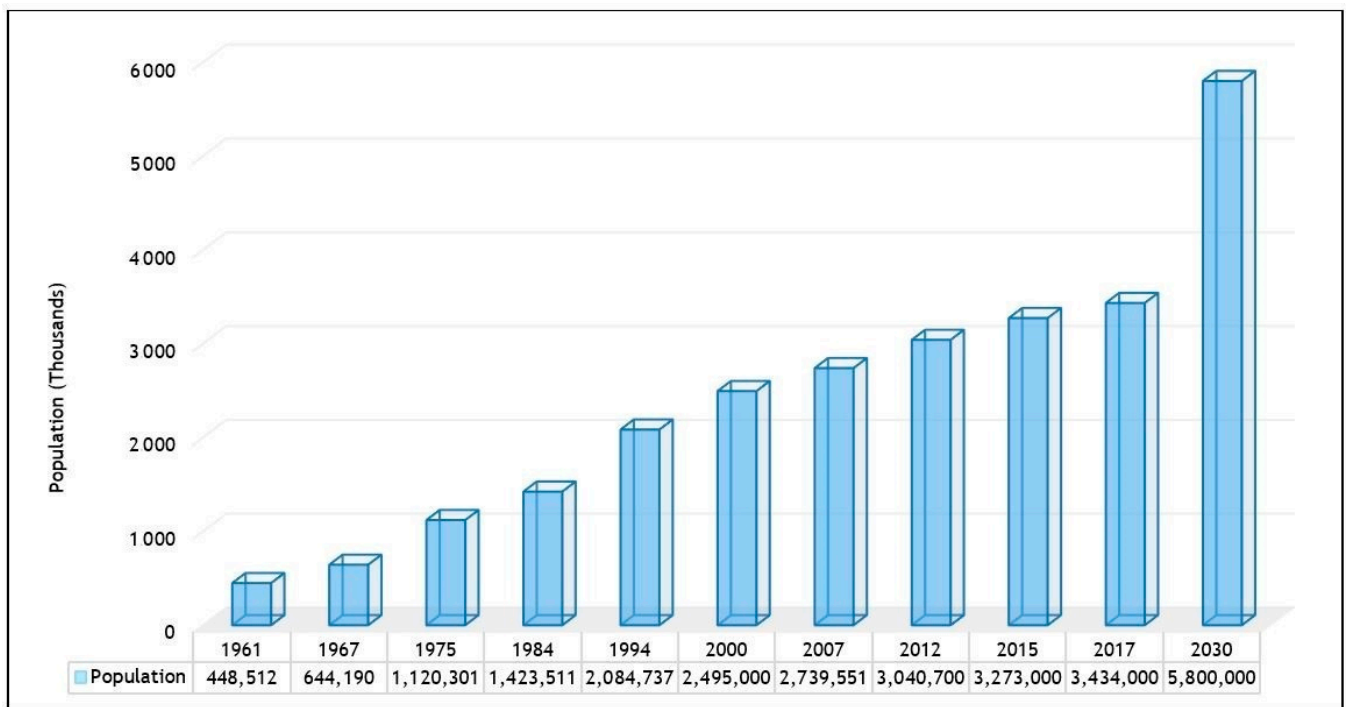


Figure 2. Population trend of Addis Ababa City. Source: CSA [93–97].

2.4. Climate-Change Impacts and Responses in Addis Ababa City

Climate change in Addis Ababa is manifested by an increase in rainfall and subsequent flooding and severe temperature, with more heat-wave occurrences [57,59–61,64,98]. The major direct impacts of climate change in the city are flooding, drought and urban heat island (UHI) [99] (Figure 3).

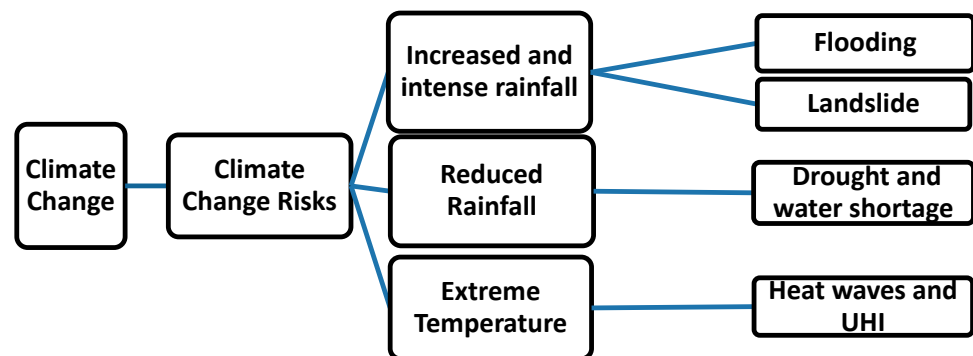


Figure 3. Climate-change risks in Addis Ababa City.

Addis Ababa is more vulnerable to the impacts of climate change in terms of extreme rainfall which causes flood [59,61,65,71]. A significant increase in city flooding is evident due to the rapid urbanization, loss of green areas, poor drainage systems and climate change [72]. There were 89 flood-related hazards in total between 2013 and 2018, with a particularly substantial increase between 2017 and 2018 [65]. Floods have caused losses of human life and harm to infrastructure and property [65,71,72,100]. More irregular heavy-rainfall events are expected to occur in the future and this is likely to result in worsening flooding conditions in the city [62–64]. The following figures show effect of floods, causing of damage to different infrastructures, including residential, commercial, roads, and water systems and the disruption of traffic and loss of property and human lives (Figure 4).



Figure 4. Flood impact in Addis Ababa city: (a,b) show damage to human life and their property; (c) damage to vehicles, human life and transport infrastructure; (d) flooded streets in the middle of the city causing disruption to the transportation system and flooding effects on roads.

In addition to flooding, drought is another impact of climate change and it affects the quantity and quality of water, the health and wellbeing of Addis Ababa's dwellers [57,58,65]. In recent years, the city has already been feeling the pressure of unprecedented drought because of reductions in seasonal rainfall, reductions in river flows, reductions in inflow into reservoirs, falling groundwater tables, and increased temperatures, which, in turn, increase evapotranspiration from the reservoirs [58,64,65].

Overheating and the UHI effect is also a major consequence of climate change in the city. Overheating or heat waves, occurring in extreme hot days and nights, can have a substantial impact on health heat stress, on air pollution, and on water and energy supply and infrastructures [65,86]. The ways the city grows and develops are both key drivers of climate change and its impacts. Besides the emission of greenhouse gases from different sectors, and unprecedented rate of urbanization and rapid population growth, built-up-area expansion, less green-area coverage, and land use changes have the most anthropogenic influence on climate change [57,58,64,101]. The impacts are also exacerbated by a lack of consideration of climate-sensitive issues in urban planning [63].

Starting from 2014, the AAEPGDC prepared a climate-change-resilient green development strategy to protect and enhance the quality of life of its residents. As shown in Figure 5a, this development strategy includes climate-change responses of both green development, which is preventing climate change (mitigation), and resilient development, which is responding to the impact of climate change (adaptation). Mitigation has been at

the heart of strategic responses to climate change in the city being practiced in buildings, transport, energy, waste, industry, urban agriculture, land use change, forestry and other sectors. Furthermore, they aimed to formulate a strategy on how to reduce the emission of GHGs from various urban system components of Addis Ababa. The strategy offers a structure to help partners collaborate more effectively and efficiently to carry out adaptation and mitigation measures [99].

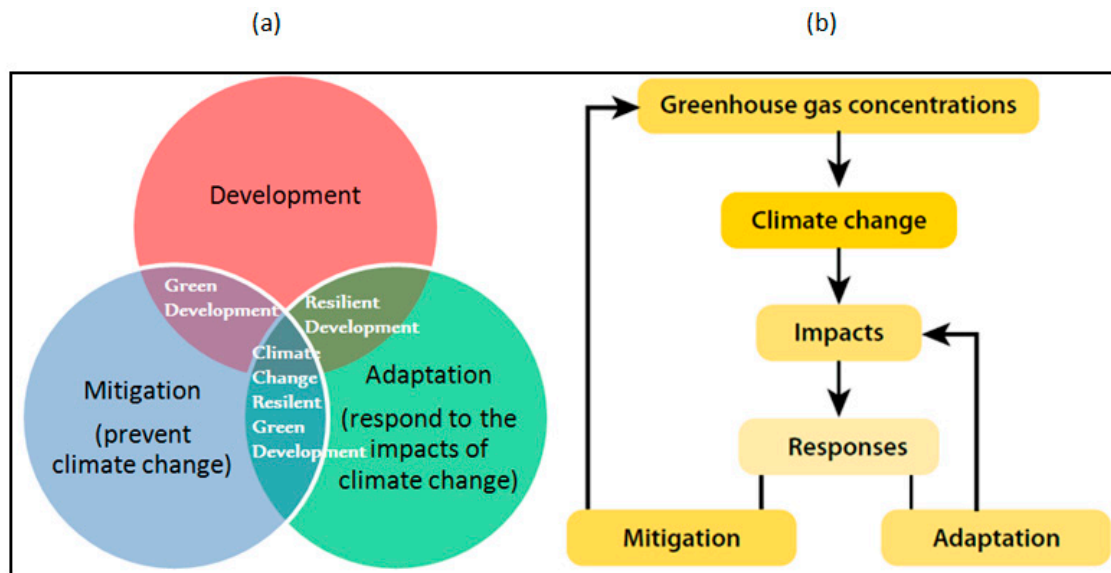


Figure 5. (a) Climate-resilient green growth strategy concept in the city and (b) relationship between climate change, impacts and responses. Source: AAEPGDC [99].

Adaptation is a key means by which resilience and reduced vulnerability in local communities and economies are built. Adaptation combines risk management, economic activity adjustment, infrastructure modifications, and changes in community needs. A fundamental problem for decision makers is determining priorities and appropriate activities to fit the dynamics of the city and lessen anticipated local climate-change impacts in Addis Ababa city. The key to effective adaptation that shields communities from the effects of climate change is a locally relevant, cogent, and multidisciplinary response strategy that works across government and community. An effective adaptation plan needs to reveal the anticipated local impacts of climate change and to build resilience when dealing with the city's vulnerabilities. Adaptation efforts in the city can offer co-benefits for climate-change mitigation and for local economic development. The climate-change-resilient green growth strategy in Addis Ababa addresses both climate-change adaptation and mitigation issues, as shown in Figure 5a,b [99].

Climate-change governance actions started well after the formulation of a strategy. The commission was appointed to oversee issues related to the city's environment and climate change. Starting from 2015, major climate actions undertaken in the city include: tree planting, encouraging community-level adaptation, and the expansion of the light-rail transit network. These actions were taken to minimize climate-change risk and emissions reduction. The city has implemented car-free days to promote walking and cycling. The car-free day is held every month, aiming to make attitudinal change in the long run. Smart parking is also another instrument to improve traffic flow and GHG emissions reduction [65].

Currently, climate-change governance is being practised in the city to address both climate-change adaptation and mitigation issues. During the planning process for climate action, the city determined 20 priority adaption measures and 14 mitigation initiatives. The city developed a climate action plan in 2020, which was started in 2017 by the C40 Cities

Climate Leadership Group. Addis Ababa joined C40 as a member of the program and pledged to achieve net-zero GHG emissions by 2050.

2.5. Sampling Methods

The data for this research was gathered from employees drawn from three administrative levels of AAEPGDC. These levels are city level, sub-city level (10 sub-cities; currently, after data collection, one sub city was added and the number of sub cities now is 11), and Woreda level (a total of 20 Woredas, with 2 Woredas randomly selected from each sub-city). We included Woreda 7 and 8 from Gulele sub-city, 5 and 6 from Yeka, 8 and 9 from Kirkos, 5 and 8 from Akaki, 1 and 10 from Arada, 7 and 6 from Bole, 1 and 10 from Lideta, 5 and 8 from Addis Ketema, 1 and 12 from Nifas Silk Lafto, and 6 and 7 from Kolfe Keraniyo.

We purposively consulted climate-change and pollution experts to gather useful information due to the existence of various directorates and departments, such as green area development, forest management, natural-resource management, climate change and pollution, and others. Finally, because of the small number of respondents, a total number of employees were selected. As mentioned in Table 1, the questionnaires were distributed among 232 experts with 219 of them responding to our questionnaires, having a response rate of 95%. In order to gather in-depth information for the research in numerous directions, purposive sampling methods were also used. These included sampling from government officials at various levels, inhabitants, private-sector representatives, and the leaders of CSO. A total of 45 respondents were selected for an in-depth interview, chosen from different actors and sectors.

Table 1. Number of respondents (experts) from different levels of AAEPGDC.

Level	Total	Return
City	17	14
Sub-city	67	65
Woreda	148	140
Total	232	219

2.6. Data Collection Methods

Both primary and secondary data sources were employed in this study, to gather both quantitative and qualitative information. A questionnaire with five-point Likert scale questions was used to gather the quantitative data. A total of 232 specialists from AAEPGDC office at the city, sub-city, and Woreda levels filled in the questionnaire. The questions were designed to generate data regarding the governance of climate-change determinant factors. A questionnaire with 30 items was created and distributed in paper form based on seven variables: policies, strategies and regulations, finance, human resource, technologies, political willingness and leadership, information, and coordination. Some of the questions included in the questionnaire are provided next. How do you rate political willingness of leaders on climate change governance in the city? How do you rate coordination's of actors in climate change response? To what extent do you believe the current human power can implement the intended climate change governance? How do you rate the adequacy of finance for implementation of plans of climate change issues? How do you rate enforcement of strategies, laws/regulations in climate change actions? How do you rate access to necessary technology for climate planning and implementation? The questionnaires data were collected from 1 March to 30 March, in 2021.

In addition, interviews with professionals from different sectors and actors were conducted to substantiate the data collected via the questionnaire. The interview questions were prepared depending on the sectors and activities of the actors to be interviewed. Some of the questions included in the interviews are provided next. How do you describe the trend of climate change in Addis Ababa city? What were the major causes and adverse effects of the changing climate in the city? What are the measures taken by your organization to tackle climate change? What legislations, laws and standards exist to address climate

change (specifically GHG)? What procedures are used to implement these mechanisms? What are the factors that impede effective climate change governance in the city? What do you suggest for effective climate change governance in the city? The interviews were conducted from March 2021 to October, in 2022. Finally, 45 professionals were asked to order the ten major factors in terms of their preference. Observations were conducted in city targeting waste-to-energy project, green areas, smart car parking, flood vulnerability and affected sites. A review of secondary data, including books, journal, strategies, regulations, plans, reports, and others related to the topic were also synthesized to produce this research.

2.7. Data Analysis Techniques

For this study, binary logit model was used to analyse the quantitative data. We used binary logistic regression model because the dependent variable is dichotomous: in this case, ineffective or effective. Where the dependent variable is dummy, binary logit model is suggested [102,103]. Hence, binary logistic model was used to determine the relationship between climate-change-governance effectiveness and the related underlying factors or independent variables, including lack of policies, strategies, and regulation; lack of finance; lack of human resource; lack of technologies; lack of political will and leadership; lack of information, and lack of coordination. The dependent variable was coded with a value of 0 for ineffective and 1 for effective; whereas, the independent variables was designated with 1 as low, 2 as moderate, and 3 as high, in the coding system. SPSS software version 26.0 was used to analysis the binary logit model by creating the high-scale level as a reference category for the independent variables.

Before applying the binary logistic regression, the logit model was evaluated for possible inadequacies. To assess the model's overall fit, a Hosmer and Lemeshow test was performed. The chi-square value for this test is = 2.791, sig = 0.947. This result shows that the model sufficiently fits the data (Table 2). How well the model categorizes the observed data is another approach to establish the model's effectiveness. Table 3 shows that, overall, 87.2% of climate-change-governance effectiveness was predicted properly. The independent/covariate variables suggest that climate-change governance is ineffective (95%).

Table 2. Hosmer and Lemeshow test.

Step	Chi-Square	Df	Sig.
1	2.791	8	0.947

Table 3. Classification table.

Step	Observed	Predicted			
		Climate-Change-Governance Effectiveness		Percentage Correct	
		Ineffective	Effective		
1	Climate-change-governance effectiveness	Ineffective	150	8	94.9
		Effective	20	41	67.2
	Overall percentage				87.2

The model summary, shown in Table 4, also highlights the goodness of the model. The result reveals that 62.8% of the variance in climate-change-governance effectiveness can be explained by a linear combination of the seven independent variables (coordination; political will and leadership; policy, strategies, regulations; finance; human resource; information and technologies). Based on the results shown in Tables 2–4, we come to the conclusion that the model, along with the given independent variables, is acceptable.

Table 4. Model Summary.

Step	−2 Log Likelihood	Cox & Snell R Square	Nagelkerke R Square
1	133.807	0.436	0.628

In addition to the binary logit model, descriptive statistics were applied for data analysis. A total of 30 questions were prepared, distributed, then later computed and recoded into seven variables, including lack of policies, strategies and regulations; finance; human resource; technologies; political will and leadership; information and coordination. The average responses from all respondents to all the questions that reflect each variable were used to discuss the findings. Each variable is represented and addressed by a distinct question. The qualitative data were also repeatedly read, coded, and similarities between the data were identified using NVivo (10.1). The findings from qualitative studies were analysed using a thematic area approach.

3. Results

3.1. Results of the Descriptive Statistics

The study results were collected based on seven independent variables: lack of policies, strategies, and regulation; lack of finance; lack of human resource; lack of technologies; lack of political will and leadership; lack of information and lack of coordination. The results are summarized in Table 5. Regarding lack of coordination, the majority of respondents (64.4%) consider that it highly affects climate-change governance, while 22.8% and 12.8% of respondents consider its effect to be moderate and low, respectively. Lack of political willingness and leadership quality is another major factor that hinders climate-change governance in the city. This factor is characterized as high by 60.7% of respondents. The table below also shows that lack of finance and policies, strategies, and regulation significantly affect climate change governance: both are characterized as high by 53% of respondents.

Table 5. Descriptive statistics results of factors affecting climate-change governance.

Responses	Lack of Policies, Strategies, Regulation	Lack of Finance	Lack of Human Resources	Lack of Technologies	Lack of Political Will and Leadership	Lack of Information	Lack of Coordination
	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
Low	57 (26)	38 (17.4)	27 (12.3)	75 (34.2)	42 (19.2)	53 (24.2)	28 (12.8)
Moderate	46 (21)	65 (29.7)	156 (71.2)	97 (44.3)	44 (21.1)	108 (49.3)	50 (22.8)
High	116 (53)	116 (53)	36 (16.4)	47 (21.5)	133 (60.7)	58 (26.5)	141 (64.4)
Total	219 (100)	219 (100)	219 (100)	219 (100)	219 (100)	219 (100)	219 (100)

Source: Survey, 2021.

Table 5 demonstrates that many respondents (71.2%) responded that a lack of human resources has a moderate impact on climate-change governance. The remaining number of expert's is divided between the relatively low factor (12.3%) and high factor (16.4%). As shown in Table 5, a high number of respondents characterized lack of information and technologies as moderately affecting climate-change governance, with percentage values of 49.3% and 44.3%, respectively.

3.2. Binary Logistic Regression Results

Seven independent variables were entered into a binary logistic regression model in order to pinpoint the major factors that hinder the effectiveness of climate-change governance. These variables are coordination; political will and leadership; finance; policy, strategies and regulation; human resources; information and technologies.

As shown in Table 6, the results of logistic regression reveal that coordination; political will and leadership; finance; and policy, strategies and regulation significantly affect climate-change governance at the 5% level of significance. Exp (B) gives the odds ratios for each variable. As shown in the table, a log odd of climate-change governance effectiveness is positively related to coordination; political will and leadership; finance; and policy, strategies and regulations. Hence, climate-change-governance effectiveness with the existence of lower problems in coordination; political will and leadership; finance; policies, strategies and regulations is 66. 861, 5.372, 5.673 and 3.379 times, respectively, more likely to have an effect than that of higher problems in coordination; political will and leadership; finance; and policy, strategies and regulations.

Table 6. Results of analysis on factors that hinder climate-change governance.

Variables	B	S.E.	Wald	df	Sig.	Exp (B)
Lack of coordination (Ref. = high)			24.232	2	0.000	
Lack of coordination (low)	4.203	0.881	22.740	1	0.000	66.861
Lack of coordination (moderate)	1.223	0.493	6.162	1	0.013	3.398
Lack of political will and leadership (Ref. = high)			11.190	2	0.004	
Lack of political will and leadership (low)	1.681	0.568	8.747	1	0.003	5.372
Lack of political will and leadership (moderate)	1.442	0.548	6.924	1	0.009	4.228
Lack of finance (Ref. = high)			7.895	2	0.019	
Lack of finance (low)	1.736	0.618	7.895	1	0.005	5.673
Lack of finance (moderate)	0.676	0.536	1.595	1	0.207	1.967
Lack of policies, strategies, regulation (Ref. = high)			7.884	2	0.019	
Lack of policies, strategies, regulation (low)	1.218	0.549	4.916	1	0.027	3.379
Lack of policies, strategies, regulation (moderate)	1.524	0.592	6.633	1	0.010	4.593
Lack of human resource (Ref. = high)			1.355	2	0.508	
Lack of human resource (low)	0.927	0.861	1.160	1	0.282	2.526
Lack of human resource (moderate)	0.263	0.673	0.153	1	0.696	1.301
Lack of information (Ref. = high)			1.680	2	0.432	
Lack of information (low)	0.757	0.678	1.244	1	0.265	2.131
Lack of information (moderate)	0.721	0.594	1.476	1	0.224	2.057
Lack of technologies (Ref. = high)			1.401	2	0.496	
Lack of technologies (low)	0.193	0.681	0.081	1	0.777	1.213
Lack of technologies (moderate)	0.652	0.623	1.097	1	0.295	1.920
Constant	−5.323	1.040	26.180	1	0.000	0.005

Source: Survey, 2021. df = degree of freedom. S.E = standard error. B = coefficient. Sig = significance. Exp (B) = odds ratio for the predictors.

Similarly, Table 6 shows that climate-change-governance effectiveness with moderate problems of coordination; political will and leadership; finance; policy, strategies and regulations are 3.398, 4.228, 1.967 and 4.593 times more likely to have an effect than that of high problems of with these factors, respectively. Hence, the above four variables (lack of coordination; political will and leadership; finance; and policy, strategies and regulations) have a highly significant effect on climate-change-governance effectiveness.

3.3. Interview Results

The quantitative result discussed above was also supported by our qualitative analysis. By using several interview questions, we collected qualitative responses from officials and

experts from federal, city, sub-city and Woreda levels; private sectors and NGOs. The result was summarised in Figure 6. As shown in the figure, the majority of interviewees repeatedly answer that the major constraints of climate-change governance in the city were weak enforcement of laws/regulations; lack of political willingness of officials and weak horizontal interaction of stakeholders. Lack of finance, accountability, and leadership are also part of the factors that hinder climate-change governance.

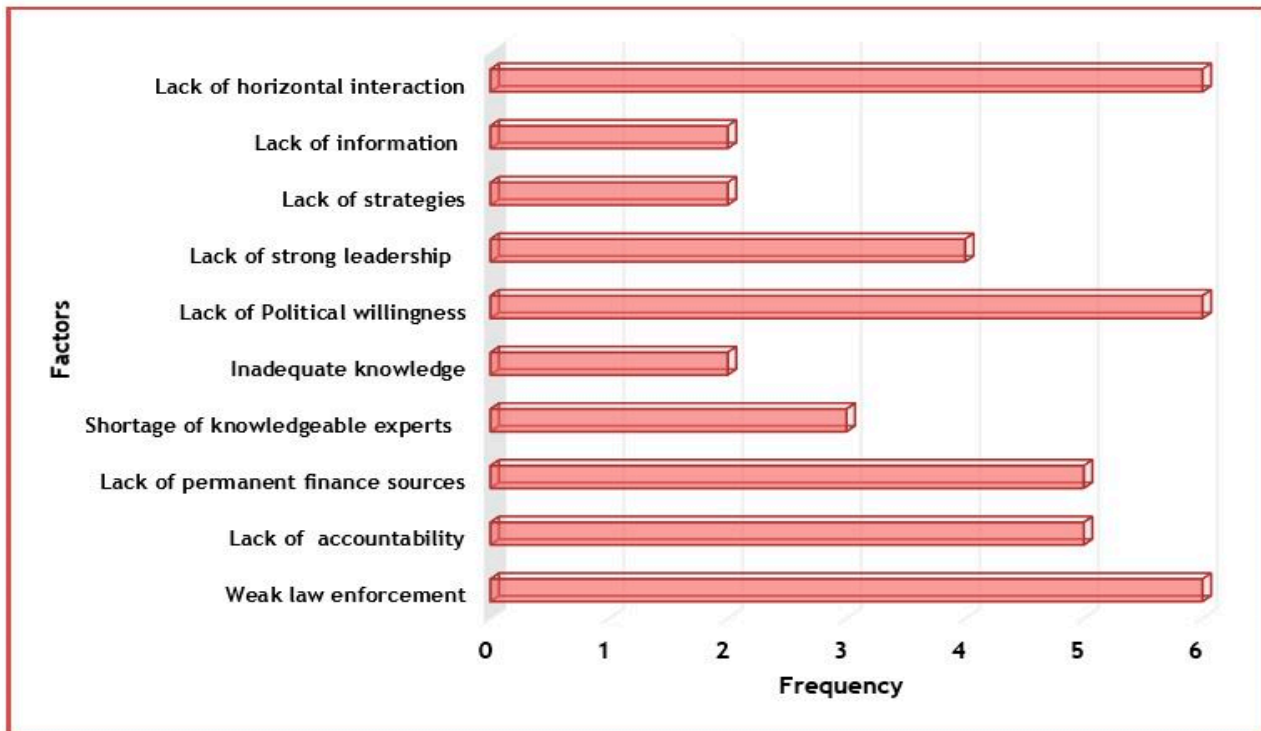


Figure 6. Factors that hinder climate-change governance in the city by professionals.

In Figure 6, we provide a summary of the top ten factors that hinder climate-change response in the city, gathered from the aforementioned interview response. Note that the figure only shows the number one responses, i.e., the most important ones according to the respondents.

To provide additional context to the results presented above, we provide a few of the interview responses as follows. An interview with AAEPGDC commissioner provides insights into the major factors that hinder climate-change response in the city. The commissioner stated that: “The major factors to take mitigation and adaptation action in city is lack of coordination of sectors and finance” [Interview, 10 August 2021]. He elaborated that, “Even though, the 2019 redesigning city administration proclamation gives the mandate to manage and control environmental issue to AAEPGDC, the proclamation lacks clarity about regulatory issue. The commission mainstreamed climate change issue in more than 23 sectors and gave training for those sectors; however, the commissioner has no authority to control, evaluate and make accountable the work of these sectors. Hence, the work of the sectors that is related to climate change issue is voluntary type activity. Although this is a very serious problem for climate change governance in the city, the commission’s major work has been planting trees. In addition, although the commission tried to establish steering committee led by the mayor, even after more than six months, it is still not functional because of several reasons, including due to the country’s security issue”.

In an interview with one of the experts of the commission, the expert said that one of the major problems of AAEPGDC, at different levels, is the constant change in leaders and weak leadership style [Interview, 21 July 2021]. Even during this study, three leaders were changed at the commission level. He added that due to a lack of legal systems,

those leaders imposed their own interests. According to the energy group leader in the commission, leaders focus on short-term goals that are politically motivated and then they ignore the long-term impact of climate change [Interview, 3 July 2021]. He added that at the commission level, for example, leaders pay more attention to the natural-resource management directorate than to climate change because the directorate mobilizes money for the commission by selling quarries in millions. On the contrary, climate-change issues need a budget, whereas leaders assume the climate-change agenda is insignificant. Hence, there is a misunderstanding by officials when it comes to climate change and its impact on economic development.

According to an interview held with a commission climate-change-mainstreaming expert regarding employees, in 2020, the city administration recruited a large number of degree holders to decrease unemployment by creating job opportunities and assigning them to different sectors using a quota system [Interview, 25 September 2021]. During that time, a large numbers of employees that were recruited, especially at Woreda level, have degrees that are not related to climate change or the environment. The majority of Woreda employees have educational backgrounds in the areas of geology, maths, physics, accounting, management, chemistry, engineering and other similar fields. Hence, a large number of experts lack an educational background related to climate change. In addition, there is a lack of training or capacity building at the sub-city and Woreda levels. During this study's data collection period, most sub-city and Woreda experts did not have knowledge of the Addis Ababa CRGE strategy. One interviewee from Bole sub-city (Woreda 6 expert) told us that the employee got the chance to take training on the Addis Ababa CRGE strategy, whereas almost all other experts did not get the training [Interview, 28 June 2021].

Interview results from the federal urban and infrastructure ministry environmental and climate-change management leader [Interview, 21 July 2021] and the federal EPGDC climate-change directorate director [Interview, 9 July 2021] revealed similar responses regarding the vertical coordination in the city. Both argued that "compared to the regional government, there was weak vertical coordination in Addis Ababa city". They said that the reason is the autonomy granted to the city, and making the assumption that the city has potential and, consequently, there is a lack of interest in obtaining support from the federal level. The federal EPGDC climate-change directorate director added that "when we call all regional and two city administration experts to give training, the Addis Ababa city commission experts did not participate."

Another example is the interview we had with the C40 adviser. The view of the advisor is: "As a city advisor in AAEPGDC, during this work, the major problem of climate change governance in the city is lack of political commitment of officials. The level of understanding about climate change is still low." He argued that "the attention of climate change response given by the city administration is very low". He added that "shortage of budget and lack of accountability system is also the major problem of climate change governance" [Interview, 12 June 2021]. The C40 advisories also reiterated that climate-change-resilient-strategy implementation has been so problematic because of poorly structured institutions and the weak cooperation of actors. Additionally, the reasons includes a weak understanding of the climate-change impacts of development on the part of policy makers and investors and a lack of action in urban areas compared to rural areas. The interviewee result of the C40 Cities Climate Leadership Group adviser indicated that new climate policy, rules, and regulations are needed to address GHG emissions in different sectors.

According to an interviewee affiliated with the City climate-change mainstreaming leader about climate-change response action [Interview, 6 July 2021], "The major problem of mitigation and adaption action is lack of political willingness of higher officials, weak leadership and lack of accountabilities". She added that, even though the commission established a steering committee led by the mayor, more than six months later the committee is not functional and repeated enquiries had not received any response.

As an example of interviewing people from private sectors, we interviewed some people from a Hujain shoes factory [Interviewee, 3 June 2021] and soufflé malt factory [Interviewee, 23 June 2021]. They indicated that the city's administration does not encourage the involvement of private sectors in preparing and implementing the climate-change strategy and plan. They also added that AAEPGDC lacks cooperation with the private sector, especially targeting issues such as, industrial emission reduction and environmental-management-plan preparation, but instead they are quite active in punishing them.

4. Discussion

Climate-change issues require support and participation not only from environmental offices or departments but also from all city administration sectors and actors. This study shows that involving only the government sectors in environmental offices for climate-change governance is not sufficient to address GHG and minimize vulnerability to climate change in the city. Thus, the result of this research determines the aspects of effective climate-change governance that are not well implemented in the city. It is clear from the study that as coordination; finance; policy, strategies, and regulations; and political willingness, and leadership improves, the effectiveness of climate-change governance will also increase. The above quantitative and qualitative results show that the effectiveness of climate-change governance is being hindered by different factors.

The major factor that hinders the effectiveness of governance in the city is a lack of coordination of actors and sectors. Even though the commission made climate-change issues mainstream across different sectors, such as transport, waste, plan commission, disaster risk management, building, health, and green development, the horizontal collaboration of these sectors in the governance process is weak. Studies found out that GHG emissions and risks in cities are not only municipal- or local-government concerns but they are also challenging for a range of actors across sectors, in creating coordination for effective climate-change governance to mitigate emissions and adaptation to climate risks [29,37,39]. Regarding the lack of coordination, the commission itself is not able and not even willing to attract the participation of NGOs and the private sector in the decision-making process. Only the C40 advisor participated actively in the climate-change action in the city. The commission is not particularly working to attract NGOs in the future. However, the federal government has one directorate, named the resource mobilization directorate, that works to attract CSOs. Our finding, in this regard, is supported by a study conducted in two cities of Africa. Studies conducted in the cities of Karonga in Malawi, and Dar es Salaam in Tanzania, also find that climate-change governance is hindered by poor collaboration between the government, private sector and CSOs [104].

Lack of political will is another major problem that hinders the response to climate change in the city. The first important thing for effective climate-change response is the political willingness of leaders in different sectors and levels [38,42]. According to the AAEPGDC, the climate-change mainstreaming team leader, the climate-change issue has lacked attention from higher officials, especially from the city administration. The reason is that the steering committee has not been functional for more than 6 months. The commissioner also argued that the steering committee incorporates different sectors and it is the most important committee for climate-change response actions, but it is not starting their work yet as the city administration gives more attention to the country's security issue and COVID-19. Security concerns and the pandemic have adversely impeded climate-change governance in Ethiopia [49].

Lack of strong leadership at the local level is another problem related to climate-change action. Leadership is an important issue because it motivates people to accomplish positive changes in the organization and play an important role in guiding who participate in the decision-making process and what actions they take. To achieve sustainable or long-term development, shaping climate-change response leadership at different levels is critical [29,43].

Weak implementation of policies, strategies and regulations is another factor that hinders the governance process. The 2014 Climate Resilient Green Growth Strategy incorporates many mitigation and adaptation strategies across different sectors. The major constraint is weak enforcement of strategies, laws, regulations, and plan. A similar study conducted in African cities, specifically in Lusaka and Durban, shows that the governance process faced serious capacity problems in executing strategies and plans, especially at the local level [48]. Even though the mandate for climate-change issues was given for EPGDC and mainstreaming is carried out across different sectors, the commission has no authority to control the sectors. Hierarchically, these sectors are accountable to the city administration and the municipality; hence, the environmental commission lacks authority over these sectors.

In addition to the weak implementation of policies, strategies and regulations, inadequate laws and legislations are also factors that determine climate-change response [24,28,32]. Climate-change issues are poorly understood by city officials and, in most cases, they assume that it is not a critical issue for our country. Hence, there is a limitation in the strategy, regulations, proclamations, and laws to address GHG emission across different sectors, including transport, waste, building, energy and others. Lack of an independent institution, which would be directly responsible for climate-change issues, is a factor that determines the local governance of climate change [17,38].

Inadequate financing for the implementation of plans or programs is another factor that hinders climate-change response. The permanent source of funds is the budget from the upper level government. The fund assigned to the work of the commission is not only for climate-change purposes and is insignificant in the first place. Furthermore, at the same time, there is lack of resource mobilization to obtain financing from different CSOs. In cities of developing countries, a shortage of financing is a major factor that hinders climate-change governance because they need budget for housing, infrastructure provision, job creation and poverty reduction [45,104]. A shortage of knowledgeable experts is another problem of climate-change response in the city. Although the number of employees, in particular, is not a problem, experts lack general climate-change knowledge. However, studies showed that experts knowledgeable on climate change are the key source of success for climate-change governance [29,33,37].

Additionally, according to the results shown above, both quantitatively and qualitatively, compared to other variables, lack of access to information is not a major factor. The study shows that information is not a major problem because the city administration holds a GHG-emission inventory every 2 years. Regarding impact and vulnerability, there are several reports that indicate that higher officials as well as the community well understood vulnerable places. Climate-change governance in cities require access to current, context-specific sources of data, including future climate predictions, GHG inventories results, climate vulnerability assessments, and impacts, such as heat waves and floods [27,34].

Finally, this study shows that, currently, lack of access to technologies is not a major problem of climate-change governance in the city. However, this does not mean that it is not a problem at all and our study shows that, in the city, there is inadequate knowledge about technologies. When it comes to climate planning, studies show that it is necessary to support climate-change response action with different technologies and technical solutions [3,32].

5. Conclusions

In Addis Ababa city, the practice of climate-change governance is ineffective. It is significantly hindered by different factors. The result of this study reveals that a lack of coordination, political will and leadership are the key problems of governance in the city, followed by inadequate finance and policy, strategy, and regulations. In addition, a shortage of knowledgeable experts and lack of access to information and technologies make their own contributions in the ineffectiveness of climate-change governance. The study also concludes that when the level of coordination, political will and leadership increase,

climate-change governance effectiveness shows improvement. Thus, the city administration should emphasise climate change like it does other crosscutting issues and should enable the steering committee by implementing a strong accountability system. In addition, the city administration should try to revise or formulate new policy, strategy or regulations, as well as establish independent institutions for climate-change issues. Specifically, the commission should create an enabling environment to attract non-state actors, and should assign one directorate to mobilise finance, following an approach undertaken by the federal environmental protection commission. The commission should also provide continuous training and capacity building to sub-city and Woreda-level leaders and experts.

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