

Article

# Effectiveness of Urban Climate Change Governance in Addis Ababa City, Ethiopia

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**Abstract:** Addis Ababa is one of the eleven cities in Africa that have been taking bold action in meeting the objectives of the Paris Agreement. At the present time, the city is working toward reducing greenhouse gas emissions and enabling the city to be resilient to the impacts of climate change. To make the city carbon neutral and resilient to climate change, the coordination of different sectors and actors is crucial. To this end, the planning and implementation of mitigation and adaptation measures needs effective climate change governance. Thus, this study was intended to explore the effectiveness of climate change governance in Addis Ababa City, Ethiopia. The study followed both quantitative and qualitative research approaches and relied on both primary and secondary data sources. A survey of 232 respondents, who were environment experts at different levels, was conducted using questionnaires. In addition, interviews and observations were conducted to gather relevant data. Secondary data were collected from different sources. The quantitative data were analysed using relative importance index (RII) analysis. The study found that existing environmental policies, strategies, regulations, proclamations, laws, and implementations in the city were facing major challenges in terms of weak accountability, the poor enforcement of regulation, and the failure to involve key actors, especially NGOs, communities, and private sectors; these failures were characterized by weak institutional setup and a lack of formal systems allowing actors (private sectors, communities, and NGOs) to interact to respond to climate change. Hence, climate change governance was ineffective in terms of accountability, participation, law enforcement, equity, institutions, the role of actors, and partnership. Thus, the Addis Ababa City Environmental Protection and Green Development Commission should give more emphasis to the coordination of other actors (NGOs, communities, private sectors, and research institutions) to respond to climate change in the city. In addition, the commission should provide training to the lower layers of experts and mobilise the community for climate change response, particularly in the undertaking of adaptation measures. Furthermore, Addis Ababa City administrators should give due attention to climate change response through an established strong accountability system to enforce regulation, rules, proclamations, laws, policies, and strategies in different sectors.

**Keywords:** climate change governance; effectiveness; Addis Ababa; mitigation; cities



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## 1. Introduction

Climate change is a globally concerning issue which strongly calls for a new governance agenda in the sectors of both theory and policy [1,2]. The growing challenges of climate change are complex and far-reaching, requiring interventions beyond a single source and actor [1,3]. Environmental problems, and climate change in particular, occur in different contexts and extents worldwide and cannot be addressed successfully by a single actor [4,5]. Climate change with cross-boundary impacts in nature has been positively impacted through climate change governance [2]. Climate change governance can therefore be described as the coordination of different institutions and actors, in horizontal and hierarchical forms, concerning climate change adaptation and mitigation actions [1,6–9].

It has also been viewed as a broad range of options of coordination concerning the prevention of greenhouse gas emissions (mitigation) and adaptation to the impacts of climate change [10,11].

Cities around the world are key in managing global carbon emissions (mitigation) and reducing vulnerability to climate change (adaptation) [12,13]. Cities occupy a unique space in terms of the causes and impacts of climate change [14]. The impacts in cities have been aggravated due to concentrated populations, high economic activity, congested transportation systems, and the construction of buildings. Furthermore, as the majority of people live in cities, more than 78% of waste is generated in cities [14]. Studies indicate that cities contribute the bulk of greenhouse gas (GHG) emissions [7,15]. Although cities cover less than 5% of the world's area [14], they produce more than 70% of the world's GHG emissions and use 80% of the world's energy [14,16,17].

Cities are also responsible for up to 75% of all global emissions of carbon dioxide from anthropogenic sources [7]. Urban areas are the largest contributors to climate change through the alteration of green covers, such as forests and grasslands, for other land uses [18]. At the same time, the projected impacts of climate change show that urban populations and infrastructure around the world are at significant risk [19]. In the face of this, cities are sites for climate action and increasingly central to the global governance of climate change, and much of their activity takes place through the interaction of governments, private sectors, and civil society at local, regional, national, and global scales [14,20]. Therefore, in an urban context, climate change governance is the set of formal and informal rules, rule-making systems, and actor networks at all levels (from local to global and from state to non-state actors), which are established to steer cities towards mitigating and adapting to climate change [6,8,9,12,21]. Climate change governance is characterized by the integration of climate adaptation and mitigation in different sectors such as energy, urban planning, transportation, water management, waste management, agriculture, health, and others that interact in various ways [1,22].

In the face of a growing global, national, and local environmental crises, good governance of the natural environment is deemed to be crucial not only for sustainable development but also for the harmonious existence of humanity with nature [23]. Owing to this, there is a growing consensus among the global actors that good environmental governance has an enduring effect on environmental actions and outcomes. Hence, in general, good environmental governance is often denoted by the effectiveness in which the environmental governance measures achieve the objective of protecting the general environment from anthropogenic hazards, as well as the optimal and sound practice of the governance systems in the reduction in environmental problems [24]. Hence, effective climate change governance must adhere to major parameters such as transparency, accountability, public participation, law enforcement, the ensuring of citizen awareness, coordination, information sharing, fairness, justice, and the involvement of actors and institutions [25–29].

Although there is no single governance solution to climate change, coordination and participation among multiple actors in the reduction in GHGs, climate risk identification, and in the prioritization and implementation of adaptation measures is known to lead to more effective urban climate change governance [30]. The effectiveness of governance in responding to climate change in cities depends on human resources, financial resources, legal frameworks, and legitimate institutions [7,31]. Scientific information is also necessary in creating a strong foundation for effective urban climate change governance [32]. In addition, effective climate change solutions should include the cooperation of various institutions and actors at different levels, whether in the prevention of greenhouse gas emissions (mitigation) or in the process of adaptation to the impacts of climate change [1,33]. According to [23], rule of law, citizens' rights of access to environmental information, meaningful participation of the wider public in environmental matters, and justice are the bases for achieving environmentally sustainable development.

Effective urban climate change governance should incorporate principles of justice in order for vulnerable groups to be represented in adaptation and mitigation planning processes, issue framing, as well as recognizing their particular needs and actions [34]. Key factors that shape responses to mitigation and adaptation measures include effective policy and strategy, coordination of different sectors, and strong municipal governance in key areas, especially in energy, transportation, and waste management [7,35]. Political commitment and mainstreaming of adaptation and mitigation measures in cities' development agendas are crucial for sustainability [36]. Having accurate scientific information about local GHG emissions and the impacts of climate change on a city is essential to take adaptation and mitigation responses [31].

Due to the growing recognition of climate change problems as a result of GHG emissions in cities, the 1990s were seen as a turning point for climate change response [6,21]. The development of the UN Framework Convention on Climate Change (FCCC), the Kyoto Protocol, and the 2015 Paris agreement are the backbone of the existing global governance system [10,12]. Even though there is a strong global consensus that climatic changes must be addressed through the coordination of actors at different level [10], measures addressing it in cities through existing governance arrangements are still far from what is required [11,37]. In summary, rather than climate action, for many cities around the globe, traditional matters, such as housing provision, sanitation, and waste disposal, are the more urgent areas for governance. Climate change remains ungoverned in cities [14,38], leaving a gap between policy rhetoric and action on the ground [14,32].

Especially in cities in developing countries, climate change governance lacks active engagement from urban actors [39]. According to [40], in most cities in developing countries, urban governments do not fully deliver their responsibilities due to various existing institutional arrangements, such as shortages of resources, inadequate capacity and weak frameworks for the engagement of actors, and weakening urban governance. Accordingly, many cities in Africa are more vulnerable to the impacts of climate change due to unplanned urbanization, lack of necessary risk-reducing infrastructure, services, and failures in urban governance [41,42]. Other challenges of climate change governance in African cities arise from lack of clarity in the assignment of responsibilities, lack of ownership over implementation, lack of resources, insufficient coordination, low political will, low private sector participation, and ineffective communication practices [43,44].

Ethiopia, an African country, faced the challenge of the governance of environmental issues [45]. Environmental law is poorly enforced, and there is weak inter-sectorial coordination and stakeholder participation and low synergy among actors in initiating development programs [46]. With low levels of environmental awareness, private companies lack adequate policies and management plans to discharge their corporate responsibility and safeguard the natural environment [47]. Enforcement of environmental regulations is often constrained by a number of institutional and resource user-constituency factors, thereby ensuing numerous social and economic harms to the wider society and the economy at large [48]. There are considerable discrepancies between those environmental commitments made by the country and the actual implementation [47]. Even though the country is championing global sustainable development, the economic component of sustainable development is given more emphasis than its environmental component [45]. Moreover, the country failed to meaningfully involve stakeholders at all levels of society, particularly at the local level [49].

The notion of urban development practice in Ethiopia involves destroying the environment rather than protecting it [50]. The climate resilience green economy (CRGE) document indicates that under current practices, greenhouse gas emission will more than double from 150 Mt CO<sub>2</sub>e in 2010 to 400 Mt CO<sub>2</sub>e in 2030, which indicates an increase of 250 Mt CO<sub>2</sub>e [51]. Out of this amount, about 42% of the increase or 105 Mt CO<sub>2</sub>e is expected to be from urban areas (transportation, building, wastes, and industries) [52]. If no further action is taken, GHG emission in the cities will increase by six-fold from 20 Mt CO<sub>2</sub>e in 2011 to 125 Mt CO<sub>2</sub>e by 2030 [52]. Addis Ababa, the capital city of Ethiopia, has experienced a

rapid rate of population growth and unprecedented spatial expansion (3.2% per year). As a result, the ecosystem services of the city are affected haphazardly [53]. More than 35% of the solid waste generated by the city is not collected [40]. The air quality in the city is affected by emissions from transport, dust from traffic roads, discharge from industrial activities, construction operations, and other overall land-use practices. According to [54], the mean value of total suspended particulate matter (TSP) was about  $195 \mu\text{g}/\text{m}^3$ , which is above the WHO safe guideline value ( $120 \mu\text{g}/\text{m}^3$ ). From the total number of vehicles registered in the country, Addis Ababa has about 70% of them, and most of the vehicles in the city are older than 15 years and consume large amounts of fuel. The emission of pollutants from these vehicles causes environmental risk in Addis Ababa [55].

Because of the increase in population, the Urban Heat Island phenomenon also became a feature of Addis Ababa [56,57]. The city is more exposed to heat waves, drought, and severe floods [58–60]. Looking at the future, the city's urban heat island exhibits a clear upward trend [57,61]. Addis Ababa Green House Gas Inventory results in 2016 show that transport and waste sector emissions grew by six- and two-fold, respectively, as compared to the results in 2012. In addition, the emissions increased from 1.17 to 2.9 t per capita from 2012 to 2016 [62]. Going forward, the maximum and minimum temperatures in Addis Ababa have shown increasing value. In addition, an overall increase in rainfall variability will be expected [56,57].

Moreover, although a lot of attention is being given to the green areas as a part of the city's development plan, the real practice is the opposite. The threshold value of minimum green space per capita has been defined by the World Health Organization as  $9 \text{ m}^2$ , while Addis Ababa attains only  $0.4 \text{ m}^2$  per capita. The disappearance of green space accounts for 40% of the flooding and landslides in the city and the recurrence of flooding is already costing ETB 0.21 million per event and estimated to be USD 6800 per year for emergency assistance at the city administration level [40]. The vulnerability to flooding is more aggravated due to a poor drainage system and rapid informal housing development, and the cause of the increase in peak flow of flood is due to climate change and urbanization [63]. Addis Ababa is vulnerable to climate change impacts and the combination of climate change and development pressures are expected to aggravate the current situation [59].

Based on the environmental policy of the country, the Addis Ababa city administration has adopted different environmental policies, strategies, proclamations, and regulations to manage the environment in general and climate change in particular. The city administration started to implement Climate Resilience Green growth and integrated climate change response strategy to minimize GHG emissions and reduce the vulnerability of the city. Even though the city government has tried to manage climate change, there still is a state-dominant governing system in the city. The powers vested in government organs for making decisions on environmental issues is for administration organs at various levels rather than the environment departments [64]. Institutional and legal frameworks that share responsibilities and accountabilities between the government, the private sector, and civil society organizations are not clearly defined [45]. Policies and strategies have been initiated; however, there are still gaps that need to be addressed, such as a lack of horizontal and vertical coordination between sectors to manage climate-sensitive resources; the poor capacity of local governments, sub-cities, and Woredas; lack of awareness on existing policies and regulations; shortage of skilled manpower; shortage of finances; accountability; and a lack of clear roles and responsibilities of various ministries, agencies, authorities, and offices [40]. The participation of communities, NGOs, CBOs, and affected stakeholders is limited. Decentralization, private–public partnership, transparency, and accountability were not well implemented in the city [40]. The major governance challenge in the city is implementing the intended plans [65].

Several researchers, such as [56], have investigate the trend of climate change with water shortage; [59] conducted a climate-change-induced risk analysis of Addis Ababa city. The flood risk and vulnerability of Addis Ababa city due to climate change was conducted

by [63], and assessment of present and projected climate change in Addis Ababa was analysed by [61]. Using a GIS-based method, the quantification and mapping of climate change and vulnerability hotspots in Addis Ababa city was conducted by [66]. Climate-change-induced heat wave hazards in Dar es Salaam and Addis Ababa were evaluated by [67]. Vulnerability of the city to climate change [66] and air pollution through vehicle emission are the major problems in the city [55]. All of the above studies have focused on the analyses of climate change scenarios, impacts, and vulnerabilities of the urban systems in Addis Ababa, but thus far, there has been no attempt made to integrate actors to respond to climate change.

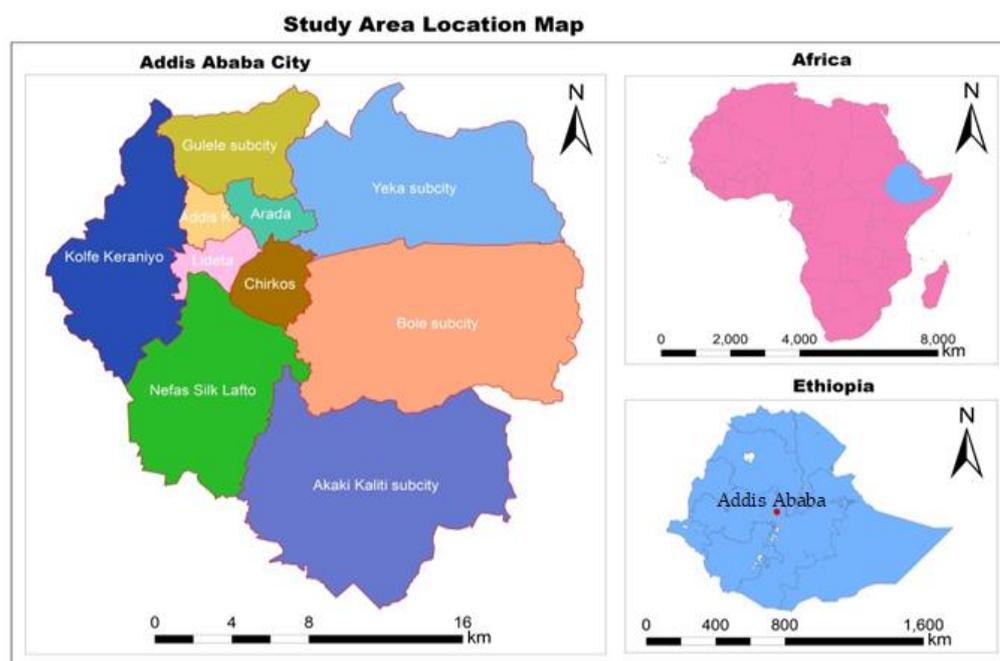
Additionally, a study conducted by [14] shows that the urban climate governance literature is still dominated by studies and scholars from the global north, with more than 86% being predominantly in North America and Europe. Despite the rapid growth in the urban climate governance literature, the knowledge from cities in the developing countries is still piecemeal. Some studies conducted in cities of developing countries include: governance framework to mitigate climate change in India conducted by [68]; the implications for urban climate change governance in West Africa studied by [69]; pathways to international cooperation on climate governance in China studied by [70]; cities and climate change mitigation in three Asian cities Kolkata, India Palembang, Indonesia, Johor Bahru, studied by [71]; the urban governance of climate change adaptation in least-developed African countries studied by [72]; and urban climate change governance within centralized governments in Egyptian cities studied by [73].

Therefore, it is important to ask about what climate change governance looks like in Addis Ababa, one of the cities of developing countries? To give a concrete answer for this question, examining the existing practice and conducting empirical scientific research is a necessity. In this regard, several global scientific research works [1,6–8,15,34,74] have been conducted. However, those studies focused on qualitative comparative analysis in the developed cities and failed to examine quantitatively in developing cities. Studies on cities in developing countries conducted by [30,43,68,71–73] also used only qualitative analysis methods by using secondary sources. Therefore, this research is initiated to explore the practice of climate change governance in Addis Ababa City. The coordination of different tiers of government, vertically (federal, city, sub-city, and Woreda level) and horizontally (government, private sectors, and civil societies) are crucial to minimizing the current climate change in the city. Hence, the main objective of the study was to explore climate change governance practice in the city of Addis Ababa.

## 2. Methodology

### 2.1. Study Area Description

Addis Ababa is located in the central part of Ethiopia and astronomically lies between  $9^{\circ}1'48''$  N latitude and  $38^{\circ}44'24''$  E longitude. The city covers a total area of 540 sq.Km [75]. Its altitude ranges from 2100 m, in Akaki in the south part, to above 3000 m above sea level, in Entoto Mountain in the north part. This makes Addis Ababa the city with the third-highest altitude in the world, after La Paz and Quito, which are cities in Latin America [75]. Its administrative structure is divided into three tiers of government: the city administration level, which is the highest tier; a middle level, which is accountable to the city administration, called the sub-city; and the woreda level, which is the lowest administrative hierarchy, having from 10 to 13 woredas per sub-city and currently totalling 116 woredas in the city. In the city, there is topography variability, particularly between the northern and southern parts. The altitude and slope decrease from north to south. The northern part of the city is part of the Entoto Mountain, which stretches in the east–west direction and is characterized by steep slopes with high mountains and flat-topped plateaus while the southern part of the city is part of Akaki sub-city, which has a gentle slope to flat (Figure 1).



**Figure 1.** Map Showing the Location of Addis Ababa City. Note: the pink part is Africa, the blue part is Ethiopia and the red circle is Addis Ababa.

Addis Ababa is the only primate city that dominates the political, economic, and historical issues of the country. It was established in 1887 by emperor Menilik II. It has the status of both a city and a state. It is the capital of the federal government, and it is also the headquarters of the African Union. It also hosts the headquarters of the United Nations Economic Commission for Africa (UNECA) and numerous other multinational and international organizations. It is the largest city in Ethiopia. The population of the city in 2022 was 3,560,000, out of which 1,522,000 are male and 2,038,000 are female [76]. The city accounts for 32.27% of the total urban population of the country. With the current population growth rate of 3.8%, the city's population is estimated to reach 9.8 million in 2037, and it has experienced an urban land expansion rate of 3.2% per year [53].

## 2.2. Climate of Addis Ababa City

Addis Ababa has a subtropical highland climate. The city has a mix of highland climate zones, with average temperature differences of up to 12.2 °C, depending on elevation and prevailing wind patterns (Bureau of Finance and Economic Development of Addis Ababa, 2013). Figure 2 shows the climate data of Addis Ababa, which are analysed on the basis of temperature and rainfall data. The analysis was conducted with 36 years (1982–2018) of data from 56 stations obtained from Addis Ababa Observatory [77]. Data were segmented into three periods' averages, and the magnitude of change in temperature within the last 36 years was computed. The analysis shows that both maximum and minimum temperature is increasing. The average maximum temperature from 1982 to 1992 was 23.1 °C, while from 1992 to 2002, the average maximum temperature was 24.0 °C. From 2002 to 2012, the average maximum temperature increased to 24.8 °C. Finally, from 2012 to 2018 the average maximum temperature increased to 25.5 °C. This shows that the rate of change in recent years is greater, and the temperature has increased faster over the last two decades than during the previous decade. Furthermore, the average minimum temperature increased from 9.7 °C in the period from 1982 to 1992 to 10.9 °C for the period from 1992 to 2002 and to 11.7 °C for the period from 2002 to 2012 (Figure 2). Mean annual rainfall distribution over the city for the last 36 years was characterized by three months of heavy rainfall each year with long and dry periods. The average annual rainfall at the Addis Ababa observatory station from 1982 to 2000 was 1036 mm, while the average mean value from 2000 to 2018

was 935 mm. Although the average rainfall did not show a significant change, it did show significant variability within each decade (Figure 3) [77].

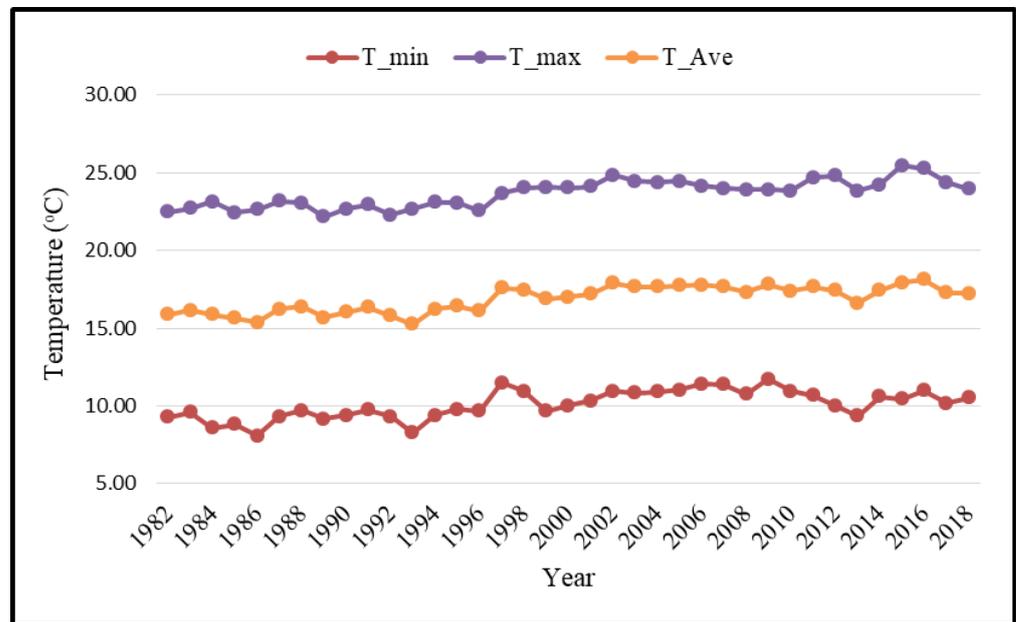


Figure 2. Annual minimum, maximum, average temperature.

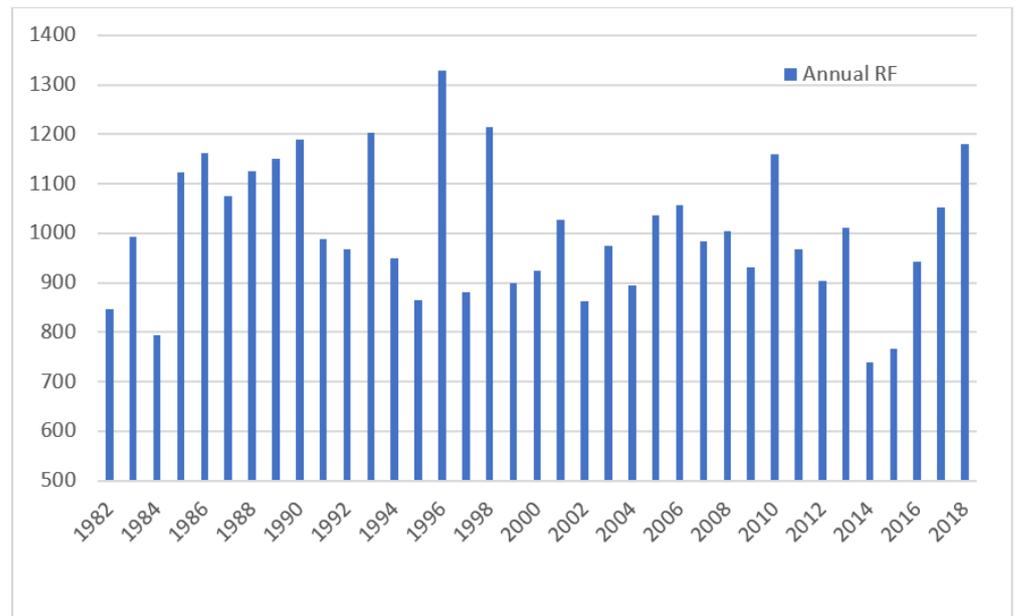


Figure 3. Annual rain fall.

### 2.3. GHG Emission Trend in Addis Ababa City

Adopted from the national CRGE, the Addis Ababa City Administration has also stressed the achievement a vision of middle-income status by 2025 in a climate-resilient green economy and net carbon zero economic growth by 2030, indicating a 64% reduction against the BAU scenario [78]. To actualize the dream of the city’s design targeted GHG reduction actions, the first step is accounting city-wide GHG emissions. Thus, the 2012 Addis Ababa GHG inventory was conducted on the basis of activities taking place within the city, assessing GHG emissions that occur inside the city boundary as well as outside the city boundary.

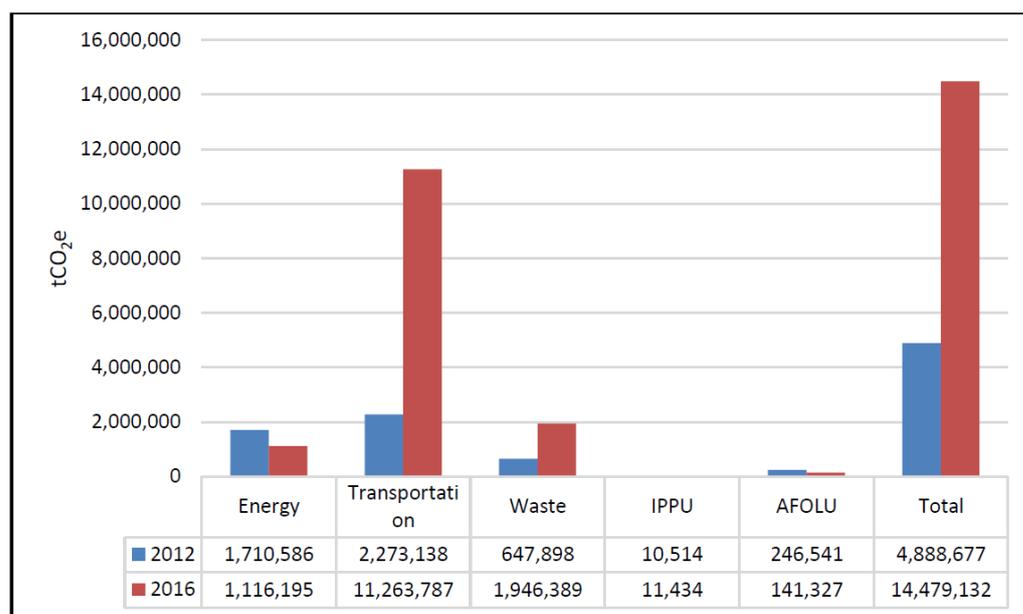
To this end, Addis Ababa city has implemented GHG inventory activities twice prior to the CRGE envision, that is, the first and the second GHG inventories conducted in 2012 and 2016, respectively [79]. The inventories identified sources of emissions and serve as a baseline for setting emission reduction goals and future benchmarking. The city's climate actions goals and targets have shown that the city has a determination to meet their climate-resilient and net zero emission reduction targets by 2030.

The 2012 GHG inventory for Addis Ababa showed that the city generated a total of 4.89 Mt CO<sub>2</sub>e, and per capita emissions for the city, which is home to a quarter of Ethiopia's urban population, were found to be 1.6 tCO<sub>2</sub>e per capita (Addis Ababa City Administration, 2012). The breakdown of total emission of the city by sub-sector indicates that transportation accounts for the highest emissions, which is about 47%, followed by stationery energy (35%), waste (13%), and agriculture, forestry, and other land use (AFOLU) (5%) [52]. The city's second round of the Green House Gas inventory in 2016 showed that the city generated a total of 14.48 million tonnes CO<sub>2</sub>e in that year. Per capita emissions for the city were found to be 4.3 tCO<sub>2</sub>e per capita (Addis Ababa City Environmental Protection and Green Development Commission and C40 climate leadership group, 2020). The breakdown of total emissions of the city by sub-sector indicates that transportation accounts for the highest emissions, which is about 78%, followed by waste (13%), stationery energy (8%), and agriculture, forestry, and other land use (AFOLU) (1%) (Addis Ababa City Environmental Protection and Green Development Commission and C40 climate leadership group, 2020).

The 2016 Addis Ababa GHG inventory enables a comparison to be made with the previous emissions inventory, compiled in 2012. An emission trend summarized in Figure 3 has shown an increase in total GHG emissions in the city over this period. Greenhouse gas in Addis Ababa emitted 14.48 million tonnes CO<sub>2</sub>e (14,479,133 tCO<sub>2</sub>e) in 2016. This estimation covers the energy, transport, and waste sectors. The transport sector was found to be the highest emitter, accounting for 78% of the total emissions, followed by the waste sector at 13% and the stationary energy sector at 8%. An analysis of Addis Ababa's GHG emissions in 2016 indicated a ~3 times increase in emissions compared with the first emissions inventory, prepared in 2012. The growth has been attributed to the rise in emissions from the transport by 8,990,649 tCO<sub>2</sub>e due to more fuel being consumed and existence of old vehicles. Emissions from waste are around 1,298,491 tCO<sub>2</sub>e higher in 2016 than 2012 due to a reduction in total waste arising sent to landfill and an increase in composting. Whereas the source from the stationery energy has been reduced dramatically by 594,391 tCO<sub>2</sub>e; this is due to improvements in generation efficiency and electricity consumption by residents. At the same time, emissions from AFOLU are around 105,214 tCO<sub>2</sub>e lower in 2016 than 2012 due to a reduction in total number of livestock and minimum application of fertilizer (Figure 4) [62]. This indicates that the Green House Gas emissions of the city in an increasing trend.

#### *2.4. Climate Change Strategy in Addis Ababa City*

Effective climate change policies and strategies that aim at mitigating GHGs emission or adapting to the impact of climate change are very crucial to achieve sustainable development. In recent years, countries have specific climate policies to respond to climate change. In Ethiopia, before 2011, the national policies and strategies regarding to climate change had not been given due attention in urban areas. Starting from 2011, Ethiopia has initiated the Climate-Resilient Green Economy to protect the country from the adverse impacts of climate change and to build a green economy that will help realize its ambition of reaching middle-income status by 2025 [78]. Ethiopia is one of the countries to have signed the Paris Agreement and has a Climate Resilience Green Economy Strategy (CRGE) that is aimed at reducing emissions by 64% in 2030 from the 2010 baseline. The CRGE will form an important part of the journey towards achieving carbon neutrality in 2050.



**Figure 4.** Comparison of GHG emission between 2012 and 2016 inventory.

Addis Ababa has a vision to create a clean, resilient, and liveable city for its inhabitants. The city recognizes that it is difficult to meet the vision without incorporating climate change into city plan and action agenda. Upon the release of the national CRGE strategy in 2011 by the federal government, the city has incorporated climate change and other issues in order to achieve compatible development. To this end, the Addis Ababa city Administration initiated a plan called Addis Ababa Climate Resilient Green Growth Plan and Integrated Climate Change Response Investment Plan (CRGCP) in 2014 [80]. This plan has been incorporated climate change response measures both (mitigation and adaptation) in different sectors such as: land (integrated land use planning), buildings and settlements, roads and transport and related infrastructures, green infrastructures and open spaces, water, energy, waste, industry, tourism, urban agriculture, health, population, and others. The Addis Ababa City Environmental Protection and Green development Commission are also mainstreaming climate change response actions in more than 26 sectors.

### 2.5. Sampling Techniques

The data for this study were collected from experts that were taken from three levels of administrative form of Addis Ababa city Environmental protection and green development commission: at the city level, at the sub-city level (from all 10 sub-cities), and at level 2 Woredas from each sub-city (20). Because of the existence of different directorate and work processes such as green area development, river basin development, forest management, natural resource management, climate change and pollution, and others, climate change and pollution experts were taken purposively in order to acquire valuable data. Lastly, because of the small number of respondents, a large number of experts were selected. Therefore, for this study, stratified, purposive, and census data were applied. A total of 232 expert respondents were purposely selected for study: 17 at the city level, 67 at the sub-city level, and 148 at Woreda level. Purposive sampling techniques were also applied, including sampling from government officials at different level, key informants from the residents, business firm's representatives, and from civil society organization heads in order to acquire in-depth information about the research in many directions. A total of 25 respondents participated in depth interview from different sectors and actors.

### 2.6. Method of Data Collection

In this study, both primary and secondary data sources were used to collect quantitative and qualitative data. The quantitative data were collected using questionnaires, which

consisted of five-point Likert scale questions and were distributed to 232 experts from the Environmental protection office at city, sub-city, and Woreda levels. It is designed to generate data about climate change governance indicators. In addition, interviews, secondary data, and observations were conducted to support and substantiate the data collected via survey questionnaire. A systematic review of relevant books, research journal articles, policies, strategies, rules, regulations, proclamations, reports, minutes, and other literature related to climate change and urban governance issues were synthesized to produce sound scientific paper.

## 2.7. Method of Data Analysis

### 2.7.1. Quantitative Data Analysis Method

Several multilateral agencies use good governance as a policy description to indicate optimum governance of countries. When we discuss the environment, good governance often denotes the effectiveness in which the environmental governance measures should achieve the objective of protecting the general environment from anthropogenic hazard and the term effectiveness represent an optimal and sound practice of the governance system in reduction in environmental problems. Climate change governance, being a rapidly growing research agenda among academics, development partners, and consultants, there has been debates as to which indicators or variables to use in quantifying the effectiveness of environmental governance in general and climate change governance in particular. Different approaches are used by scholars to measure environmental governance, depending on the specific set of goals. For this research, based on theoretical and empirical literature, nine indices have been chosen to measure the level of governance related to climate change, involving specific 43 indicators. The indices are adapted from many researchers including: accountability, participation, equity/fairness, awareness rising, institution, actors, climate change law, law enforcement, partnership [26–29,81–84]. For this study, the data analysis method adapted from the above sources is used to measure effectiveness of climate change governance. Hence, effective climate change governance is assumed to be the result of interaction among the nine components, which were used to measure effective climate change governance, and the indexation is used to create a single measure of climate change governance by using nine components. The quantitative data were analysed by using SPSS (26.0) software. The methodology places multiple indicators under the broad nine components and 43 specific indicators. A composite index approach was used to calculate effectiveness of climate change governance. To produce a single result, the following steps were applied.

First the data collected through Likert-type questions were normalized to bring consistency using the Relative Importance Index formula for each of the indicators.

$$\text{RII} = \text{Sum of weights } (W_1 + W_2 + W_3 + \dots + W_n) / A \times N$$

where  $W$  = weights given to each factor by the respondents and will range from 1 to 5, where '1' is less significant and '5' is extremely significant.

Equation (1):

$$\text{RII} = \Sigma W / (A \times N) \quad (1)$$

where

$W$  = weighting as assigned on Likert's scale by each respondent in a range from 1 to 5, where 1 = strongly disagree, 2 = Disagree, 3 = Natural, 4 = Agree and 5 = strongly agree;

$A$  = Highest weight (here it is 5).

$N$  = Total number in the sample.

Second, after each variable was standardised, the value for the nine components were averaged using:

$$V1 = \Sigma(I) / N \quad (2)$$

where  $V_1$  = the value for one of the nine indices,  $\Sigma(I)$  represents the sum of standardised value for variables under the first indicator, and  $N$  = stands for number of variables in the first indicator.

Third, once the values for each of the nine indices were calculated, they were averaged using Equation (3) to obtain a single measure of climate change governance by using 9 major indicators and 43 specific components. The climate change governance index was computed as a raw sum of the different variables divided by the number of variables for each of the 9 components, which was latter aggregated to acquire the composite index by multiplying the respective index value with the weights attached to each index (i.e., number of variables that formed each component). Thus, if the result of indexed value is  $\leq 0.50$ , the climate change governance is ineffective:

$$X = \frac{(A_1 \times W_1) + (A_2 \times W_2) + (A_3 \times W_3) + \dots + (A_9 \times W_9)}{\sum_{i=1}^{n=9} (W_i)} \quad (3)$$

$X$  = Composite index;

$A$  = Indicator;

$W$  = Weight of specific index.

### 2.7.2. Qualitative Data Analysis Method

The qualitative data were collected using interviews; secondary sources and observations were prepared in Amharic language. Then, the data were translated into English. Subsequently, the data were repeatedly read and coded, and similarities between the data were identified using NVivo (10.1) software (NVivo is a software program developed by QSR International based in Burlington, MA, USA). The results from qualitative studies were analysed by using a thematic area approach and summarised in the form of texts and direct quotes along with the quantitative survey results.

## 3. Result and Discussion

### 3.1. Climate Change Governance Indicators in Addis Ababa City

Realizing good urban climate change governance is a prerequisite to ensuring sustainable urban development. Hence, nine major indicators with forty-three specific components were used to determine the existence of good or effective climate change governance in Addis Ababa City. It is clear that as participation, accountability, equity, awareness rising, institutions, actors, climate change law, law enforcement, and partnership increase, the effectiveness of climate change governance increases, which, in turn, greatly contributes to sustainable city development. Below, the indicators of effective climate change governance in the city are discussed.

#### 3.1.1. Participation Indicator

Participation of actors in climate change governance was broken down into seven specific components in order to evaluate participation. In response to the first component, participation of private sectors in the planning of climate change governance measures has a value of 0.40, while the early-phase planning and problem identification of civic associations is 0.41 and the participation of the community in climate change response actions is 0.51.

In terms of the private sector, we found that the result for participation in the implementation of adaptation and mitigation measures is 0.51. With regard to the engagement of civic associations in the implementation of adaptation and mitigation measures, the result is 0.43. Related to the existence of public forums about climate change issues, the result is 0.42. Moreover, the survey result indicates that involvement of other government sectors in climate change governance is 0.52.

The above result indicates that in the planning phase, the CSOs and the private sector have shown weak engagement, whereas in the implementation of climate change

action, especially in the planting of trees, the private sector and the community both show good performance. In the city, there is a lack of inclusive planning, especially in terms of the involvement of the private sector and civil society [85]. The participation of CSOs, communities and private sectors in the decision-making process of climate change issues is poor compared to the city stakeholders of the Addis Ababa City Environmental Protection and Green Development Commission (AAEPGDC) (Table 1). When we see the general survey results, actors' participation in climate change response is not effective, as indicated by result of 0.45.

**Table 1.** Participation indicators.

Participation (0.45)	Index Result
Your office invited private sectors in planning of climate change governance measures	0.40
Civic associations are involved in planning of climate change governance measures	0.41
Your office invited the community in climate change response actions	0.51
Private sectors are involved in implementation of adaptation and mitigation measures	0.51
Your office participates civic associations in the implementation of adaptation and mitigation measures	0.43
Your office prepared public forum about climate change issues	0.42
Other government offices are involved in Climate Change Governance (CCG)	0.52

Source: Survey, 2020.

The interview with the Addis Ababa Environmental Protection Green Development Commission Commissioner and the Climate Change Work process head revealed that the general participation of actors (private sectors, the public, and CSOs) is poor. However, due to the existence of the country's green legacy, the private sector and the communities are participating in planting trees. Literature surveys show that more effective urban climate change governance needs the participation of multiple actors in the reduction of GHGs and in climate risk identification, prioritization, and implementation of adaptation measures [30]. Challenges of climate change governance in African cities arise due to insufficient coordination and low private sector participation [43,44]. In the Ethiopian context, despite a genuine interest in the participatory governance principles, a highly centralized approach is being implemented, with a government party making all major decisions while some limited room is left for citizen participation [40,46]. (A study conducted by [65] shows that Addis Ababa city faced a problem of good governance, which is manifested by top-down and non-participatory approaches to the governance system.)

### 3.1.2. Accountability Indicators

The accountability indicator in climate change governance is considered as the sum of six components, as indicated in Table 2. The results show that there is a lack of accountability in government bodies when they make decisions that aggravate climate change (0.21). Similarly, the results shows that roles and responsibilities of the office are not clear in terms of climate change response measures (0.32). By the same token, the survey response has generated a negative outcome for the rest of the four major components of accountability. The result for lack of accountability when they deviate climate change protection law is 0.24; the result for lack of timely responses to communities vulnerable to climate change is 0.31; the result for poor clear performance audit of the office budget for climate change activities is 0.38; and finally, the result for the climate change governance not being consistent with the respective climate laws is 0.22. This indicates that there is a poor exercise of accountability in relation to clarity of roles and responsibilities, whereas the government bodies across relevant tiers are exercising weak accountability to respond to their actions, and inconsistent practice on the part of the government bodies prevails in undertaking climate change actions. Among the six component indicators of accountability, there was

no component that received a positive response. Thus, the study indicated that there is very weak practice of accountability in climate change governance (0.28) (Table 2).

**Table 2.** Indicators of accountability.

Accountability (0.28)	Index Result
Government bodies are held accountable when they decide that aggravate climate change	0.21
The roles and responsibilities of your office is clear in terms of climate change response measures	0.32
Your office are held accountable when they deviate climate change protection law	0.24
Your office timely responds to vulnerable community to climate change	0.31
There are clear performance audit of your office budget for climate change activity	0.38
Decisions in your office in terms of CCG (climate change governance) are consistent with the respective climate laws	0.22

Source: Survey, 2020.

The above quantitative findings were also supported by the qualitative information collected from interviews and secondary sources. The interviews extracted from the Addis Ababa City Environmental Protection and Green Development Commission commissioner and the climate change team leader indicates that even though the commissioner was working in mainstreaming climate change issues among more than 22 organizations at the city level, there is still a lack of clear system of accountability regarding the GHG reduction and adaptation response. At the same time, interview responses from the federal environment and the Green Development Commission have also shown consistent results similar to the above findings. In particular, the Federal Climate Change Directorate director has responded that Addis Ababa city has top-down organizational structure problems as a result of being autonomous, which, in turn, leads to weak accountability and ineffective governance practice.

In Addis Ababa city, the existing practice of the governance system follows top-down decision-making structures. Furthermore, a weak accountability system and the absence of mechanisms to engage non-government stakeholders are major obstacles for effective urban governance [85]. According to [45], in Ethiopia, institutional and legal frameworks that share responsibilities and accountabilities between the government, the private sector, and civil society organizations are not clearly defined. In a country with a low level of environmental awareness, private companies lack adequate policy and management plans in order to discharge their corporate responsibility and safeguard the natural environment [47]. Effective environmental governance needs implementation of transparency and accountability parameters [25,28].

### 3.1.3. Equity Indicator

In order to capture the extent of equity, only two indicator components were conducted in relation to the governance of climate change. The responses to the first component have shown that there is no clear policy, strategy, or plan that supports the poor or the most vulnerable (0.39). In terms of women's involvement in climate change response measures, the result is 0.48. In general, climate change governance activities have not been implemented by practicing equity principles (Table 3). Effective urban climate change governance should incorporate principles of justice in order to represent vulnerable groups in the adaptation and mitigation planning processes, issue framing, and setting and to recognize the particular needs and actions of vulnerable groups [32,34].

**Table 3.** Indicators of Equity.

Equity (0.44)	Index Result
There are pro-poor policy to climate change response	0.39
Your office involved women actively in climate change governance	0.48

Source: Survey, 2020.

### 3.1.4. Indicators of Awareness Creation

In order to understand the extent of awareness in climate change governance, six indicator components were considered. Regarding awareness-raising practices in relation to climate change measures for actors, the result looks positive (0.79). The rest of the five components indicated poor performance regarding awareness creation about climate change and its response in different actors, including their employees. Specifically, the result indicated a poor awareness creation campaign for the communities (0.48), poor existence of training programs about climate change adaptation and mitigation measures (0.49), low participation of employs in training/meetings related to climate change governance (0.42), poor change about climate change governance (0.43), and low awareness of the experts about climate change actions (0.47). Hence, it can be said that there has been awareness-raising practices, especially for stakeholders, but there are challenges in terms of knowledge, attitude, and skills about the climate change response action of experts. In general, there is a growing tendency in the level of awareness among actors with regard to climate change action and governance compared to the past, and the responses to these components have shown positive results (Table 4).

**Table 4.** Indicators of awareness.

Awareness Raising (0.51)	Index Result
There are awareness raising practice for actors about climate change measures	0.79
There are awareness creation campaign for the communities about climate change and its measures	0.48
There are training programs about climate change adaptation and mitigation measures	0.49
You are participated in training/meeting related to climate change governance	0.42
Training efforts have been able to change your attitudes about climate change governance	0.43
You are well aware about climate change Actions	0.47

Source: Survey, 2020.

Evidences from the Addis Ababa City Environment and Green Development Climate Change Team Leader interviews have shown that training and awareness creation campaigns were held at the city level for around 26 sectors' stakeholders for the commission. The leader added that there will be a plan for training sub-city and Woreda experts. However, at present time, there is lack of expert training at the sub-city and Woreda levels as well as awareness-creation campaign about climate change and its response in the city's residents. Other interviews held with sub-city- and Woreda-level experts also revealed that they did not receive training about climate change and its actions. A study conducted in Kenya revealed that awareness-raising campaigns about climate change issues among the community is very important for an effective response to climate change [25]. Having accurate scientific information about local GHG emissions and the impacts of climate change on a city is essential to make adaptation and mitigation responses [31].

### 3.1.5. Institutional Indicators

The existence of an adequate number of environmental institutions, adequate resources, clear regulation, and systems together with the engagement of local community-based organizations were the major indicator components used to measure the institutional factor for climate change governance effectiveness. Hence, the results have shown that there were no adequate environmental institutions in charge of specific climate change issues in the local and upper levels (0.40). Additionally, governance decisions are not solely carried out by the local-level institutions (0.42), and they also lack the necessary support from upper-level government (0.43). Regarding the adequacy of the resource capacity to enact a climate change response, the results show that there are inadequate resources at Woreda level, sub-city level, and even at the city level (0.39). Regarding the involvement of

CBOs (community-based organizations) in climate change decisions, the results show a lack of involvement of communities (0.40) (Table 5).

**Table 5.** Indicators of institutions.

Institutions (0.41)	Index Result
There are adequate Environmental Institutions in the locality with clear mandate to coordinate Environmental protection	0.40
Climate change governance decisions are carried out solely by local level institutions or without intervention of upper levels	0.42
Climate change governances are carried out with adequate support from the upper level government	0.43
Your office has adequate resource capacity to coordinate climate change governance	0.39
CBOs (community based organizations) have significant role in climate change governance	0.40

Source: Survey, 2020.

Interviews with sub-city and Woreda team leaders about institutions have shown that adequate local governmental environmental institutions, which coordinate environmental issues, have failed to give attention to climate change and have been unable to provide a clear allocation of mandates. Even though there are local environmental institutions which coordinate environmental protection and governance activities, they have not been creating an enabling environment for CBO, NGO, or private sector actors. Thus, climate change governance is limited to government institutions, but it is neither working with communities' institutions nor empowering non-state actors. Similarly, there were empirical studies that support the importance of strong institutions for climate change governance. To this end, studies suggest that climate change solutions need the coordination of different institutions and actors in horizontal and hierarchical forms concerning climate change adaptation and mitigation [1,6–8,33]. According to [86], in most cities in developing countries, urban governments do not fully deliver on their responsibilities due to problems of institutional arrangements.

### 3.1.6. Actor Indicators

The survey findings regarding the engagement of different actors in climate change governance in particular has also shown consistent results with the above indicator components. In this study area, it was evident that there was less involvement of non-state actors, especially NGOs, in mitigation and adaptation measures. Accordingly, the results show that the governance of climate change is carried out only by government bodies (0.74). The roles of NGOs and communities have been very minimal, with values of 0.36 and 0.41, respectively. Involvement of the private sector is also low (0.46). The study has also revealed inadequate combined effort from state and non-state actors in the conservation of environmental protected areas (0.44). Thus, actor involvement in the study areas has merely been limited to the government bodies while there was no significant involvement of communities, NGOs, or the private sector (Table 6).

**Table 6.** Indicators of actors.

Actors (0.48)	Index Result
Climate change governance is carried out by only government bodies	0.74
Climate change governance is supported by NGOs	0.36
Climate change governance is carried out by participation of local communities	0.41
Climate change governance process engages private sectors	0.46
Environmental protected area is conserved by collaboration of actors	0.44

Source: Survey, 2020.

The interview with Addis Ababa City green development commission climate change team leader indicated that the climate change issue is being mainstreamed in 26 government sectors, which means almost all the actors are government bodies. In addition to the above response, the community and private sectors are participating only in the planting of trees. Regarding NGOs, there is only C40, which has participated in climate change issues. The team leader added that, at the city administration level, the steering committee was established by the city mayor from different sectors to lead climate change issues. However, although the steering committee has been established more than six months, nothing has been enacted by the committee. In addition, there is a lack of political commitment regarding climate change action among the higher-level officials. This study shows that establishing coordination of actors in mitigation and adaptation response is crucial to addressing the problem of climate change action. Similarly, there were empirical studies that support the findings presented above. To this end, studies show that, especially in cities in developing countries, climate change governance lacks active engagement of urban actors [30,43,72,73]. In addition, effective climate change solutions should also include the cooperation of actors, whether in the prevention of greenhouse gas emissions (mitigation) or adaptation to the impact of climate change [1,33]. In addition, in developing countries, it is difficult to implement climate change governance framework without strong coordination of actors and different sectors [71,87].

### 3.1.7. Indicators of Climate Change Laws

In terms of rules and regulations in relation to climate change action and governance, three component indicators were presented to capture the perceptions of employees. With regard to adequacy of laws and regulations, the study result shows that there were adequate laws and regulations (0.78). Regarding awareness of experts about climate change protection laws, rules, and regulations, the results shown that laws, rules, and regulations were known by experts (0.47) while the rules and regulations set by the community have little to do with the governance of climate change (0.45). In general, the results show that there are adequate climate change laws, rules, and regulation actions to respond to the adverse impact of climate change in the city (Table 7).

**Table 7.** Indicators of Climate Change law.

Climate Change Law (0.57)	Index Result
There are climate change governance rules or regulations at your office	0.78
You are well informed about rules, regulations, proclamation related to climate change	0.47
Besides government regulations, local community regulations has also been used for climate change protection	0.45

Source: Survey, 2020.

The effectiveness of governance to respond to climate change in cities depends on legal frameworks and legitimate institutions [7,31]. The 1995 constitution of Ethiopia provides principles and guidelines for environmental protection and management. Based on the constitution and environmental policy of the country, several related legislations were formulated to mitigate environmental problems. Some of the legislations are: Proclamation on Environmental Impact Assessment (Proc. No. 299/2002) [88], Proclamation on Environmental Pollution Control Proc. No. 300/2002 [89], Proclamation on Public Health Proc. No. 200/2000 [90], and others. However, there is no proclamation crafted that relates different sectors, such as transport, waste, energy, and others, to climate change response action.

### 3.1.8. Indicators of Law Enforcement

In order to find out the extent of implementation of environmental laws, rules, and regulations, four indicator components were administered during the survey. In terms of ease implementation of the rules and regulations, the results show that the rules and regulations

were relatively not easier to enforce (0.39). In relation to the proper implementation of rules and regulations, the findings show that challenges in the enforcement of laws or regulations were faced (0.21). In terms of actors' participation in the implementation of regulation and rules, the findings show that there is lack of involvement of NGOs, communities, and businesses during implementation (0.32); likewise, people or companies who deviate from the rules and regulations fail to receive punishment according to the law (0.24). Therefore, the study result shows that there was weak implementation of the rules and regulations (Table 8).

**Table 8.** Indicators of laws enforcement.

<b>Laws Enforcement (0.29)</b>	<b>Index Result</b>
The existing climate change protection rules and regulations are easy for implementation	0.39
Climate change protection regulations are implemented properly	0.21
Climate change protection regulations are implemented by participation of Actors	0.32
People or company who deviate the rules and regulations are punished according to the law	0.24

Source: Survey, 2020.

The interview with Addis Ababa City Environmental and Green Development Commission climate change team leader showed that environmental policy, strategy, regulations, laws, and proclamations and their implementation have been problematic. This problem is due to the nonexistence of accountability systems and a weak understanding of the environmental impacts of development on the part of higher officials. Another interview with the Federal Climate Change Directorate director also repeated the same concern, which is that environmental policy implementation has been so problematic, lacking accountability lines, having poorly designed institutional structure, and a weak constellation of actors regarding climate change issues. According to the Addis Ababa City Environmental and Green Development Commission commissioner, laws, rules, legislation and proclamation implementation are significant problems for the city because environmentally specific climate change response action implementation involves several sectors. He further explained that mitigation and adaptation action is not the only mandate of environmental and green development commission and that it needs the coordination of different sectors. According to [65], in the city, the major gaps of governance system is implementing the intended plans and the actual development processes is not related. A weak regulatory environment and the limited enforcement capacity of environmental agencies exacerbate environmental pollution and degradation in the city [85]. In Ethiopia, environmental law is poorly enforced, experiencing weak inter-sectorial coordination and low synergy among actors in initiating development programs [46]. Moreover, institutional and legal frameworks that share responsibilities and accountabilities among government, private sector, and civil society organizations are not clearly defined [45].

There are considerable discrepancies between those environmental commitments made by the country and the actual implementation [47]. Even though the country is championing the global sustainable development, the economic component of sustainable development is given more emphasis than its environmental component [45].

### 3.1.9. Indicators of Partnership in Climate Change Governance

In order to understand the extent of partnership being practiced among involved stakeholders, five explicit components were used. Regarding partnership with community-based organizations, the result indicated that there was poor partnership between the local environmental protection offices and the communities (0.44). Comparatively, environmental protection offices have good partnership with other government offices (0.51). Related to NGOs, there was no adequate partnership with NGOs (0.36). There was also inadequate partnership between environmental protection offices and research institutions (0.41) and between environmental protection offices and the private sector (0.42). Therefore,

the result indicated that partnership is exercised only between environmental protection offices with other government stakeholders, while there is weak links among NGOs, private sectors, and CBOs with environmental protection office, which indicate that climate change governance is dominantly practiced by the government (Table 9).

**Table 9.** Indicators of Partnership.

Partnership (0.43)	Index Result
Your office has strong partnership with community based organizations	0.44
Your office has strong partnership with other government offices	0.51
Your office has strong partnership with NGOs	0.36
Climate change governance is conducted in partnership with private sectors	0.42
Climate change governance is conducted in partnership with research institutions	0.41

Source: Survey, 2020.

### 3.1.10. Summary of Climate Change Governance Indices

Following the descriptive statistics of indicators, the indices used to measure the effectiveness of climate change governance are presented in Table 10 and discussed hereunder. Participation of actors was found to be an important indicator with a value of 0.45. Accountability, being a sum of six component indicators, has been computed with an aggregate index value of 0.28. Hence, the survey respondents have shown that accountability is a key to the effectiveness of climate change governance. The equity index, as an outcome of two components and as one of the key indices to measure effectiveness of climate change governance, has been computed with an aggregate index value of 0.44.

**Table 10.** Summary of Indices.

No.	Indicators	Average Index	Composite Index
1	Participation	0.45	3.15
2	Accountability	0.28	1.68
3	Equity	0.44	0.88
4	Awareness raising	0.51	3.06
5	Institution	0.41	2.05
6	Actors	0.48	2.4
7	Climate change Law	0.57	1.71
8	Law enforcement	0.29	1.16
9	Partnership	0.43	2.15
			<b>18.24/43 = 0.42</b>

Source: Survey, 2020.

The awareness index, as an outcome of six components and as one of the key indices to measure effectiveness, has a mean index value of 0.51. Institutional performance was another key indicator with a mean index value of 0.41. Similarly, the role of different actors and the level of discharging responsibilities have been strongly considered with a mean index value of 0.48. The availability and clarity of adequate rules, laws, and regulations pertaining to climate change was also considered as one of the major indicators, with a mean index value of 0.57. Law enforcement, which is considered as the most crucial indicator, has a mean index value of 0.29, and it has the lowest index value next to accountability. The partnership index has a mean value of 0.43 and is also a key indicator of the effectiveness of climate change governance. Among these, only the existence of climate change laws,

regulations, rules, or proclamations and awareness raising have the highest index values, with mean values of 0.57 and 0.51, respectively. Moreover, to determine whether the current climate change governance practice is effective or not, the study developed a composite index for measuring the effectiveness of climate change governance for future policy direction. In this regard, the average of the indices shows a value of 0.42. Thus, the climate change governance outcome is ineffective, falling below the threshold, which is  $\leq 0.50$  (Table 10).

#### 4. Conclusions

This study investigates the effectiveness of climate change governance in Addis Ababa City, adapting nine key indicators of effectiveness based on the literature. The findings indicated that the implementation of and adherence to these nine key indicators was found to be inadequate. Particularly, this study arrived at such a conclusion that climate change governance was ineffective in terms of the implementation of almost all key indicators, which include accountability, participation, law enforcement, institution, the role of actors, equity, and partnership.

In addition, environmental policy, law, regulation, and proclamation implementation in the city have been facing major challenges in terms of weak accountability, poor enforcement of regulation, and failure to involve key actors, especially NGOs, communities, and private sectors, characterized by weak institutional setup and a lack of formal systems for actors to interact (the private sector, communities, and CSOs) to respond effectively to climate change. Moreover, there was a lack of capacity building through training among the sub-city- and Woreda-level experts and a lack of awareness-creation campaigns about climate change and its response for city residents. Thus, the Addis Ababa City Environmental Protection and Green Development Commission should give more emphasis to the coordination of other actors (NGOs, community, the private sector, and research institutions) to respond to climate change in the city. In addition, the commission should provide training to the lower layers of experts and mobilise the community for climate change response, especially in terms of adaptation measures. Moreover, Addis Ababa city administrators should give due attention to climate change response through established strong accountability systems to enforce regulation, rules, proclamations, laws, policies, and strategies in different sectors.

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## Abbreviations

AABFED	Addis Ababa Bureau of Finance and Economic Development
AACA	Addis Ababa City Administration
AAEPGDC	Addis Ababa City Environmental Protection and Green Development Commission
CCG	Climate Change Governance
CRGE	Climate Resilient Green Economy Strategy
FDRE	Federal Democratic Republic of Ethiopia
GHG	Greenhouse Gas
UHIE	Urban Heat Island Effect
Mt CO <sub>2</sub> e	Million Tons Carbon Dioxide Equivalent
PM <sub>10</sub>	Particulate Matter with aerodynamic diameter of <10 microns
tCO <sub>2</sub> e	ton of Carbon dioxide equivalent
UN-HABITAT	United Nation Human Settlement Programme
UNFCCC	United Nation Framework Convection for Climate Change
WB	World Bank
WHO	World Health Organization
WMO	World Metrological Organization

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