Best Urban Practices of Climate Change Adaptation Applications

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Abstract

The escalating impacts of global climate change, characterized by rising global temperatures, sea-level rise, and an increasing frequency and intensity of extreme weather events pose significant challenges, particularly for densely populated urban areas. These areas, home to over half the world's population and concentrations of valuable assets, are further susceptible to localized climate phenomena such as urban heat islands, which can exacerbate health risks during heat waves. Recognizing the urgent need to address these challenges, this research undertakes a comprehensive analysis of 386 case studies to identify and synthesize best practices in urban climate change adaptation. The outcomes of this study highlight key needs, document instances of maladaptation, extract crucial lessons learned from real-world applications, and compile a collection of effective strategies implemented in diverse urban contexts. By providing these insights, this paper aims to inform policymakers, urban planners, and practitioners in their efforts to build climate-resilient and sustainable cities, while also understanding potential pitfalls and essential requirements for successful implementation in the face of ongoing climate change.

Keywords: adaptation tools, content analysis, climate change, urban planning

Introduction

High levels of greenhouse gas emissions are leading to climate change, which has negatively affected our natural and human systems. The negative impacts of climate change cause damage to infrastructures, ecosystems, livelihoods, reduce water and food security, which leads to high levels of migration and mental health issues, all contributing to increasing levels of inequality (IPCC, 2014, 2022). With the continuous urbanization, the majority of the world population currently resides in urban areas and most of the population growth will continue to happen in urban areas. This increases the vulnerability of urban life and this should not be underestimated as urban disasters reflect the failures of urban governance (Archer et al., 2014; Dodman & Satterthwaite, 2008). Mitigation and adaptation significantly contribute to reducing climate change risks(IPCC, 2023). Climate change adaptation is needed immensely and its implementation has to be fast and sustained in order to close adaptation gaps. Although the field of urban adaptation is still new, several attempts have been made regarding policy, practice, and research. Climate change adaptation must be prioritized at the same level as mitigation (UN Framework Convention on Climate Change UNFCCC, 2010; as cited by Carter et al., 2015). Moreover, The Intergovernmental Panel on Climate Change (2023) documented that the effectiveness of adaptation has been shown in some sectors and regions, and cities are connecting and sharing their knowledge on good practices through global networks. Despite these efforts, maladaptation instances are increasing in multiple fields and regions (IPCC, 2023). Many reasons contribute to these issues, for example, limited experience, insufficient systems that enable consistent development, and not understanding future impacts and vulnerabilities (Bours et al., 2015; Palutikof et al., 2019). In aim of understanding the complexities of this matter, this paper conducts a systematic content analysis of 386 literature resources to identify best practices, key lessons, and maladaptation instances that occurred to bring a collection of effective urban climate change adaptation applications for diverse urban contexts.

Background

The urgency of climate change calls for global cooperation to reduce the global average temperature to reach a balance between greenhouse gas emissions and removals by sinks in the second half of this century (UNFCCC, 2015; IPCC, 2023; Dolšak & Prakash, 2018). The objective of mitigation action is to reduce anthropogenic emissions in the atmosphere or their sinks; on the other hand, adaptation is the process of adjusting and coping to present or future climate hazards (IPCC, 2023). Adaptation evolved

from being a secondary option or quick fix into an action as important as mitigation. (Bitner-Gregersen et al., 2011). Within adaptation literature, several terms have been developed to facilitate a better understanding of the field. The UNFCCC (2015), in its synthesis of case studies on good practices and lessons learned in adaptation planning processes, defined 'good practices' and 'lessons learned' as follows:

"Good practices include but are not limited to processes and structures that: (1) are particularly conducive to stakeholder engagement; (2) consider traditional, indigenous and local knowledge; (3) include monitoring and evaluation to inform iterative adaptation planning; and (4) are concrete examples from the case studies submitted. Lessons learned highlight and summarize factors that influence success as well as challenges, without explicit reference to any examples; rather, they are based on overall assessment of the case studies under each thematic area".

Maladaptation is defined according to Barnett & O'Neil (2010) as: *"action taken ostensibly to avoid or reduce vulnerability to climate change that impacts adversely on, or increases the vulnerability of other systems, sectors or social groups".*

PROVIA (2013) points to the disconnect between the conceptual understanding of adaptation needs and the current applied practices. This highlights the need to bridge this gap by integrating methodologies and fostering consistent development of new methods and tools. Maladaptation instances have been extensively documented by IPCC across many regions and sectors, several contributors to these are insufficient knowledge, short-term thinking, governance planning and implementation that is single-sector or non inclusive. Most of the lessons learned through adaptation programs are not fully documented in academia or even across grey literature therefore these insights have not been fully analyzed. The lack of documenting such work does not mean it is not happening in real life (IPCC, 2022). This paper focuses on adaptation urban practices because urban areas host more than 60% of the world's population, and contribute to most greenhouse gas emissions, which is why urban planning practices tailored for mitigation and adaptation are very needed (Pinto, 2014). Many cities are including adaptation measures in their planning , but Anguelovski & Carmin (2011) argue that there is no clear standard for adaptation measures in city planning schemes. This is because adaptation is highly context-based, and each region will have a different set of priorities (Anguelovski & Carmin, 2011). Cities are considered a complex systems made of networks of infrastructure, social make-up, population density (Defra, 2012; EEA, 2010; Schauser et al., 2010 as cited in Carter et al., 2015). Similarly, adaptation is also considered a complex process, and while science can inform us on potential outcomes and options, the final decision about what is considered right or good is influenced by societal values and various narratives (Boykoff & Moser, 2013).

Indeed, integration, collaboration and benefit-sharing among various international and regional frameworks have been effective in enhancing resource security and responses to climate change in areas like Africa (Jensen and Lange, 2013; World Bank, 2017a; Dombrowsky and Hensengerth, 2018 as cited in IPCC, 2022, chapter 9). This paper, therefore, connects real-world applications with a theoretical framework on adaptation, and draws a set of insights, key lessons, best practices and maladaptation instances.

Methodology

The research design carried a qualitative systematic document analysis of 386 literature resources. The number of the analyzed documents was set due to saturation of data and patterns were recognized. The aim of this method was to collect and synthesize frequent occurring practices, lesson learned and maladaptive instances. Grey literature and academic works were both considered for data collection. The reason for this is that many non-academic reports hold practical experiences and methods for climate change adaptation are being published (IPCC, 2022). This includes: projects, international and national reports and agreements, policy documents. Academic works had a mix of peer-reviewed and non-peer-reviewed, and Google Scholar was the main search engine. Keywords included: Adaptation methods, climate change adaptation, best practices on adaptation, lessons learned for adaptation, urban adaptation, maladaptation.

The inclusion criteria was mainly their relevance to climate change adaptation practices, explicit or implicit mention of adaptation practices, lessons shared or maladaptation. The language used was English. The scanning phase of the documents included a set of 20 questions that were applied to every source, in order to make the synthesis process more organized. These questions were based on a survey made by FutureMed platform, with multiple choice and textual questions. Five sample questions are given below:

1. What types of hazards were identified and addressed in the case study? (Select all that apply, and please specify if you select "Other")
   (e.g., Floods, Heatwaves, Drought, Sea Level Rise, Air Quality, Wildfires, Water Scarcity, Other).
2. What were the major challenges faced during the practical implementation? (Select all that apply)
   (e.g., Financial constraints, Technical difficulties, Community opposition, Regulatory issues, Institutional constraints-Lack of capacity/expertise).
3. What are the key lessons learned from this case study?
4. What recommendations would you give to others looking to implement similar projects? (Select all that apply) *(e.g., Engage the community early and often, Secure adequate funding before starting, Be flexible and adaptable, Foster collaboration and partnerships, Prioritize monitoring and evaluation)*
5. Were any best practices or instances of maladaptation encountered during the implementation of the case study? Please explain the reasons behind these outcomes.

Results

The results of the document content analysis, including the four most frequently occurring practices hat align with the established definition of 'good practice'. These practices include *community engagement, flexibility and adaptability, collaboration and partnerships, and long-term planning*. The analysis indicates that community participation was observed in (61%) of cases, with no documented local community participation in the remaining (39%). The involvement of stakeholders reveals that local governments have participated with (25%), private sector 14%, community organizations (14%), academic institutions (23%), NGOs (23%), and other (1%), these results are shown in Figure 1. The most frequently documented hazards are presented in Figure 2. Floods accounted for the highest hazard occurrence (20%), followed by heatwaves (15%), drought (15%), sea level rise (15%), air quality (6%), wildfires (4%), water scarcity (13%), and other hazards (12%). Figure 3 illustrates the distribution of the challenges faced, with financial constraints (29%) being the most prominent, followed by institutional constraints (28%), technical difficulties (26%), regulatory issues (12%), community oppositions (4%), and other challenges (1%).

The setting of each document's case study is documented in Figure 4, showing urban areas as the most common setting (32%), followed by rural (24%), coastal (16%), diverse context (13%), mountainous (4%), historic (4%), other (4%), peri-urban (3%).

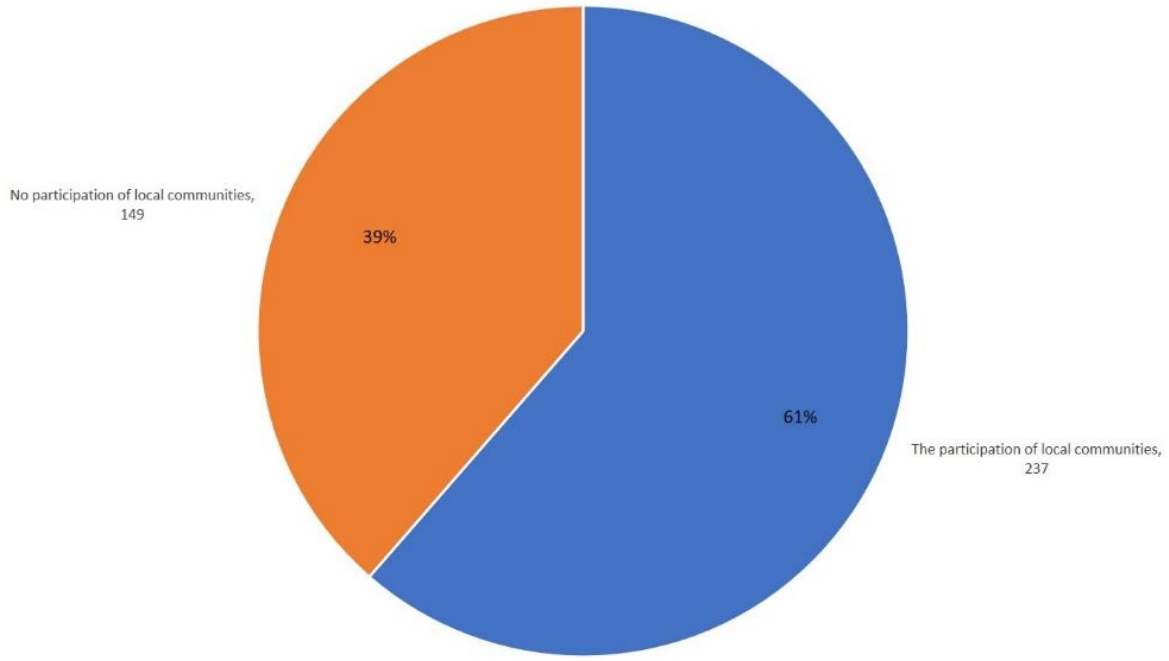

Figure 1. The participation of local communities

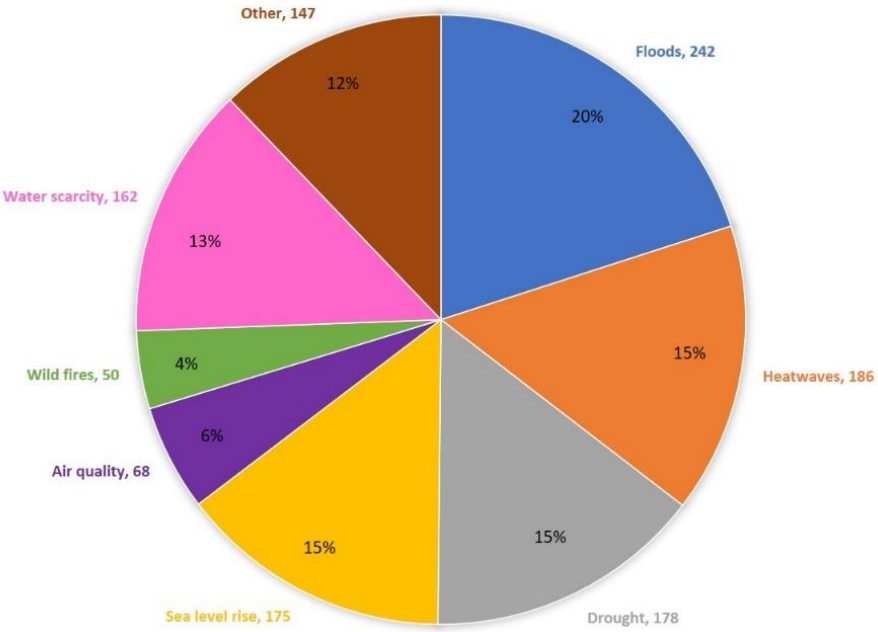

Figure 2. Hazard frequency

The synthesis of maladaptation instances reveals a range of failures and unintended consequences in climate change adaptation efforts. The failure to consider the interconnectedness of systems was the most critical theme. Other maladaptation instances included: local governance deficiencies, power dynamics imbalances, urban green infrastructure loss, urban poort neglect, heritage sites concerns, coastal adaptation problems, knowledge integration difficulties. Key lessons extracted from the analysis emphasize the importance of: the reliance on evidence-based assessments, having more locally integrated policies, adaptive frameworks, financial and institutional support, cross-sectoral integration, socially inclusive, ongoing learning and monitoring. Lastly, the analysis provided key principles for successful adaptation. These principles include: community centric approaches, adaptive management, systematic thinking, institutional capacity, collaboration and partnerships, and addressing social and cultural barriers.

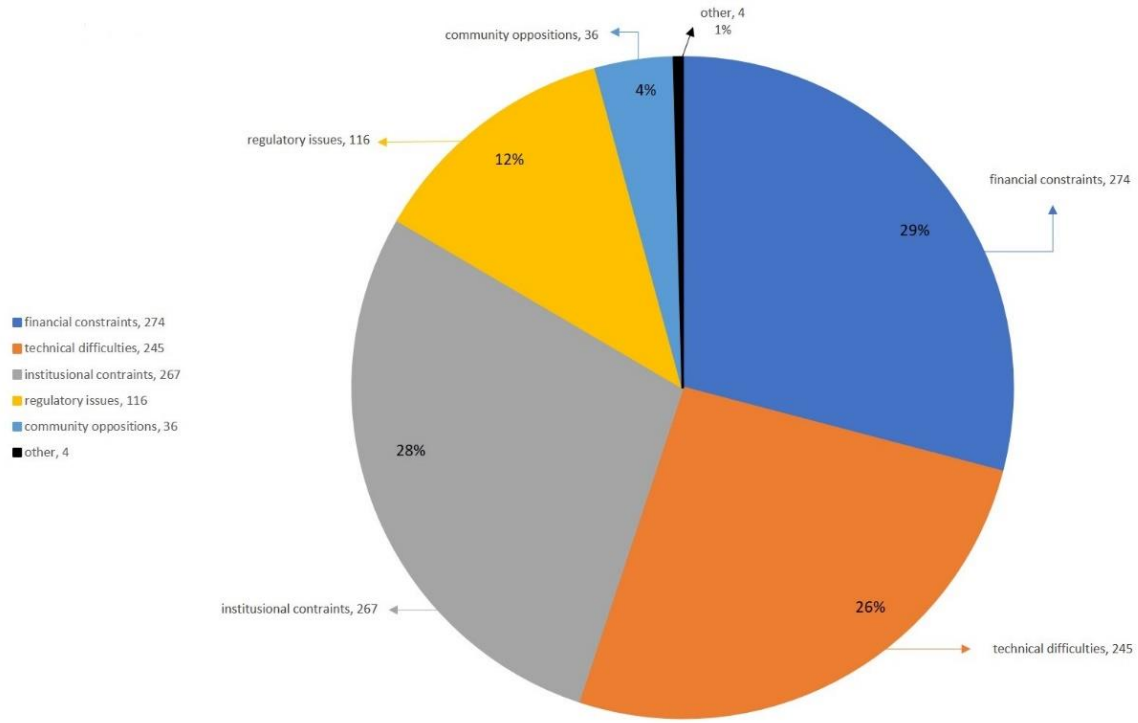

Figure 3. The challenges faced during implementation

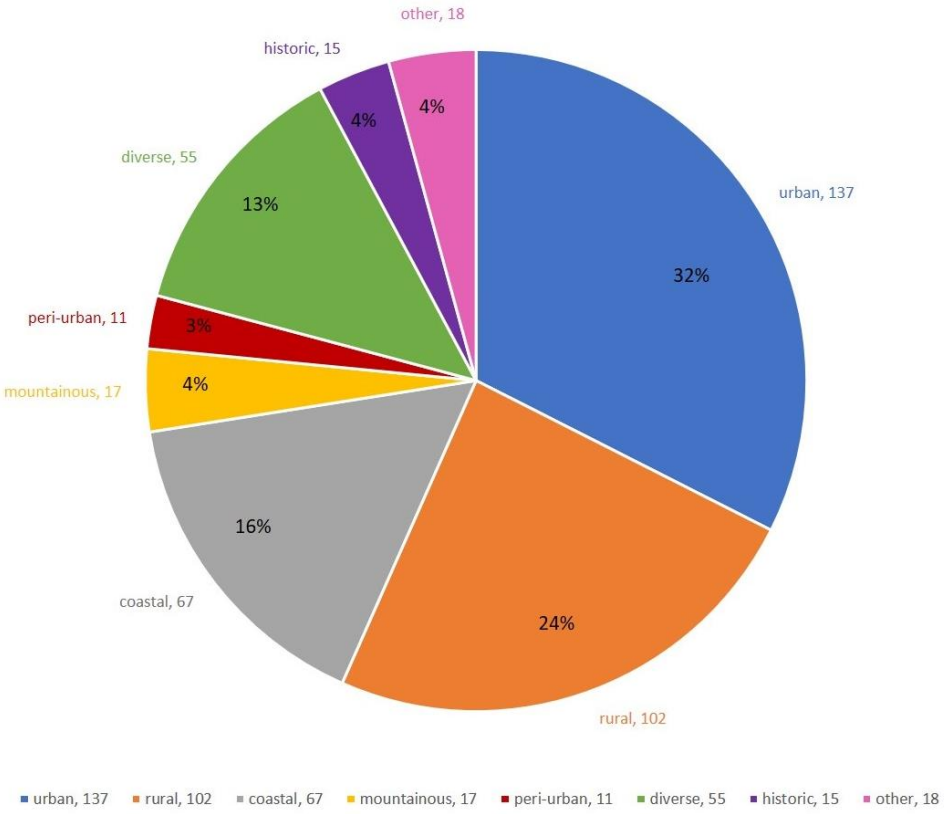

Figure 4. Case study setting

Discussion

Despite the differences in case study settings, the anlaysis indicates mutual challenges acorss these settings. While most of the identified challenges were consistent with existing literature, community opposition, in particular, is often overlooked yet significantly shapes the trajectory of adaptation applications. Having different stakeholers can be seen as positive step towards effective collabration, which in turn links to the participation of local communities throughout the adaptation process. Altough the documented percentage of community particpation than those who did not, it is crucial to increase this percentage. This is specially relevant in developing countries since they are the most vulnerable ones. Moreover, the involvement of communicatity organizations can also be considered positive, as it indicates a level of integration with local community structures during the implementation of adaptation practices.

Community Engagement has seen crucial for successful adaptation, specially when it engages the community early and often. This practices appears consistent across case studies. Similarly, collaboration and partnership reflects that working with diverse stakeholders ensures the continuity of adaptation applications. Long-term planning has been extensively discussed in the literature as key to effectively addressing climate change, and adaptation projects have frequently incorporated this as a good practice. That aligns with having planning that is flexible and adaptive measures as conditions and the intensity of some hazards can be unpredictable, therefore having constant feedback is important for developing adaptation planning.

The maladaptation instances highlighted in the study emphazied that disconnection between systems leads to unintented consequences. This necessitates a network of cross-sector considerations since adaptation is a holistic process requiring multiple factors to succeed. Instances of disconnections can be seen when power dynamics do not align leading to imbalances, for example, adaptation aimed at one group or specifc sector can negatively affect other groups or sectos. Other maladaptation instances included the neglect of urban areas specially poor and vulnerable areas, which are highly susceptible to maladaptation. Moreover, the absence of adequate financial support can lead to local governance deficiences.

Coastal areas are highy susceptible to maladaptation. Multiple failures have been observed when constructing sea walls with additional bureactratic delays. Furtherrmore, the energy sector also faces issues, including intensive demand that can increase the production of greenhouse gas emissions, and lack of investment in certain practices like biogas trials. Depleting the earth resources will have its

consequence on urban areas, as urban green infrastrucurtres loss is excaerbating the urban heat island effect. In addition lack of proper knowledge leads to the degradation of historical cities and the maintenance of its buildings.

Lastly, the content analysis proposed six key principles to consider for adaptation sucsses, several of which were discussed previously. *Systematic thinking and future consideration* are integral to adaptation scope and should be incorporated into planning agendas. *Collboration and partnerships* more specifically cross-sector collaboration and stakeholder engagmenet are contributors to adapatation success. *Community-centric approach* means responding to community needs and integrating local knowledge into adaptation planning and implementation phases. Furthermore, *institusional capacity and reosuce manageemnt* consitute critical foundation to adaptation planning. Lastly, *addressing social and cultural barriers* can allow more social inclusion and enhance locals communities' adaptive capacities.

Conclusion

Urban climate adaptation is very needed in our current time, due to more than half of the world's population residing in urban areas. These areas are vulnerable to the impacts of climate change. Adaptation has already been implemented in city planning schemes, yet gaps and challenges remain. It is why cities are working together to collaborate and share knowledge. This paper attempts to highlight key lessons and best practices that occurred in adaptation applications in both academic and grey literature through a systematic document analysis of 386 case studies. The study resulted in four best practices occurring in the majority of the analyzed case studies. These practices include *community engagement, flexibility and adaptability, collaboration and partnerships, and long-term planning.* Several Maladaptation instances were drawn including: local governance deficiencies, power dynamics imbalances, urban green infrastructure loss, urban poor neglect, heritage sites concerns, coastal adaptation problems, knowledge integration difficulties with the failure to consider interconnectedness between systems as a critical point. Lastly, the study suggests six principles for adaptation success and these encompass: *community-centric approaches, collaboration and partnerships, systematic thinking, institutional capacity including organizational capabilities and resource management, adaptive management, and addressing social and cultural barriers.*

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