

## Article

# Integrating Climate Change Adaptation Strategies into Urban Policies for Sustainable City Resilience: Barriers and Solutions in the Central African City of N'Djaména

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**Abstract:** Climate change has become a serious threat to human life. This study aims to reveal the face of climate policies and the integration of urban adaptation into urban planning policies in the city of N'Djaména. To achieve this, we adopted a methodology combining both quantitative and qualitative approaches. Surveys of key informants were used to gather information on how to achieve the objectives set. The results show that key informants believe that climate policies have not met the expectations of the city's citizens in terms of effectiveness and positive impacts. These players assume that urban policy planning does not take urban adaptation into account. The four categories of barriers hindering the integration of urban adaptation and its implementation relate to a lack of information and knowledge, political ill will, and organization and constraints linked to the mobilization and availability of resources. This study suggests the sharing of information, knowledge, and communication involving all stakeholders in N'Djaména's urban development, the organization of the city's state and municipal structures, the involvement and support of political authorities, greater access to financing, and the establishment of professional networks of expertise as catalysts for success.

**Keywords:** integrating urban adaptation; climate policy; urban governance; involvement of urban players

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## 1. Introduction

Climate change has become a major challenge that poses a serious threat to human life through induced disasters and environmental degradation [1]. In recent years, a great deal of research has focused on adaptation to the adverse effects of climate change at sectoral and national levels. There are gaps in urban adaptation in all regions of the world and for all types of risk, which justifies the enormous limit to national adaptations [2]. According to J. Lobo et al. [3], it is increasingly recognized that responding to climate change requires urban adaptation, and there are significant capacity gaps at city and community levels that hinder urban adaptation. These include the lack of integrated planning to protect communities and the lack of access to innovative financing mechanisms that can strengthen city resilience [4,5]. According to Patterson and Huitema [6], these problems can be solved by strengthening local decision-making and integrating adaptation into local urban policies. Cities and local authorities are key players among others in facilitating adaptation to climate change in towns and cities.

Multi-level governance measures supported by local governments can foster effective adaptation approaches and address risks and vulnerabilities at all scales [7]. Thus, any action worthy of effectiveness on the part of local governments requires the support of the national government. Without national support, local government has difficulty coordinating action between the various stakeholders [2]. National urban adaptation actions and programs can influence municipal action and planning, but there is evidence that national policy alone is not enough to act on the ground without understanding local conditions [8]. To this end, new policy innovations such as urban policies are emerging to meet the multi-level governance requirements of climate change [9,10]. There is no one-size-fits-all approach to adaptation, as local implementation conditions strongly influence the feasibility and impact of adaptation [11]. Integrated planning, multi-agency intervention, and multi-scale, sectoral action are the means of fostering conditions conducive to adaptation [12,13]. While Nina et al. [14] argue that the need to integrate climate change adaptation into development planning and decision-making processes has been recognized, this is still a long way off in developing countries.

In Chad, the provisions and mandates relating to adaptation to climate change are entrusted to the Ministry of the Environment, Fisheries and Sustainable Development through the Department of Environmental Education and the Fight against Climate Change (DEELCC). Given the country's high exposure to the effects of climate change, Chad has developed several policies, strategies, and initiatives aimed at effectively combating the adverse effects of climate change [15]. According to information contained in the third national communication on climate change [16], the housing sector in N'Djaména is subject to major climatic threats such as flooding and extremely high temperatures, making habitats and populations vulnerable. Faced with the major risks and challenges associated with climate change on natural and human systems, in 2016, the Ministry of the Environment, Fisheries and Sustainable Development initiated the process of formulating the National Strategy for Combating Climate Change (SNLCC). Considering the five strategic axes and eight main sectors of this national policy, the urban sector is not a priority when it comes to adapting to the adverse effects of climate change.

According to the updated National Determined Contribution (NDC) [15], Chad's urban centers are subject to flooding episodes during heavy rain or river flooding. Examples include the heavy floods of 1996, 1999, 2004, 2005, 2006, 2007, 2008, 2010, and 2016, which affected precarious neighborhoods in urban centers. In N'Djaména, the floods left thousands of people homeless, houses destroyed, property washed away, and many urban casualties. According to Allarané et al. [13], extreme weather events such as flooding, heat waves, and high winds have affected not only infrastructure, but also the living environment and human health in the city of N'Djaména. The impacts of flooding include the multiplication of endemic diseases (malaria, cholera, etc.), impassable roads, deterioration of social and community facilities, and increased mortality rates. For these authors, heat-waves cause cardiovascular accidents, health problems, and overheating in city dwellings. The impacts of high winds include pollution of the living environment, recurrence of lung disease, and contamination of biological mucous membranes. One of the policy measures envisaged by the authors is to integrate adaptation strategies into urban policies to cope with these climate risks.

The government of Chad has put in place a clear national policy framework for achieving adaptation objectives, but this has limitations in terms of assessing the effectiveness of adaptation actions undertaken at city level. According to Atchadé et al. [17], for local communities to effectively plan for climate change adaptation and ensure that decisions are not isolated, a uniform national adaptation policy is needed to integrate it into local and municipal planning. However, the lack of clear and precise policies and strategies at the local or municipal government level in Chad ultimately makes it difficult to guide adaptation decisions and actions for urban resilience. In this context, this study is intended to be a milestone to mark out the landscape for the introduction of the

integration of adaptation into urban planning in the city of N'Djaména. It seeks to achieve the following:

- Gather feedback from stakeholders on the effectiveness of national climate policies in the city of N'Djaména;
- Identify the barriers to integrating adaptation into urban policies in the city of N'Djaména for stakeholders;
- Propose the strengths/potentials (drivers) to remove the barriers to integrating effective adaptation into urban policies.

Achieving these objectives will create the link between urban adaptation planning and implementation for the resilience of N'Djaména's urban systems. This will boost the effectiveness of community adaptation policies and the coordination of local government development actions. This article is structured as follows: introduction, literature review, materials and methods, main results obtained, discussion of results, and conclusion.

## 2. Literature Review

### 2.1. Urban Adaptation to Climate Change and Conditions for Effective Action

Urban adaptation is an essential aspect of climate change studies and actions. It can be defined as “the process of adjusting to climate change” and to actual or anticipated climate risks, by seeking to reduce negative impacts or exploit beneficial opportunities” in urban and peri-urban environments [18]. This definition does not differ from the more general concept of climate adaptation, which is defined in the 2014 IPCC report as “the process of adjusting to actual or expected changes in climate and its effects”. There are similarities between urban adaptation and climate adaptation, both of which emphasize the need to adapt to changed circumstances. Urban adaptation recognizes the need for cities to adapt to changing circumstances, to undertake a process of adjustment in response to change, with the aim of restoring or improving the quality of life of inhabitants [19]. Climate adaptation has become a more visible and pressing issue in recent years. However, although adaptation can potentially reduce the negative effects of climate change, little attention has been paid to the consequences of adaptation policies and practices on urban sustainability [20]. Adaptation is also a question of interaction between local strategies for managing change and policies and decisions that may favor certain strategies and developments over others [21].

An adaptation strategy will then define a range of political, technical, institutional, societal, and behavioral guidelines to limit the negative impacts and take advantage of the opportunities offered by climate change. This strategy is structured either sectorally or more transversally and is broken down into strategic and/or operational objectives and a program of actions [18]. Local players are often ill equipped to make decisions in a changing climate environment. Indeed, climate change is a dynamic, ongoing process, and adaptation policy must be implemented in an unstabilized and particularly uncertain context. According to Lobo et al. [3], several municipalities and communes have taken the initiative to draw up climate change adaptation plans that are increasingly aligned with international agreements such as the Sendai Protocol, the UN Sustainable Development Goals, the Paris Agreement on Climate Change, and the New Urban Agenda. Paradoxically, the research and data analysis carried out by Bai et al. [22] have highlighted the extent to which these municipal adaptation policies and plans have proved ineffective in achieving their stated objectives. Moreover, it is becoming increasingly clear that many proposed climate adaptation plans can exacerbate urban poverty, foster community conflict, and compound long-standing environmental injustices [10]. According to Lee and Kim [23], municipal adaptation plans face obstacles when it comes to achieving effective adaptation outcomes, and the actions implemented often deviate from urban development plans. Bulkeley [24] believes that scientific communities must propose ongoing dialogs to link action and development in a set of transitions framed by measures and action plans for sustainable socio-economic development. This will facilitate the effectiveness of

urban adaptation actions. Stakeholder engagement and involvement are increasingly recommended in decision-making processes linked to actions to combat climate risks [25]. The degree of stakeholder involvement ranges from instruction and consultation to cooperation, equivalent to the exchange of information and knowledge in the decision-making process [26]. According to Eriksen et al. [27], the literature on adaptation and resilience to climate change emphasizes the increase in participatory approaches. These approaches deepen engagement and overcome challenges [28].

## 2.2. Urban Adaptation Planning and Catalytic Factors

In recent years, methods have been developed for simultaneously considering societal and sectoral objectives, climate risks, and adaptation options [21]. A study by Chu et al. [29] assessed how civil society actors contribute to adaptation planning and implementation. They found that adaptation approaches need to be designed and modified according to local institutional strengths, civil society capacities, and urban climate adaptation needs. Collins et al. [30] noted that the transitions required for climate-resilient development should be supported by radical changes in governance, knowledge development, finance, economics, and social norms. According to Bobylev et al. [31], the planning of adaptation measures in cities should apply conflict-free approaches by ensuring participatory methods.

Local communities are the most sensitive to risks and vulnerabilities and have a distinct role to play in climate change adaptation [32]. Cities are the spaces where climate change exerts its greatest impacts through disasters and rising temperatures or sea levels, and where there are opportunities for effective, transformative adaptation [5]. There are therefore gaps in knowledge about the effectiveness of multi-level governance actions and how to transfer the burden of responsibility for adaptation action to local communities [33]. A combination of infrastructural, natural, institutional, and socio-cultural interventions is needed to reduce the multifaceted risks facing cities and settlements [2]. Urban stakeholder engagement is increasingly part of climate-related decision-making processes [25]. The degree of stakeholder engagement ranges from instruction and consultation to cooperation, equivalent to information exchange, influence, and partners in decision-making [26]. The literature on climate change adaptation and resilience has seen an increase in participatory approaches that deepen engagement and overcome challenges, as well as some evaluations of their effectiveness [34].

More public participation can lead to more transformational adaptation as well as greater ambition for local mitigation [26]. Challenges to stakeholder engagement include access to cutting-edge science, the ability to recognize and respond to unreliable or false climate science information, and the elimination of cognitive biases [35]. Participatory and elicitation approaches, which consider the concerns and involvement of a wider range of interest groups and stakeholders, can improve the effectiveness of decision-making [3]. Participatory planning includes a variety of co-generative strategies and approaches through which goals and objectives, knowledge, implementation, and evaluation of strategies can be decided collaboratively between practitioners, decision-makers, local groups, and scientists [19]. More specifically, for climate change adaptation, these decision-making strategies can integrate expert, indigenous, and local knowledge. The challenge will be to bring these different players together, as stakeholders tend to act within a partial process rather than a decision-making one. According to Westman et al. [7], there are a series of factors that can facilitate or limit the planning and implementation of adaptation options and, potentially, their effectiveness. These include governance, financing, knowledge, and cultural, social, political, and economic differences that influence the willingness and ability to act individually and collectively [2].

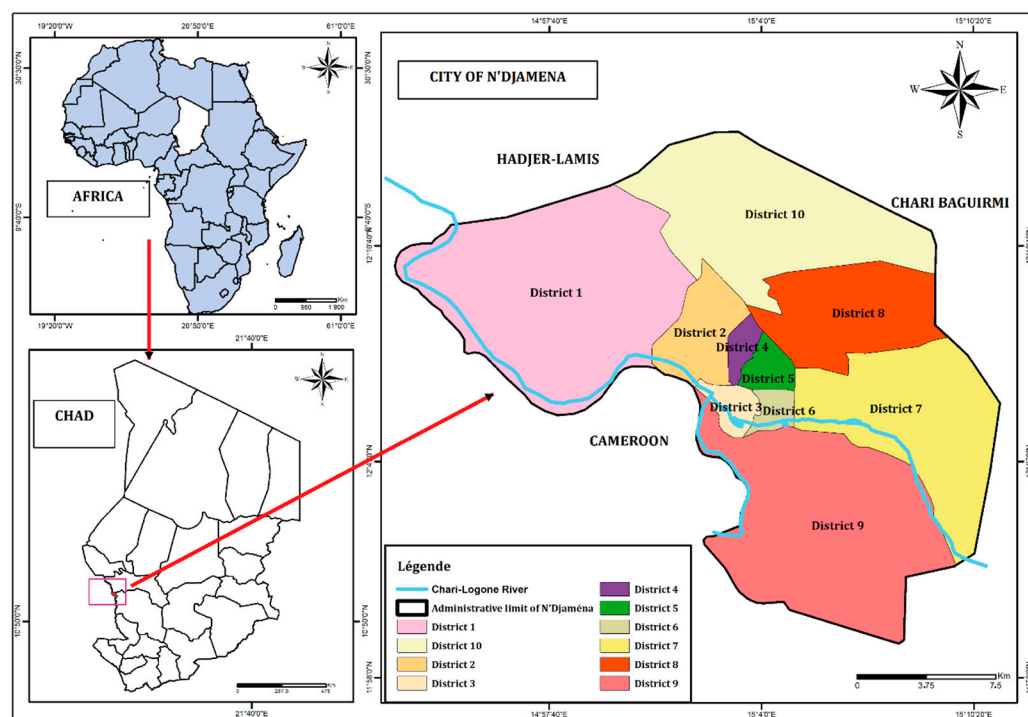
In a study by Preston et al. [36], adaptation is first and foremost “local”, and the specificity of the adaptation context is indisputable. Although the effects of climate change are felt at the local level, and the local level is well placed to adapt to climate change, local action needs to be framed and facilitated across different levels or spheres of government.

Adaptation to climate change, as a political issue, is by necessity cross-cutting, multidisciplinary, and multi-sectoral, and requires significant degrees of collaboration and cooperation to be successful. Governance structures and leadership for climate change adaptation vary considerably between levels and spheres of government around the world, but problems of intergovernmental coordination are common [37].

### 3. Materials and Methods

#### 3.1. Study Area

The city of N'Djaména, which forms the spatial framework of this study, is located between 12°00' and 13°00' north latitude and 15°00' and 16°00' east longitude. The town is bordered to the north by the Hadjer-Lamis region, to the southeast by the Logone river, to the east by the Chari-Baguirmi region, and to the west by Cameroon (Figure 1). N'Djaména has a dry tropical Sahelian climate characterized by two distinct seasons: a long dry season of 7 to 8 months from November to May, and a short rainy season of 3 to 5 months from May to October [38]. Maximum temperatures range from 33.7 °C to 37.6 °C, and the minimum from 20.9 °C to 22.7 °C. Rainfall, in the form of showers, ranges from 400 to 700 mm/year. The city has 10 arrondissements [39] with an estimated population of 1,699,208 in 2020 [40].



**Figure 1.** Geographical location of the city of N'Djaména.

#### 3.2. Sampling and Data Used

This study was carried out using a mixed methodology based on documentary research and surveys of key informants identified in state and municipal structures. The literature search was carried out in two phases: firstly, it enabled us to explore similar studies carried out in other geographical environments, and secondly, it enabled us to collect and analyze climate policy documents and urban planning policy documents drawn up to frame the urban development of the city of N'Djaména. These climate policy documents are the National Determined Contribution (NDC) and the National Adaptation Plan (NAP). Urban planning policy documents include N'Djaména's Urban Planning Framework Document (DCPU) and the National Land Use Plan (SNAT).

Surveys of key informants were used to gather their opinions on their knowledge of the various climate and urban planning policies. Using the approach adopted by Vögt et al. [21], we surveyed a sample of one hundred (100) key informants from the following state and municipal structures (Table 1): twenty-five (25) at the Ministry of the Environment, Fisheries and Sustainable Development, twenty-five (25) at the Ministry of Regional Planning, Housing and Urban Development, ten (10) in the Urban Planning, Development and Urban Transport Department of the N'Djaména municipality, and forty (40) in the ten (10) district municipalities.

**Table 1.** Breakdown of key informants by structure.

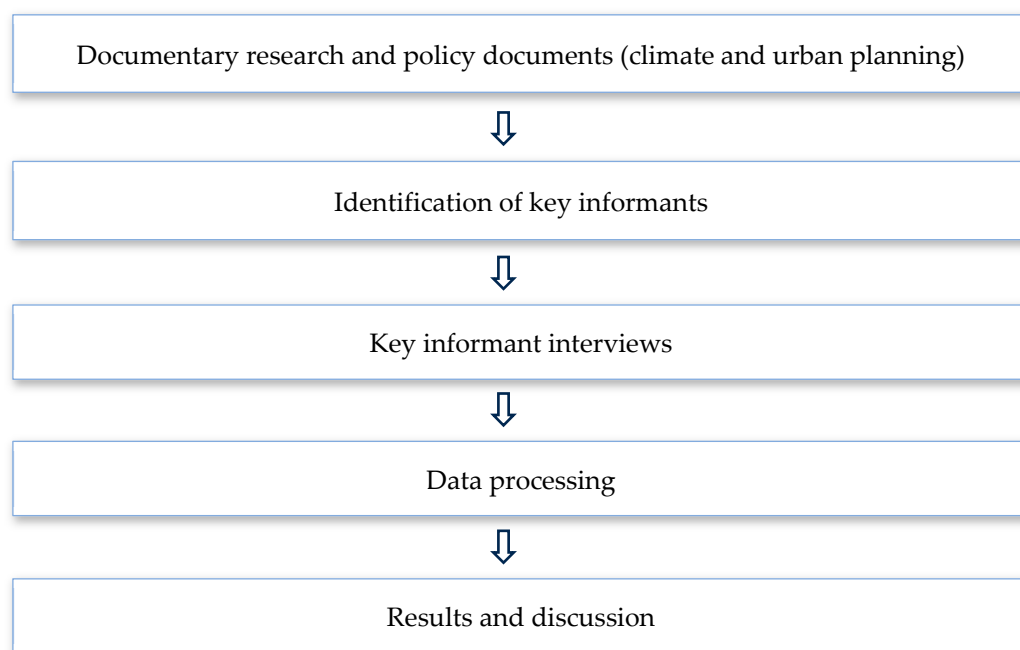
State/Community Structure	Number Interviewed
Ministry of the Environment, Fisheries and Sustainable Development	25
Ministry of Regional Planning, Housing and Urban Development	25
Urban Planning, Development and Urban Transport Department	10
District municipalities	40
Total	100

The collection sheets used with key informants included information such as the following:

- Socio-demographic characteristics (gender, age, level of education);
- Knowledge of climate and urban planning policies;
- Synergy between climate and urban planning policies;
- The effectiveness of climate policies;
- Integrating climate policies into urban planning.

### 3.3. Data Processing and Analysis

For the purposes of this study, the data collected were arranged and formatted using Microsoft Excel version 2304. We also used R-Studio 4.2.1 software with specific packages to produce certain graphics. The Mosaic diagram represented using the vcd package [41] of the R programming language [42] was used to determine the factors of the level of effectiveness of climate policies according to the gender and educational level of key informants. Using this diagram is an excellent way of visualizing hierarchical data. This representation is based on a collection of rectangles representing all the elements to be visualized, with rectangles of different sizes. Colors are used to categorize respondents' gender and education levels. The Chi2 statistical test was used to determine the probability of non-existence of a relationship between the organizational plan variables and the suitability of political authorities. To visualize the nature of the deviation from possible independence between these two variables, we deepened our analysis through factorial correspondence analysis (FCA). As for the various catalysts, spider-web diagrams were drawn to show their proportional evolution by category. The presentation map of the study town was produced using ArcGis 10.4 software, based on shapefile data obtained from the Geographic Information System (GIS) department of N'Djaména town hall. Figure 2 summarizes the methodological approach adopted for this study.



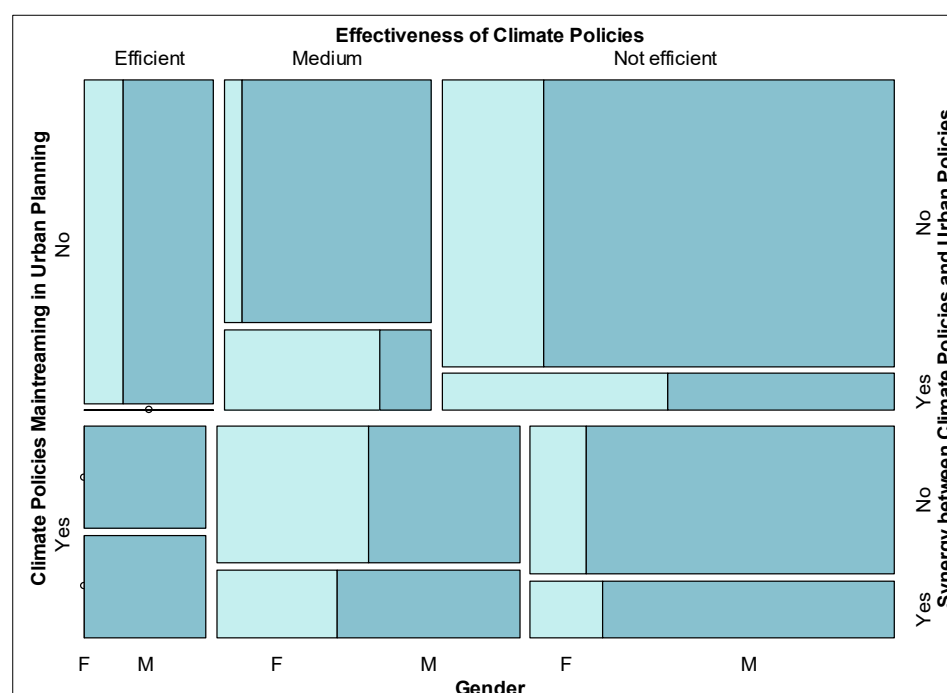
**Figure 2.** Summary of the study’s methodological approach.

## 4. Results

### 4.1. Perception of the Effect of National Climate Policies on the City of N’Djaména

#### 4.1.1. Perceptions of Climate Policies and Their Synergy with Urban Planning Policies as a Function of Gender in the City of N’Djaména

The figure below highlights the correlations between the perceived integration of climate policies, their synergy with urban planning policies, and their effectiveness, according to the gender of key informants. The size of the tile is proportional to the percentage of respondents in that level combination. Color variation is gender-dependent (Figure 3). From this figure, the opinion of key informants is that climate policies are ineffective (53% of respondents). This observation was made by both women (12%) and men (41%). This statement is mainly made by respondents who feel that there is neither integration of climate change into urban planning policies nor synergy between climate policies and urban planning (31%). Similarly, 13% of respondents feel that there is integration but no synergy between climate policies and urban planning.

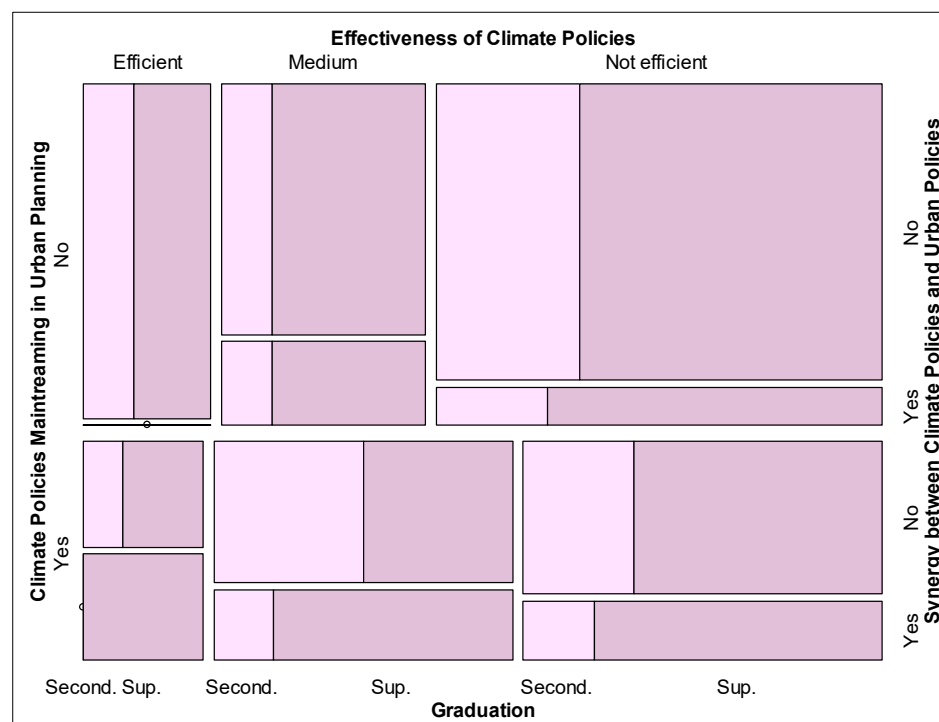


**Figure 3.** Assessing climate policies and their synergy with gender-based urban planning policies in the city of N'Djaména. M = male and F = female.

#### 4.1.2. Perceptions of Climate Policies and Their Synergy with Urban Planning Policies as a Function of Intellectual Level in the City of N'Djaména

The figure below highlights the correlations between the perceived integration of climate policies, their synergy with urban planning policies, and their effectiveness, according to the educational level of the key informants. The size of the tile is proportional to the percentage of respondents in that level combination. Color variation is a function of intellectual level (Figure 4). From this figure, the opinion of key informants with an advanced level of education (secondary: 16%; higher: 37%) is that climate policies are ineffective. For these key informants, the ineffectiveness of climate policies is linked to their lack of integration and synergy with other city policies, such as urban planning. A key informant estimates that *“the lack of political will and coordination of climate actions at national and sub-national level is a major obstacle to the effectiveness of climate policies and programs in Chad. This creates a breeding ground for an upsurge in the impacts of climatic hazards, which can be observed on a permanent basis in cities. Flooding destroys infrastructure and people’s homes, orchestrating regular migrations during flood periods. Heat islands and strong winds continue to cause health and socio-economic problems and damage. This suggests that the municipal and national authorities are not taking any initiatives to protect people from extreme weather conditions”*.





**Figure 4.** Assessment of climate policies and their synergy with urban planning policies according to the level of education of urban actors in N'Djaména. Second = secondary and Sup = superior.

#### 4.2. Barriers to Integrating Adaptation into Urban Policies

Table 2 shows the barriers to integrating urban adaptation into urban planning in the city of N'Djaména. From this figure, key informants from the city of N'Djaména identified four categories of barriers that need to be removed to facilitate the integration of urban adaptation into urban planning. These include information and knowledge barriers, political and organizational barriers, and resource constraints.

In terms of information and knowledge barriers, respondents listed problems relating to data availability and access, a lack of community support for adaptation planning due to ignorance, a lack of expertise among municipal staff, and an inability to identify or manage the uncertainties associated with climate risk variability. At the political level, questions were raised about the lack of political will and commitment, the absence of adaptation planning at the municipal level, and the divergence of priorities between the city's municipal units.

On an organizational level, the barriers identified by stakeholders are the absence of silo planning in municipal government, the unclear roles and responsibilities of local authorities in adaptation, and the lack of federal/state leadership in adaptation. A key informant declared that *"silo planning and the lack of synergy between municipal and national approaches and actions are the bottlenecks to adaptation planning in Chad's cities. There really isn't a structured enough organization to prioritize issues relating to the adaptation and resilience of urban communities in the city of N'Djaména. As the climate continues to threaten not only the survival of citizens and their livelihoods, but also creates enough structural losses and damage to be perceptible at various levels of the social scale"*.

Very limited access to financial resources at local level, difficulties in mobilizing funds for adaptation, and the lack of national allocation for urban adaptation to climate risks are the main challenges and barriers raised by key informants in the city of N'Djaména. For some key informants, *"the government and municipalities, or even communes, must, in a symbiotic postulate, pay more attention and interest to issues of mobilizing funding from national and international sources. This makes it easier to plan climate change adaptation actions in the city"*.

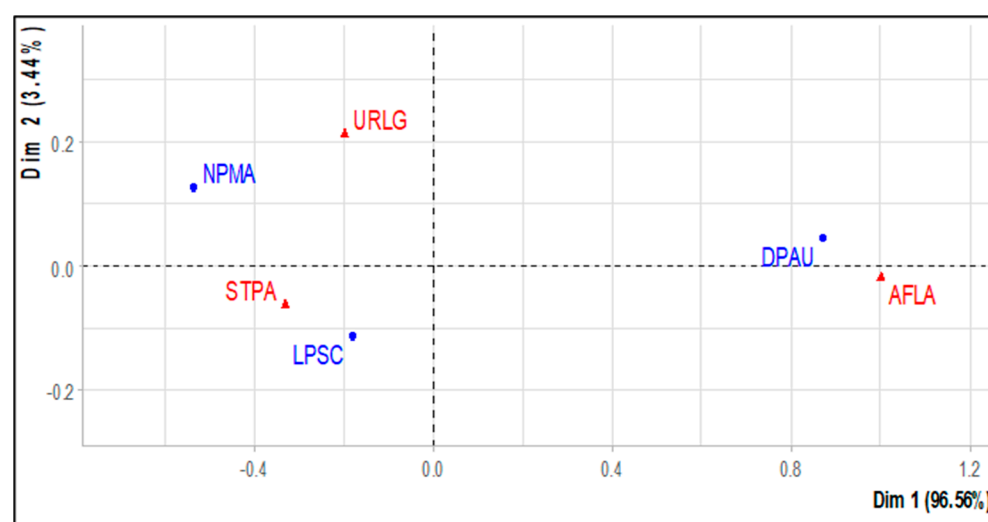
**Table 2.** The main categories of barriers to urban adaptation planning in the city of N'Djaména.

Information and Knowledge Barriers	Political Barriers
<ul style="list-style-type: none"> <li>Data availability and access issues (DAAI)</li> <li>Lack of community support for adaptation planning (LSAP)</li> <li>Lack of municipal staff expertise (LMSE)</li> <li>Inability to manage uncertainties related to climate risks (IWCI)</li> </ul>	<ul style="list-style-type: none"> <li>Lack of political will and commitment (LPSC)</li> <li>Lack of urban adaptation planning at municipal level (NPMA)</li> <li>Divergence of priorities between municipal administrative units (DPAU)</li> </ul>
Barriers related to resource availability	Organizational barriers
<ul style="list-style-type: none"> <li>Limited access to financial resources at local level (LAFL)</li> <li>Difficulties in mobilizing funds for adaptation (DMAF)</li> <li>Lack of national allocation for adaptation to climate risks (LNRA)</li> </ul>	<ul style="list-style-type: none"> <li>Lack of silo planning in municipal administrations (STPA)</li> <li>Unclear roles and responsibilities of local authorities in adaptation (URLG)</li> <li>Lack of federal/state leadership on adaptation (AFLA)</li> </ul>

#### 4.3. Correlation and Implication of Barriers Preventing the Integration of Adaptation into Urban Policies

The chi2 test carried out between the barriers shows that the hypothesis of independence between the four barrier categories is rejected ( $p$ -value < 0.001). This implies that there is a significant correlation between barriers relating to information and knowledge, policy, organization, and resource constraints.

To visualize the nature of the link, a factorial correspondence analysis (FCA) was carried out (Figure 5). From this visualization, it emerges that views on relative organizational barriers and the adequacy of political authorities are linked through sub-categories of barriers such as divergence of priorities between municipal administrative units (DPAU) and lack of federal/state leadership on adaptation (AFLA). Similarly, the lack of political support and commitment to actions to integrate adaptation into urban planning policies (LPSC) is correlated with the absence of silo planning in municipal administrations (STPA). It should be noted that the issues of integrating urban adaptation into policies are not current priorities for municipal authorities (NPMA). This correlates well with ignorance of their adaptation roles and responsibilities (URLG).

**Figure 5.** Correlation and implication of barriers preventing the integration of urban adaptation on a political and organizational level. Legend: Lack of urban adaptation planning at municipal level

(NPMA), unclear roles and responsibilities of local authorities in adaptation (URLG), absence of silo planning in municipalities (STPA), lack of political will and commitment (LPSC), lack of federal/state leadership on adaptation (AFLA) and diverging priorities between municipal administrative units (DPAU).

#### 4.4. Catalysts to Facilitate the Integration of Adaptation into Urban Policies

Figure 6 summarizes the facilitating elements by category for integrating adaptation into urban planning, based on discussions with key informants. According to this figure, five categories of elements or categories of facilitators can influence the integration of adaptation into urban planning. This involves the sharing of information, knowledge, and communication (IKC) involving all players in N'Djaména's urban development, organizational aspects of state and municipal structures (SOA), policy adaptation and authorities (PAA), enhanced access to finance (EAF), and the establishment of professional networks of expertise (BPN).

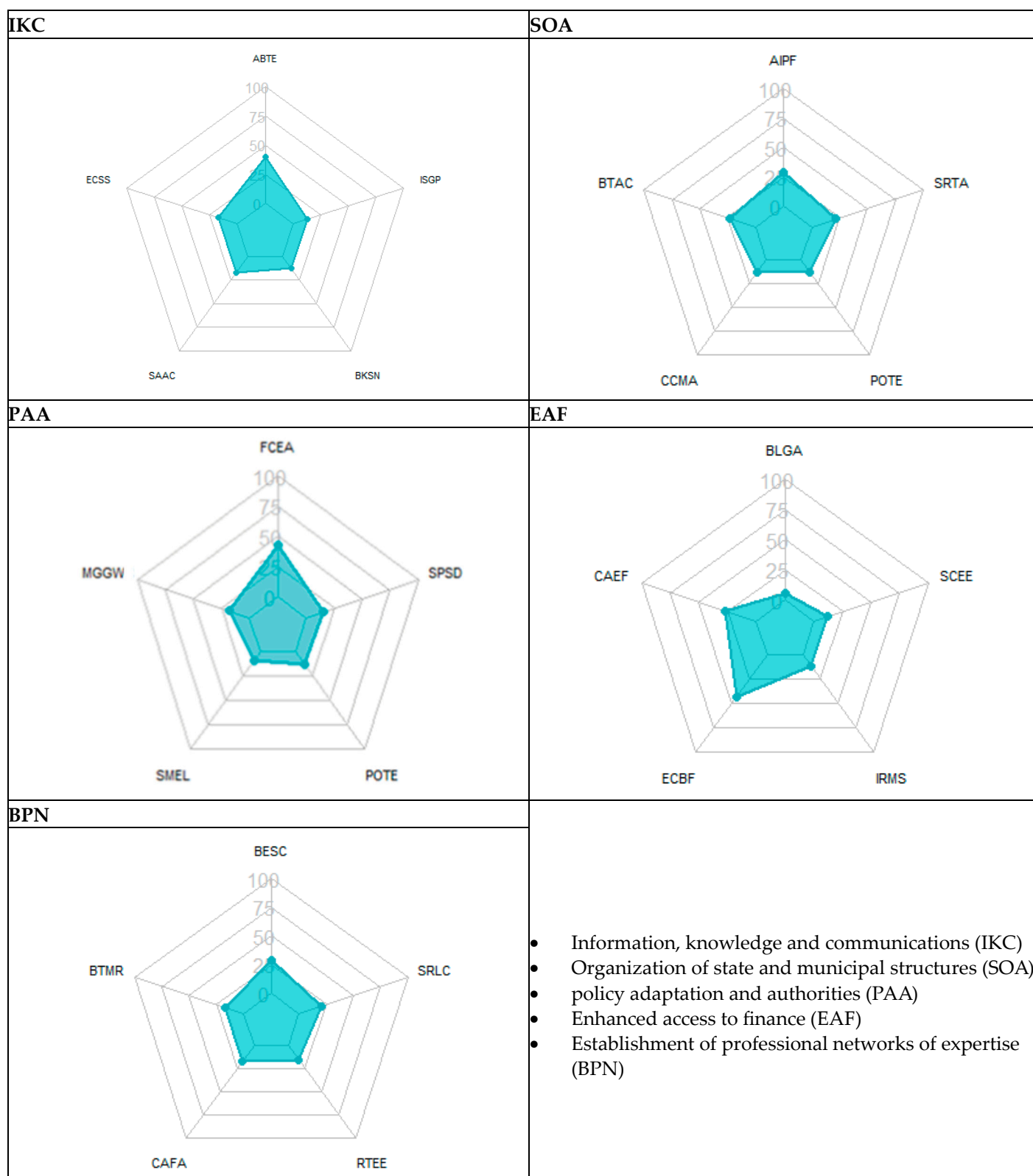
About the sharing of information, knowledge, and communication (IKC), emphasis must be placed on the co-benefits and synergies of adaptation to enhance the visibility of actions (ECSS), support active communication on adaptation and scenario planning with the community (SAAC), and develop initiatives and events to trigger communication (ABTE). These communication triggers account for 40% of key informants' perceptions.

At the organizational level of state and municipal structures (SOA), the catalytic factors that can accelerate the integration of adaptation into urban policies are setting up an integrated planning framework for urban adaptation (AIPF) and building trust between state and municipal authorities (BTAC), with proportions of 29% and 23%, respectively. Other sub-categories of elements were also listed by stakeholders, such as the creation of a governance framework and legal provisions for urban adaptation (SRTA), the presence of a triggering event (POTE), and the development of a culture of participative collaboration in municipal administrations (CCMA).

Regarding policy and authority adaptation (PAA), 43% of key informants noted that the main element that can foster the integration of urban adaptation is meeting community expectations for community action and knowledge (FCEA). We must also support and promote sustainable decisions for financing urban adaptation (SPSD), present a triggering event (POTE), provide political and municipal support for urban adaptation (SMEL), and finally, improve multi-level governance with governmental and local structures (MGGW).

About enhanced access to finance (EAF), key informants mentioned setting up mixed financing for adaptation between partners (public, private, etc.) (ECBF) and catalyzing access to the adaptation champion (CAEF), with 43% and 27% of respondents, respectively. Outreach to local municipalities (BLGA), support for the engagement of climate experts (SCEE), and internal resource mobilization strategy (IRMS) are also the sub-categories of catalysts highlighted by key informants.

For the establishment of professional networks of expertise (BPN), key informants mentioned strengthening external support and collaboration (CGS) and strengthening regional and local collaboration (SRLC), with 29% and 21%, respectively. The other sub-catalysts highlighted concern the demand for external expertise (RTEE), the creation of a convivial atmosphere between urban development players (CAFA), and the building of trust and mutual respect (BTMR).



**Figure 6.** Categories and sub-categories of catalysts for integrating urban adaptation.

The categories are defined as follows: develop communication initiatives and events (ABTE), launch a storytelling subsidy program (ISGP), create a knowledge-sharing network (BKSJ), support active communication on adaptation and scenario planning with the community (SAAC), emphasize the co-benefits and synergies of adaptation for greater visibility of actions (ECSS), set up an integrated planning framework for urban adaptation

(AIPF), create a framework of governance and legal provisions for urban adaptation (SRTA), presence of a triggering event (POTE), develop a culture of participative collaboration in municipal administrations (CCMA), building trust between state and municipal authorities (BTAC), meeting community expectations for action and knowledge at community level (FCEA), supporting and promoting sustainable decisions for financing urban adaptation (SPSD), presence of a triggering event (POTE), political and elected municipal support for municipal adaptation (SMEL), multi-level governance with national and local government structures (MGGW), raising awareness among local municipalities (BLGA), support for the hiring of climate experts (SCEE), internal resource mobilization strategy (IRMS), set up adaptation financing mechanisms for public and private structures in the city of N'Djaména (ECBF), catalyzing access to champion adaptation, external financing (CAEF), strengthen external support and collaboration (CGS), strengthening regional and local collaboration (SRLC), request for external expertise (RTEE), creating a convivial atmosphere (CAFA), and building trust and mutual respect (BTMR).

## 5. Discussion

### 5.1. Urban Adaptation Planning and Results as Seen by Local Communities

Many key informants in the city of N'Djaména (53% of respondents) believe that climate policies have not met the expectations of the city's citizens in terms of the effectiveness and positive impacts of adaptation actions. They imply that urban policy planning does not truly integrate urban adaptation. Better still, these respondents feel that there is no concerted action in terms of national adaptation policies and urban planning policies. According to the latest IPCC report [2], there are gaps in urban adaptation in all regions of the world and for all types of risk. This justifies the enormous limits to the effectiveness of national adaptation actions and policies. Actions at the national level do not necessarily impact decentralized communities in areas where climatic hazards are rife. Some authors recognize that responding to climate change requires urban adaptation, and there are significant capacity gaps at the city and community level that hinder urban adaptation [3]. These include the lack of integrated planning to protect communities and the lack of access to innovative financing mechanisms that can strengthen city resilience [5]. Climate adaptation has become a more visible and pressing issue in recent years. However, although adaptation can potentially reduce the negative effects of climate change, little attention has been paid to the consequences of adaptation policies and practices on urban sustainability [19]. The research and data analysis conducted by Bai et al. [22] have highlighted the extent to which municipal adaptation policies and plans have proved ineffective in achieving their stated objectives. According to Lee and Kim [23], municipal adaptation plans face obstacles when it comes to achieving effective adaptation outcomes, and the actions implemented often deviate from urban development plans.

Recent studies and reports such as the Intergovernmental Panel on Climate Change (IPCC) Special Report have ushered in a new era of climate research and identified cities as one of the areas in which urgent action is needed [43]. According to the World Climate Research Program [44], the need to accelerate climate adaptation through science–policy–practice partnerships has become more evident in recent years due to the failure of national policies and actions in city resilience. Although cities and urban areas are recognized as areas of climate vulnerability and greenhouse gas emissions, they are also centers of innovation in climate change adaptation [20]. However, these reports underline the fact that solutions and resources for and by cities are not yet sufficiently high on the policy and action agenda. While cities and urban areas have begun to be recognized within the United Nations Framework Convention on Climate Change (UNFCCC), there is an urgent need to fully mobilize multi-level climate action in which cities play a central role [45]. For Allarané et al. [13], the means of fostering conditions conducive to adaptation in cities in sub-Saharan Africa are integrated planning, multi-agency intervention, and multi-scale and sectoral actions. Ali et al. [46] suggest the implementation of appropriate policies,

programs and measures to strengthen adaptation and resilience in developing countries that are most vulnerable to the effects of climate change.

### *5.2. Barriers and Catalysts to Integrating Adaptation into Urban Policies*

Stakeholders in the planning and management of the city of N'Djaména identified four categories of barriers that need to be removed to facilitate the integration of urban adaptation into urban planning. These include information and knowledge barriers, political and organizational barriers, and resource constraints. In terms of information and knowledge, respondents raised problems relating to the availability of and access to data, the lack of community support for adaptation planning due to ignorance, the lack of expertise among municipal staff, and the inability to identify and manage the uncertainties associated with the variability of climate risks. According to Orlove et al. [25], stakeholder engagement is increasingly part of climate-related decision-making processes. The degree of stakeholder engagement ranges from instruction and consultation to cooperation. This is equivalent to the exchange of information and knowledge in decision-making [26]. Challenges to stakeholder engagement include access to cutting-edge science, the ability to recognize and respond to unreliable or false climate science information, and the elimination of cognitive and other biases [35]. Malik and Ford [47] believe that the lack of access to innovative financing mechanisms that can strengthen resilience is one of the obstacles to integrated community adaptation planning. Local players are often ill equipped to make decisions in a changing climate environment. Indeed, climate change is a dynamic, ongoing process, and adaptation policy must be implemented in an unstabilized and particularly uncertain context [5].

This study revealed that organizational challenges involve the absence of silo planning in municipal government, unclear roles and responsibilities of local governments in adaptation, and the absence of federal/state leadership in adaptation. The literature on adaptation and resilience to climate change points to an increase in participatory approaches, structured interactions between different types of stakeholders, and organizational leadership to strengthen interactions and increase awareness of the institutional context [27]. Westman et al. [7] insist that multi-level governance measures supported by local governments can foster robust adaptation approaches and address risks and vulnerabilities at all scales. Effective action by local governments therefore requires the support of the national government. Without national support, local government has difficulty coordinating action between urban development players [2]. National urban adaptation guidelines can influence municipal action and planning, but there is evidence that national policy alone is not enough to act on the ground without understanding local conditions [8]. According to Patterson and Huitema [6], these problems can be solved by strengthening local decision-making and integrating adaptation into local urban policies. Cities and local authorities are key players among others in facilitating adaptation to climate change in cities and conurbations.

To overcome these obstacles, the results of this study suggest the sharing of information, knowledge, and communication involving all stakeholders in N'Djaména's urban development, the organization of state and municipal structures, the adaptation of policies and authorities, greater access to funding, and, finally, the establishment of professional networks of expertise. Nina et al. [14] urge the research community to actively partner with local authorities in the co-design of urban adaptation policies and programs throughout the implementation process. In their view, this can mean facilitating access to and interpretation of local information, as well as advice on feasible adaptation paths according to the circumstances, priorities, and capacities of each local council, which vary according to place and time. We also need the support of adaptation experts to identify and communicate the co-benefits of adaptation and the allocation of financial resources.

## 6. Conclusions

Urban adaptation is an essential aspect of climate change studies and actions. Surveys carried out among key informants enabled us to gather their opinions on their knowledge of the climate and urban planning policies drawn up to frame the urban development of the city of N'Djaména. The results showed that most key informants in the city of N'Djaména (53% of respondents) believe that climate policies have not met the expectations of the city's citizens in terms of effectiveness and positive impacts. They also imply that urban policy planning does not truly integrate urban adaptation. Thus, four categories of barriers need to be removed to facilitate the integration of urban adaptation into urban planning. The study revealed that organizational challenges involve the absence of silo planning in the city's municipalities, unclear roles and responsibilities of local governments in adaptation, and the absence of federal/state leadership in adaptation. To remedy these obstacles, the results of this study suggest the sharing of information, knowledge and communication involving all N'Djaména's urban development stakeholders, the organization of state and municipal structures, the adaptation of policies and authorities, greater access to funding, and the establishment of professional networks of expertise. Institutionalizing the integration of urban adaptation starts with strategic visioning and planning, profiling and designing action plans, and finally planning the implementation and monitoring/evaluation of actions. It would have been better if this study had considered people's opinions on their involvement in the process of drawing up urban planning documents in the era of climate change. That is where its limitations lie. Future studies could therefore focus on climate losses and damage in urban areas in sub-Saharan Africa that are prey to major climatic hazards. Indeed, these urban areas are subject to regularly rising temperatures, permanent flooding, drought, and violent winds, all of which have a considerable impact on populations and infrastructures.

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